Managing Pipeline Integrity

An Issues Workshop on

Pipeline Lifecycle

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June 9 - 10, 1994

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NOTES FOR THE OPENING ADDRESS

by

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CANMET

AT

MANAGING PIPELINE INTEGRITY:

AN ISSUES WORKSHOP ON PIPELINE LIFECYCLE

BANFF, ALBERTA

JUNE 9, 1994

WELCOME TO THE WORKSHOP

Good morning ladies and gentlemen.

Welcome to this Workshop on Managing Pipeline Integrity. Like last year we are all here to work together, to address pipeline issues.

BREADTH OF THE PIPELINE INDUSTRY

Those of us in the pipeline industry have recognized for many years that our success depends on shared vision and responsibility, and the partnership of everyone concerned. This includes pipeline designers, contractors, inspection companies, and maintenance personnel. Of the 100 participants at this Workshop, about one third come from companies that own and operate pipelines. About one quarter are with firms that serve the pipeline industry as consultants, contractors, and suppliers. Most of the remainder come from research organizations, universities, and government laboratories. There are also some from regulatory organizations in Canada and the United States.

PIPELINES ARE AN ESSENTIAL PART OF THE CANADIAN INFRASTRUCTURE

Two weeks ago, a report on the United Nations Development Program listed Canada as Number 1 out of 173 countries in terms of "human

development." The rankings were based on a combination of three factors: average income, life expectancy and educational attainment. A well-developed Canadian infrastructure supports this high standard of Canadian development. Much of Canada's development is based on energy -- energy for the engines of industry, energy for transportation, and energy for basic human needs in every Canadian home and business enterprise.

Underground pipelines are the arteries of our nation, the lifeblood of our society. They work silently and continuously, 24 hours a day, 365 days a year, to deliver the energy to enable our country to thrive.

GOVERNMENT-SUPPORTED R&D

Government funding for R&D on pipelines is funded by the Federal Interdepartmental Program on Energy R&D (PERD). This program provides funding for all the pipeline work at CANMET and other government Departments and agencies. This includes not only the R&D projects that are carried out at CANMET's laboratories but also that contracted-out to private sector laboratories, as well as conferences, seminars, and workshops like this one.

As many of you are aware government is evaluating all of its programs. The question that I am asked weekly if not daily is why should government support this program or that program.

I would like to briefly describe a few of the reasons I believe exist for government support of R&D on pipelines.

WORKING TOGETHER IN CANADA

WHY GOVERNMENT?

Canadians enjoy a long history of working together and governments should play a catalytic role in ensuring that this occurs for the benefit of Canada. In the pipeline industry, CANMET plays this role. We have, and continue to bring the players together to address and solve important issues.

In carrying out pipeline R&D, CANMET has formed partnerships and consortia to support projects jointly. Research carried out in partnerships is financially attractive because costs are reduced through sharing. But this is not the most important reason for forming partnerships. More important is that there is an opportunity to build multi-disciplinary teams of industry and government experts, and to share complementary resources which facilitates tackling some of the most difficult R&D issues.

TECHNOLOGY TRANSFER

WHY GOVERNMENT?

Technology transfer is another important role for government. This Workshop is the sixth in a series of conferences, seminars, and

workshops that CANMET has organized over more than a decade to help in transferring pipeline technology to industry. These technology transfer vehicles started with the 1983 International Conference on Pipeline Inspection held in Edmonton.

In 1988 the CANMET Pipeline Seminar was held in Calgary, and in 1989 another Pipeline Seminar was also held in Calgary. One outcome of this seminar was the development of specific projects on stress-corrosion cracking in several laboratories.

The Metals Technology Laboratories of CANMET observed their 50th Anniversary in 1992, and marked the occasion with a very special conference, The International Conference on Pipeline Reliability, held in Calgary in June 1992 and last year CANMET organized The Issues Workshop on Pipeline Lifetime, held in Red Deer. Last year's meeting was successful, not only with regards to technology transfer but also in catalyzing the formation of the Producers' Group on Corrosion and Materials. I understand that this group has been meeting regularly since the Red Deer Workshop to address materials issues of importance to their industry.

Also shortly after the Workshop, the Canadian Energy Pipeline Association was formed. This Association represents the major pipeline transmission companies in Canada. I am glad to see from the program that Bob Hill, CEPA Vice President for Technology and Operations, is giving the luncheon talk today.

I believe that only government can maintain this unbroken interest and focus over the long term.

INFORMATION ESSENTIAL TO THE FEDERAL GOVERNMENT

WHY GOVERNMENT?

Another reason for the Federal Government's support of pipeline R&D is that the government must have the right information on which to approve the operation of pipelines. CANMET, with its staff of research scientists and technical specialists provide the Federal Government with independent technical advice on pipeline issues.

STANDARDS, CODES, AND REGULATIONS

WHY GOVERNMENT?

Government supports R&D in this area to help develop standards, codes, and regulations to ensure that pipelines are safe and that the environment is protected. In Canada, we can be proud of the very fine record achieved in the safe construction and operation of pipelines. On average, there is roughly one incident per thousand kilometres of oil and gas pipelines per year. A challenge to us all is to reduce this occurrence through improved inspection, maintenance, and repair technology. No doubt, this type of technology will become even more important in the years to come, as the network of Canadian pipelines now in the ground continues to age.

COST REDUCTION

WHY GOVERNMENT?

Better standards, codes, and regulations, supported by R&D, will lead to safer and more readily maintained pipelines. But in addition, they can reduce the costs of pipelines through better knowledge. For example, the economic viability of a pipeline could depend on R&D which make construction possible in one field season, instead of two. If more and better knowledge were available, environmental assessments could be accelerated, reducing costs. Better pipeline design could reduce maintenance costs. Indeed, R&D on all stages of pipeline lifecycle has the potential to reduce costs to industry and to the public. This would make all Canadian industry more competitive in a highly competitive global marketplace.

Our challenge is to focus R&D on cost reduction as one of our main objectives. I encourage you, at this Workshop, to identify opportunities to reduce costs through R&D.

MARKET DEVELOPMENT

WHY GOVERNMENT?

Correctly directed R&D on new technology, carried out with effective partnerships to develop new products and services, can give Canadian industry enhanced access not only to Canadian

markets, but also to the international marketplace. Pipeline technology is a particularly attractive area from this perspective because other countries are very similar to Canada with respect to the severity of pipeline conditions. This provides a business opportunity to consultants, manufacturers and contractors alike.

NEED FOR COORDINATION

WHY GOVERNMENT?

The Canadian pipeline industry includes quite a number of companies. About 1,000 in fact own and operate pipelines. All these companies have similar interests in managing pipeline integrity and a shared responsibility for public safety.

In this respect, there is an analogy with the Canadian mining industry, where a large number of companies share a common environmental concern -- acid mine drainage. In response to the 3 to 5 billion dollar projected liability, the Federal government, 8 Provincial governments, and the mining industry initiated the Mine Environment Neutral Drainage (MEND) Program. The program was established to coordinate Canadian R&D on reducing the environmental impact and financial liabilities of acidic drainage from tailings, waste rock, and mine openings. In addition to funding, CANMET provides a Secretariat for MEND.

At the 1993 Red Deer Workshop, a need for more cooperation,

communication, and coordination was identified, to protect the huge public investment in pipelines. Development of shared sources of information -- databases -- was a unifying issue that dominated the Workshop and was viewed as a critical element in efficient and effective use of R&D investment. Information, accessible to all parts of the pipeline industry, would be useful in many ways, such as in planning R&D strategy, in carrying out risk analysis, and in ensuring effective utilization of R&D results.

PIPELINE SECRETARIAT

This year, you may wish to consider whether a continuing Secretariat to assist with communications, linkages, and financing would be useful in helping the pipeline industry to maximize its return on R&D investment and to optimize R&D choices for managing pipeline integrity. Several organizations could consider operating a Secretariat of this type. For its part, CANMET has some experience gained from organizing and operating Secretariats in other areas, such as the MEND Program, that could be usefully applied to a Pipeline Secretariat.

CONCLUSION

In conclusion I hope that I have explained why I believe that

government has a role to play in pipeline technology development and transfer. Whether or not we will continue will be clearer in the months to come. It will very much depend on you, the stakeholders. You will have a significant role in influencing the decision. I am sure that you will make your voice heard.

Returning to this workshop, I urge you to continue the deliberations begun in Red Deer last year, and to consider the formation of more partnerships between industry, university, and government to advance the management of pipeline integrity and to advance the technology in this area.

Before I close, I would like to thank the organizations that have assisted this workshop financially, Interprovincial Pipe Line Inc., IPSCO Inc., TransCanada PipeLines, and the National Energy Board with support from the Federal Interdepartmental Program on Energy R&D.

And now, it is my distinct pleasure to declare this workshop open.

Thank you.

R & D Partnerships

R & D PARTNERSHIPS

(Sink or Swim Together)

ALBERTA CHAMBER OF RESOURCES

MANAGING PIPELINE INTEGRITY

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R & D PARTNERSHIPS

ALBERTA CHAMBER OF RESOURCES
E. YILDIRIM, D. Eng. Sc.
CANADIAN OCCIDENTAL PETROLEUM LTD.

1.0 ABSTRACT

The Alberta Chamber of Resources has represented private sector resource interests in the Province of Alberta for 58 years. The Chamber's primary objective is to promote and support the orderly development of Alberta's natural resources. The Chamber has been working towards this objective through a process of close communication and cooperation with its members for an accurate understanding of its members' ever changing needs. Over the years, the Chamber has developed an excellent working relationship with the two levels of government. Because of this strong relationship, the Chamber has been a solid linkage between the governments and industry.

In the early 1980's, the Chamber identified Alberta's oil sands as the priority mineral resource for further development during that decade. Towards this end, a Task Force of industry and government representatives was set up in 1984 to promote oil sands development. One objective of the Task Force was to identify and publicize the social and economic benefits of oil sands operations.

During the last ten years, the Chamber has proposed new approaches to oil sands development including the "Concept of a Regional Upgrader and Satellite Production Facilities", initiated detailed studies and published reports and position papers. More recently, the Chamber has focused on technology requirements for oil sands which have led to the development of viable strategies. Since then, the R & D strategies for oil sands have been an area of serious programs and initiatives which have been directed towards the formation of an R & D network and strategic alliances in Alberta.

This paper describes briefly the technology requirements for oil sands, discusses the status of various programs and initiatives on R & D strategies and identifies practical models of R & D partnerships employed for sharing risks and benefits of research in oil sands, hydrogen and natural gas conversion. The Alberta Chamber of Resources believes that the R & D partnership models presented in this paper are also applicable to the pipeline industry.

2.0 TECHNOLOGY REQUIREMENTS

In 1990, the ACR Oil Sands Task Force initiated a new program to address the long-term technology requirements and R & D strategies for oil sands.

The rationale behind the Chamber's interest in the long-term technology requirements was the recognition of the fact that the future economic competitiveness of bitumen or synthetic crude production from oil sands would be contingent upon the further improvements in both capital and operating costs. Any significant cost reduction, in turn, would only be achieved through advancements and break-throughs in technology. The Chamber recognized the progress recorded in previous years and acknowledged the on-going R & D efforts in diverse areas of oil sands technologies. However, the Chamber was not aware of the existence of a long-term plan for oil sands R & D to guide the funding agencies and the technology developers in identifying the needs that will determine priorities. Therefore, the Task Force was concerned that in the absence of an overall R & D road map, sufficient funds would not be available or the precious few funds that were available, might not be allocated to the appropriate R & D programs.

The ACR Oil Sands Task Force's identification of the future technology requirements was based on a projected scenario which pointed out the importance of fossil fuels well beyond the year 2010. In this scenario, Western Canada's oil sands and coal resources were predicted to supply a major portion of Canada's energy requirements throughout the 21st century. However, the realization of this potential was highly dependent on the assumption that:

> "the governments of Canada and Alberta recognize the importance of new technology as the key to the development of oil sands resources. The governments together with the energy industry allocate the necessary resources to oil sands R & D for the purpose of commercializing new technology which will enable the oil sands projects to become economically attractive and environmentally acceptable".

Technological advancements and break-throughs were necessary to achieve the desired level of production from oil sands with the degree of economic competitiveness as well as environmental acceptability. Therefore, it was crucial that the necessary funds be made available such that a higher level of R & D activity could be carried out on a more continuous and consistent basis. Because of the long lead time involved, meeting the technology requirements ten to twenty years into the future would necessitate the increased level of R & D sooner rather than later. Otherwise Alberta's oil sands would never be developed to a full potential. In order to resolve the environmental issues and to avoid any regulatory impediments, cooperative efforts between the governments, industry and ultimately the end-users would be necessary so that the policies which would promote further research and technology development could be designed and implemented on a timely basis.

The objectives established by the Task Force for the future technologies initiative were as follows:

- ensure that the oil sands resource is a major factor in the Canadian and world energy picture of the next century;

- identify future technologies for oil sands which will enable the commercial development for the production of hydrocarbon fuels on an economically competitive and environmentally acceptable manner;

- cause action by stakeholders to conduct well planned oil sands R & D programs at the present and in the future.

The ACR Oil Sands Task Force's efforts on technology requirements continue. During the last four years, the Task Force has made a series of presentations to the public and government officials emphasizing the importance of R & D and the potential effects of new technologies on future development. The Task Force published two papers; the first paper in 1991, identified the following areas in which further technology development would enhance the competitiveness of oil sands:

- mining

- extraction

- tailings

- upgrading

- by-products

- environmental

More recently, technologies for pipeline transportation of various products from oil sands have been identified as "essential technologies". "Emulsion pipelining technology" and "oil sand slurry pipelining" or "hydraulic transport" technology have been developed to a commercial application stage. The technology for "intermediate products" or "froth" pipelining is in an early research phase.

We believe that further development of oil sands require an extensive pipeline network facilitating the shipment of bitumen and/or froth from the producing fields to the regional upgraders and the markets.

The same paper offered the following recommendations which are still valid after three years:

The governments and industry must increase the level of funding for oil sands R & D.

Research and technology grants must be made available to individual inventories and developers.

An R & D clearing house must be established in Alberta. A quarterly publication containing summary information on all the active R & D programs should be initiated by AOSTRA or ARC, PRI or SRC.

CANMET should consider establishing a more visible presence in Alberta and should have a more hands-on involvement in oil sands R & D.

Finally, serious consideration should be given to the formation of a "National Oil Sands Research and Technology Development Center" in Alberta. This center should have a strong manpower base together with the necessary core facilities and infrastructure to meet the requirements of pilot and demonstration tests. This national center should be jointly funded by both levels of government. The industry contribution to the center's funding should be through the sponsorship of and participation in specific R & D programs generally directed to applied research. The center should cooperate and collaborate with the existing organizations, i.e. research organizations, funding agencies and universities. If there is a risk of redundancy in certain functions, then the center should incorporate or consolidate such functions and link up with the existing research facilities.

The objectives of the last two recommendations have been partially fulfilled by CANMET's decision to establish a "National Centre for Upgrading Technologies" (NCUT) in Devon, Alberta and by the introduction of a formalized network for oil sands R & D.

3.0 OIL SANDS R & D
STRATEGIC ALLIANCES AND NETWORKING

In 1992, Syncrude Research, ARC and CANMET initiated a process and formed committees to explore the feasibility of establishing a "Center of Excellence for Oil Sands Research". The Chamber was approached by the members of the new alliance for facilitating the development of a set of R & D priorities and strategies. The cooperation between the alliance members, ACR and Alberta Energy led to the planning and implementation of a two-day R & D strategies workshop in Red Deer, Alberta. The workshop produced a list of oil sands R & D topics and confirmed the importance of R & D networking and alliance formation as significant strategies in maximizing the benefits of the R & D dollars. In order to carry these messages further and emphasize the importance of R & D for

developing new technologies for oil sands, the Chamber proposed to organize and conduct an R & D Summit in 1993.

3.1 Oil Sands R & D Network Committee "Collaboration For Success"

Since the implementation of the R & D Strategies workshop in Red Deer in the summer of 1992, good progress has been recorded in the conceptualization and design of an Oil Sands R & D Network. The original members of the R & D alliance of 1992, joined by a significant number of stakeholders, have focused on an intensive program to formalize and implement the network concept. The stakeholders of the Network Committee included the Alberta Chamber of Resources, AOSTRA, Alberta Research Council, CANMET, Imperial Oil, PRI, Shell, Syncrude, University of Alberta and University of Calgary. The Network Committee's work has concentrated on a process which fosters collaborative research, supported and rationalized by a clear vision focusing on industry's future technology needs.

Since a coherent oil sands research strategy is clearly recognized by the Alberta Chamber of Resources as the most important element to the development of this resource, the Chamber has combined its efforts on technology requirements with the Network Committee and has become the facilitator in spreading the committee's message through correspondence and presentations to a wide range of stakeholders.

3.2 R & D Summit

The Chamber planned, organized and conducted an Oil Sands R & D Summit meeting in June 1993. The timing of such a special event was important for its success. Therefore, the planning and implementation of the R & D Summit were synchronized with the formation and organization of a National Task Force on Oil Sands Strategies to achieve the maximum support for the summit.

The objectives of this special event were as follows:

- To familiarize the attendees with the advantages of a collaborative and coordinated oil sands research.
- To familiarize the attendees with the features of a formalized oil sands R & D Network Concept.
- To determine the level of interest and support for the proposed R & D Network Concept.

The Summit meeting was intended for the senior managers and executives of all the stakeholders. Therefore, the invitation list included the representatives of:

- Research Organizations
- Universities
- Federal and Alberta Governments
- Industry

The Summit meeting was a unique gathering of representatives from diverse backgrounds with an enormous collective wisdom, capability and authority to make an impact on the future of oil sands R & D in Canada.

We believe that the R & D Summit was a success. The efforts which were initiated with the first R & D workshop in Red Deer and continued with the summit meeting have lead to the formation of CONRAD, i.e. the Canadian Oil Sands Network for Research and Development early in 1994.

3.3 CONRAD

"Collaboration for Success" is the founders' vision for CONRAD, the Canadian Oil Sands Network for Research and Development. CONRAD has been formally established for the purpose of cooperating in a collaborative and coordinated research network. The network will bring together the public and private sectors to share their expertise and resources. Coordinated and shared research focusing on common industry needs will improve research efficiency, effectiveness and innovations.

This R & D network is expected to:

- Lead to sustained profitability of the existing industry through continuous improvement in current operations;
- Promote the development of new technologies which will lead to further development of the oil sands;
- Derive the maximum benefits from the R & D investments.

The network is unique with its features as follows:

- It focuses on industry's technology requirements;
- It brings industry, government and academic expertise together;
- It is strongly supported by stakeholders;
- Its founders and participants share a willingness to work towards the common good of the industry.

3.4 Other Forms of R & D Partnerships

In addition to "Strategic Alliance" formation and "Networking" for the purpose of R & D, other forms of R & D partnerships are practiced within the energy industry in Canada and particularly in Alberta. Although the energy companies still have the option of carrying out their own in-house R & D programs, the recent trend in R & D has been towards the shared programs through partnerships.

Currently recognized and often practiced R & D partnerships can be summarized in the following categories:

- R & D Joint Ventures
- Exclusive R & D Consortia
- Open R & D Consortia
- University Program Partnerships
- R & D Information-only Networks

Generally, serious R & D efforts require significant amounts of funds, adequate facilities and dedicated people. In other words real R & D is expensive and program costs escalate in orders of magnitude as a program progresses from a laboratory bench-scale proof-of-concept testing to piloting to field demonstration. Therefore, a strategy directed towards sharing risks and rewards is an excellent way of maximizing the return on the R & D dollars. In addition, the synergy emanating from joining research teams and combining concepts can be invaluable.

As the form of the R & D partnership changes from joint ventures to open consortium and to broader network there will be a certain loss of control over the R & D program content as well as the direction and speed of progress. However, given the options of a "high cost/high risk/total control" scenario versus a "modest cost/low risk/reduced control" scenario,

the smart choice is rather obvious. In recent years, the research community's options within the energy industry have been further reduced to "shared research" versus "no research". For this reason a practical form of R & D partnership may be the only option for survival.

3.4.1 R & D Joint Ventures

The most common form of R & D joint ventures is a partnership of two parties. In this form of an R & D venture, one participant brings to the table a technology or concept of a technology and the other participant provides the funding. Generally, the participant with the technology would carry out a specific program agreed upon by both parties. If either party does not have the research or piloting capabilities, then, the program may be contracted out to a research organization.

For example, Bitmin Resources, a partnership between Fording Coal and Kilborn Engineering is an R & D Joint Venture which is currently active in bitumen extraction.

Like most business Joint Ventures, an R & D Joint Venture could also have more than two participants for sharing risks and rewards.

In certain cases, a joint venture which has been established to fulfill a broader business objective, may also decide to carry out R & D programs to improve the viability of the joint venture's business.

Generally, in R & D Joint Ventures the technology ownership, use rights and licensing rights are shared equally. Sometimes, the technology ownership is retained by the original owner or inventor.

3.4.2 Exclusive R & D Consortia

AOSTRA and CANMET have been the pioneers of exclusive R & D Consortia in the energy industry. Consortium programs offered by these government agencies are usually funded on a 50/50 basis where one half of the funding is provided by the government agency, i.e., AOSTRA or CANMET and the remaining half of the cost is shared equally by the industry participants. Therefore, the larger the number of companies participating in an R & D Consortium, the smaller the cost paid by each company.

Some examples of this type of R & D partnership are as follows:

1. Emulsion Upgrading

   A CANMET/Industry Consortium which is sponsoring a research and testing program in bitumen and heavy oil upgrading has been active since 1990.

   The program objectives and work plans are jointly developed by the Consortium members and the program is conducted at the CANMET Energy Research Laboratories (ERL) in Bell's Corners, Ottawa.

2. Methane Conversion

   A CANMET/Industry Consortium which is sponsoring a program in methane conversion to liquid products has been active since 1990.

   As in the Emulsion Upgrading Consortium, the research and testing work is conducted at the ERL in Bell's Corners.

3. Underground Test Facility (UTF)

   An AOSTRA/Industry Consortium which is sponsoring a program in bitumen recovery through horizontal wells drilled from underground tunnels has been active for about a decade.

   AOSTRA has been the operator from the beginning until recently and the components of the work programs have been executed by various consultants and contractors.

Some other research organizations such as ARC, PRI and SRC also offer consortium programs. In general, the cost of such programs is equally shared by all the participants.

In exclusive R & D consortia, the intellectual property rights reside with the government agency (AOSTRA, CANMET) or the research organization which initiates the program. The Joint Venture participants earn the rights to use the intellectual property and technology arising from a joint venture program.

3.4.3 Open R & D Consortia

The Alberta Chamber of Resources (ACR) has been a pioneer in the initiation and support of Open R & D Consortia. The ACR Oil

Sands Task Force, which started the tradition of publicizing the benefits of oil sands through position papers, special studies and business plans, also initiated R & D programs on hydrogen utilization and optimization in bitumen upgrading.

The Task Force conceives these programs, obtains funding from its members and government organizations and contracts out the program to reputable laboratories or consultants.

The progress of a program is usually reported at the quarterly Task Force meetings and the final report is usually made available to the members as well as to any interested parties. The research results and information generated through an Open Consortium program can be utilized by anyone.

Generally, a workshop is also organized to present the results and solicit ideas from the attendees for new programs and future directions.

There are other organizations which initiated R & D programs or studies in an exclusive consortium format with the objective of disseminating study findings or R & D results. In such cases, only some of the detailed information and/or proprietary data are held confidential.

It may be worthwhile to point out a couple of examples in this category:

1. CO_2 Capture & Disposal Study

   An AOSTRA/Industry Consortium sponsored this study during the period of 1991 to 1993. AOSTRA was the operator and the major findings of the study have been publicized through various papers

2. Full Fuel Cycle Emission Analysis to Electric Power Generation in Alberta

   This program was initiated in 1993 jointly by industry, Alberta Energy, CANMET, Environment Canada and the National Energy Board. The program is being carried out by a consultant under the direction of a steering committee of the participants. Although it is an Exclusive Consortium program, we expect that portions of the findings from this

program will be publicized without the confidential data supplied by the participants.

3.4.4 University Program Partnerships

Both the University of Alberta and University of Calgary offer research expertise and research facilities to carry out programs in partnership with industry.

Currently, there are on-going research programs in oil sands funded by AOSTRA and programs in Hydrogen production and utilization funded by Alberta Energy.

University Program Partnership is an effective way of conducting R & D. The rights to the intellectual property are usually held by the industrial sponsor(s).

3.4.5 R & D Information-Only Networks

The energy industry in Alberta has witnessed the emergence of fairly successful networks for information sharing.

CORDNET which has been active for the last four years gathers and disseminates information of CO_2 emissions. The CORDNET group has had a membership of about twenty five (25) organizations. The group meets infrequently under the chairmanship of TransAlta Utilities. The secretarial function has been carried out by Alberta Energy.

MOTIG which stands for Management of Technology Interest Group has been active since 1992. The group has a membership of forty two (42) individuals from twenty two (22) organizations, i.e., energy companies and universities. The group meets once a month for two hours starting at noon. A guest speaker discusses an R & D topic. This formal presentation is usually followed by an open forum discussion. The conference room and lunch are provided by a host company. The representatives of Amoco, NOVA, Shell and University of Calgary provide leadership in arranging schedules, selecting topics, finding speakers and disseminating information to MOTIG members.

4.0 Requirements for Success in R & D Partnerships

Success in any type of R & D, whether it is conducted internally by a single company or sponsored by a partnership, requires the following elements.

- A good inventory of technology needs;
- A good set of research ideas and process concepts;
- A well-established set of criteria for ranking research programs and performance measures to evaluate progress;
- Well-placed milestones for "stop" or "go" decisions;
- The will to admit and accept failures and cancel programs not producing the expected results.

Also required are:

- Good program content;
- Good project management;
- A competent and dedicated R & D team;
- A well-equipped laboratory and pilot facilities.

In addition to the requirements described above, the success of R & D partnerships and their programs further require:

- Open mindedness and unbiased judgment at all levels of the partnership organization;
- Equal chance and opportunity for all research ideas regardless of the rank of the originator;
- Strong commitment and financial support from all participants for the duration of the program;
- Champions who believe in the merits of a program;
- A strong review group for periodical reviews;
- Open forum discussions among researchers, and between researchers and non-researchers, to nurture creativity and idea generation.

We in the Alberta Chamber of Resources believe that these requirements can be fulfilled and that R & D partnerships can be beneficial. In recent years, we have

witnessed the implementation of successful R & D programs in various models of R & D partnerships.

5.0 Strategic Considerations

The R & D partnership models described above are particular to the energy industry with special examples from the oil sands industry. However, these forms of Joint R & D programs are also available to the pipeline industry. The participants in such partnerships could include producers, suppliers, builders, and research organizations. For example, some of the partnerships within the oil sands industry included potential technology providers and EPC organizations.

The R & D partnerships may also be used to create other Joint Ventures with broader business objectives where the intellectual property and new technology arising may provide the necessary "business advantage" for these new ventures.

Furthermore, serious consideration should be given to projecting the future growth of the energy business in Western Canada. The question for you is: "how should the pipeline industry affect that growth and help to shape it?". We believe that the long term growth scenario in the energy sector will depend on the success of developing "synergistic industries" along with the expansion of oil sands and coal industries.

If we could assume that these synergistic industries will successfully be developed then it would be possible to project a picture of this long term scenario as an "industrial mosaic" within which the pipelines will become the "life lines". This vision, however, will require that the pipeline sector start developing partnerships not only in R & D, but also in other areas of the energy business, so that the pipeline sector can play an effective role in the growth and development of Western Canada's natural resources and diverse industries.

6.0 Conclusions and Recommendations

In recent years, the Canadian energy industry and particularly the oil sands sector have reached the conclusion that the most cost effective R & D strategy is to conduct R & D programs through R & D partnerships. The oil sands and heavy oil industry in Western Canada has been successful in forming various R & D partnership models and implementing multi-sponsor programs. More recently a broader scope R & D network has been established in Alberta for sharing the costs and benefits of joint R & D programs.

We believe that the models described in this paper are proven to be practical and cost effective. We also believe that these models could be used in forming partnerships within the pipeline sector with participants from a wide-range of stake holders. These R & D partnerships could concentrate on common industry

stake holders. These R & D partnerships could concentrate on common industry problems where joint research programs may be directed towards the practical solutions to these problems.

It is conceivable that the success of an R & D partnership may also lead to some other joint ventures with broader objectives.

We believe that R & D workshops such as this one on "pipeline life cycle" are an effective approach to bringing together all the stake holders who may be interested in participating in an R & D partnership.

We recommend that the open forum discussions intended for this workshop continue until a complete list of common problems is developed. This list could be used as the starting point in sorting out the priorities and ranking. This in turn will require the development of a set of criteria. The group which will take the time to tackle these tasks may become the nucleus of the first partnership in R & D for the pipeline industry.

Similarly, the pipeline company that tackles the technological and business challenges facing it as we move into the 21st century may well find itself in a unique and profitable leadership role.

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R & D PARTNERSHIPS

Outline

- Introduction
  - ACR Initiatives
- Technology Requirements
- OilSands R & D
  - Strategic Alliances and Networking
- Requirements for Success in R & D Partnerships
- Strategic Considerations
- Conclusions and Recommendations

R & D PARTNERSHIPS

Oil Sands R & D

- Strategic Alliances and Networking

  - Oil Sands R & D Network Committee
  - R & D Summit
  - CONRAD

- Other Forms of R & D Partnerships

  - R & D Joint Ventures
  - Exclusive R & D Consortia
  - Open R & D Consortia
  - University Program Partnerships
  - R & D Information-only Networks

R & D PARTNERSHIPS

R & D Summit

- Objectives

  - To familiarize the attendees with the advantages of a collaborative and coordinated oil sands research

  - To familiarize the attendees with the features of a formalized oil sands R & D Network Concept

  - To determine the level of interest and support for the proposed R & D Network Concept

R & D PARTNERSHIPS

CONRAD

"Collaboration For Success"

- Expectations

  - Lead to sustained profitability of the existing industry through continuous improvement in current operations

  - Promote the development of new technologies which will lead to further development of the oil sands

  - Derive the maximum benefits from the R & D investments

R & D PARTNERSHIPS

CONRAD - Continued

"Collaboration For Success"

- Participants
  - Research Organizations
  - Universities
  - Federal and Alberta Governments
  - Industry

R & D PARTNERSHIPS

CONRAD - Continued

"Collaboration For Success"

- Unique Features

  - It focuses on industry's technology requirements

  - It brings industry, government and academic expertise together

  - It is strongly supported by stakeholders

  - Its founders and participants share a willingness to work towards the common good of the industry

R & D PARTNERSHIPS

Other Forms of R & D Partnerships

- R & D Joint Ventures
- Exclusives R & D Consortia
- Open R & D Consortia
- University Program Partnerships
- R & D Information-Only Networks

R & D PARTNERSHIPS

Requirements for Success

- General Requirements

  - A good inventory of technology needs

  - A good set of research ideas and process concepts

  - A well-established set of criteria for ranking research programs and performance measures to evaluate progress

  - Well-placed milestones for "stop" or "go" decisions

  - The will to admit and accept failures and cancel programs not producing the expected results

R & D PARTNERSHIPS

Requirements for Success

- General Requirements - Continued

  Also required are:

  - Good program content
  - Good project management
  - A competent and dedicated R & D team
  - A well-equipped laboratory and pilot facilities

R & D PARTNERSHIPS

Requirements for Success - Continued

- Special Requirements

  - Open mindedness and unbiased judgment at all levels of the partnership organization

  - Equal chance and opportunity for all research ideas regardless of the rank of the originator

  - Strong commitment and financial support from all participants for the duration of the program

R & D PARTNERSHIPS

Requirements for Success

- Special Requirements - Continued

  - Champions who believe in the merits of a program

  - A strong review group for periodical reviews

  - Open forum discussions among researchers, and between researchers and non-researchers, to nurture creativity and idea generation

R & D PARTNERSHIPS

Strategic Considerations

- R & D Partnership Models Are Available To The Pipeline Industry
- R & D Partnerships May Bring Together All Stakeholders: Pipeline Companies, Producers, Suppliers, Builders and R & D Organizations
- R & D Partnerships May Pave The Way To The Creation Of Joint Ventures With Broader Business Objectives

R & D PARTNERSHIPS

Strategic Considerations

- Growth In The Energy Industry Will Depend On The Success Of "Synergistic Industries"
- If Growth Is Materialized and If Synergistic Industries Are Developed, Then The Long Term Composite Picture May Be A "Industrial Mosaic" Within Which The Pipelines Will Become The "Life Lines"

R & D PARTNERSHIPS

Conclusions and Recommendations

- Advancement In "State-of-the-art" Technologies Is Essential For Staying Competitive
- R & D Is The Key To This Advancement
- Real R & D Is Expensive and Risky
- Partnership In R & D Is A Proven Strategy For Sharing Risks And Rewards
- Pipeline Industry Should Concentrate On Common Problems Of "Pipeline Life Cycle"

R & D PARTNERSHIPS

Conclusions and Recommendations - Continued

- Workshops Such As This One On "Pipeline Life Cycle" Should Continue:

  - To develop a comprehensive inventory of common problems
  - To form R & D partnerships and information networks

- The Pipeline Company That Tackles The Technological Problems And Leads The Way To Partnerships May Well Find Itself In A Unique and Profitable Leadership Role

20 Years of Limit States Design in Canada

(copies of slides available upon request from CANMET)

Updates from the 1993 Issues Workshop in Red Deer

(copies of overheads used)

PIPELINE RESEARCH DATABASE

- At the Red Deer Workshop last year, it was suggested that there is a need for a database of information concerning what research is being conducted in Canada, and who it is being conducted by.
- C-FER volunteered to do the initial work to set up the database, by writing to all attendees at the Red Deer Workshop and request information.
- To date, eleven companies have responded; if the database is to be useful, more companies will need to provide input.

CANADIAN PIPELINE

RESEARCH DATABASE

INFORMATION COMPRISED FROM DATA RECEIVED SINCE PIPELINE WORKSHOP IN REDDEER, ALBERTA JUNE 1 & 2 1993

Project Title	Project Summary	Research Company	Contact Person	Phone Number	Client	Budget ($)	Status	Completion Date	Public / Proprietary
Non-destructive Methods for Inspection of Pipes in Gas Piping Systems -Fundamental Research on Remote Field Eddy Current Defect Interaction	The Remote Field Eddy Current (RFEC) technique uses low frequency and a special probe geometry to obtain through wall transmission. It responds with approximately equal sensitivity to internal or external flaws and is potentially well suited to crack detection as well as the measurement of external and internal corrosion. Response to stress corrosion cracking (SCC) has been demonstrated but the details of its response to cracks in steel pipes are initially surprising. This project is concerned with fundamental theoretical and experimental investigations of RFEC slit defect interactions. Measurements and calculations of the energy flow patterns, current and field distributions near slits of different orientations using a special simulated RFEC probe are being undertaken.	Applied Magnetics Group, Department of Physics, Queen's University, Kingston, ON., K7L 3N6.	Prof. David L. Atherton	(613) 545 2701 Fax: 545 6463	Gas Research Institute, Chicago	548,217 US	active	95-11-30	public
Applied Magnetics	This research is concerned with ferromagnetic hysteresis, the effects of stress on the magnetic properties on pipeline steels and the use of magnetic Barkhausen noise measurements for characterizing pipeline steels to aid in the interpretation of magnetic flux leakage inspection signals.	Applied Magnetics Group, Department of Physics, Queen's University, Kingston, ON., K7L 3N6.	Prof. David L. Atherton	(613) 545 2701 Fax: 545 6463	Natural Sciences and Engineering Research Council	135,000	active	95-03-31	public
Small Diameter and Remote Field Tools for Pipeline Inspection	This project is for further development of advanced, high resolution, small diameter, magnetic flux leakage detectors and for long term research on the remote field eddy current inspection technique and its potential application to the detection of stress corrosion cracking.	Applied Magnetics Group, Department of Physics, Queen's University, Kingston, ON., K7L 3N6.	Prof. David L. Atherton	(613) 545 2701 Fax: 545 6463	Natural Sciences and Engineering Research Council and Pipetronix	540,000	active	94-05-31	public
Characterization of Magnetic Flux Leakage Indications Found During In-Line Inspection of Natural Gas Transmission Pipelines - Research on the Effects of Line Pressure Stress, Magnetic Properties and Test Conditions on Magnetic Flux Leakage Signals	This project is concerned with the effects of line pressure, bending and residual stress on defect-induced Magnetic Flux Leakage (MFL) patterns. It is supported by extensive ongoing research on the effects of stress on the magnetic properties of line pipe steels. Detailed precision mapping of MFL patterns due to simulated corrosion pits are being made as functions of stress.	Applied Magnetics Group, Department of Physics, Queen's University, Kingston, ON., K7L 3N6.	Prof. David L. Atherton	(613) 545 2701 Fax: 545 6463	Gas Research Institute, Chicago	536,760 US	active	96-04-30	public
Finite Element Field Calculations for Remote Field and Flux Leakage Inspection Tools	This project helps maintain our Finite Element Field Computational Laboratory which is used to support development of magnetic flux leakage and remote field eddy current inspection tools for pipelines.	Applied Magnetics Group, Department of Physics, Queen's University, Kingston, ON., K7L 3N6.	Prof. David L. Atherton	(613) 545 2701 Fax: 545 6463	Province of Ontario, University Research Incentive Fund	180,000	active	95-08-31	public
Stress Corrosion Cracking	SaskEnergy is supporting research into stress corrosion cracking.	CANMET	Guru Rao	(306)777-9623	SaskEnergy	15,000	active	TBA	proprietary

Project Title	Project Summary	Research Company	Contact Person	Phone Number	Client	Budget ($)	Status	Completion Date	Public / Proprietary
Development of Standardized Methodologies for Inhibitor Evaluation and Qualification for Sour Service	The main objective of this project is to develop standardized methodologies for qualifying inhibitors for use in sour service. The project will focus on methodologies for evaluating and qualifying inhibitors for four main types of systems: wet sour gas, sour crude oil, wet sour gas containing CO2, and a refinery system in which HIC is important. Laboratory and field evaluations of experimental methodologies will be carried out.	CANMET	Winston Revie	(613)992-1703					
External Stress Corrosion Crack Growth in Pipelines	A full-scale test is being carried out on 20-inch diameter line pipe to evaluate the growth rates of stress-corrosion cracks under realistic conditions. This work includes a study on the effects of microorganisms on stress-corrosion cracking.	CANMET	Winston Revie	(613)992-1703					
Hydrogen Cold Cracking of Pipeline Girth Welds	The sensitivity of steels to hydrogen cold cracking, or delayed hydrogen cracking, in reheated heat-affected zones was investigated both experimentally, using commercial and experimental heats of steel, and analytically using finite element modelling. The experimental steels produced at CANMET were used to establish the relationship between composition, yield strength, and cracking susceptibility. The investigation at CANMET identified a mechanism of crack initiation as being associated with a microstructural feature not previously associated with this phenomenon. The results of the project are being used to evaluate and specify pipe for new construction.	CANMET	J. E. M. Braid	(613)992-6400					
Engineering Critical Assessment of Girth Welds	The objective is to develop methods to assess girth weld defects in pipelines undergoing large plastic bending and to establish the applicability of engineering assessment procedures, reference stress method of PD 6493: 1991 and Appendix K of CSA-Z184.	CANMET	Bill Tyson	(613)992-9573					
Pipeline Fracture Control	Practical approaches will be developed for assessing defects in pipelines taking into account differences in strength of pipe and weld metal, and a database will be developed on toughness properties of linepipe and weldments.	CANMET	Bill Tyson	992-9573					
Detection of Cracks by Electro-Magnetic Acoustic Transducer (EMAT)	A new technology of non-contact non-destructive testing using EMAT sensors designed in-house to detect cracks is being developed. The sensors are placed in close proximity to the inspected surface, and an acoustic wave is generated in the material by electromagnetic coupling. Two types of acoustic vibration are applied, shear horizontal bulk waves and Lamb waves. The high risk associated with development of such sensors will be ameliorated by parallel development of conventional ultrasonic technologies, such as phased arrays.	CANMET	George Roy	(613)992-0328					

Project Title	Project Summary	Research Company	Contact Person	Phone Number	Client	Budget ($)	Status	Completion Date	Public / Proprietary
Monitoring Localized Corrosion in Sour Media by Electrochemical Noise and AC Impedance Measurements	Electrochemical impedance spectroscopy (EIS) and electrochemical noise have been used in monitoring corrosion rates in sour media. EIS has been found to be a rapid and accurate technique in yielding information on localized corrosion. The results obtained in two field tests serve to illustrate the advantages of using EIS for on-line monitoring of general and localized corrosion.	CANMET	Shankar Asatri	(613)996-4367					
The Effects of Vanadium on the Parent Plate and Weldment Properties of API 5LX-80 Steels	The effects of vanadium, nitrogen, and titanium levels and cooling rate through transformation on the parent plate and weldment properties of laboratory cast, controlled rolled, and accelerated cooled API 5LX-80 linepipe steels have been investigated. Parent plate yield strengths >600 MPa have been achieved by control of processing conditions and chemical composition. The yield strength was shown to depend on grain size, substitutional strengthening, and precipitation strengthening. Superior transverse Charpy toughness (>90 J @ -100 C) has also been obtained in steels which contained a small (0.01%) titanium addition. Furthermore, the levels of weld metal and heat-affected zone toughness for typical commercial seam welding conditions have been compared with published information and have been shown to be broadly typical of such steels.	CANMET	John Bowker	(613)992-0710					
Investigation of Failed Condensate Pipeline	The project involved examination of a failed pipeline and subsequent laboratory testing to determine the factors which contribute to failure. Slow strain rate testing was performed on various steels in environments very similar to that actually present in the product. (CO_2, H_2S, condensate inhibitors, etc. Results permitted development of a specification for replacement pipe.	CANSPEC GROUP INC.	Ted Hamre	440-2131	Mobil Pipe Line Co., Dallas	65,000	complete	93-09-01	proprietary
Mechanized Ultrasonic Inspection of Large Diameter Girth Welds	An internal ultrasonic scanner was developed for inspection of fusion and porosity defects in GMAW girth welds. The scanner uses a fixed array of focused probes and is capable of complete volumetric weld inspection at a rate of approximately 3 feet per minute. The 16 channel system provides gaited amplitude and position information for each channel, as well as the ability to save all A-Scans and B-Scans.	CANSPEC GROUP INC.	Talman Pizzey	440-2131	CANSPEC GROUP INC>	$1 M	complete	93-07-01	proprietary
Mechanized Ultrasonic Corrosion Mapping of Underground Storage Bullets	An internal ultrasonic scanner was developed for corrosion mapping of a 54 inch diameter bullet measuring 1300 feet long. The scanner transports an array of (12) ultrasonic thickness probes used to detect and size external corrosion. Approximately 100,000 thickness readings are acquired and plotted on a C-Scan image for each 1 meter length of pipe. A C-Scan is simply a roll out drawing where colour represents thickness	CANSPEC GROUP Inc.	Talman Pizzey	440-2131	CANSPEC GROUP INC.	40,000	completed	92-09-01	proprietary

CANADIAN PIPELINE RESEARCH DATABASE

Project Title	Project Summary	Research Company	Contact Person	Phone Number	Client	Budget ($)	Status	Completion Date	Public / Proprietary
Pipeline Reliability Assessment Based on Intelligent Pig Data	A model is being developed to assess the reliability of a corroding pipeline as a function of time, using data obtained by a magnetic flux pig inspection. The model considers growth of corrosion damage (number and size of metal loss features) for a given pipeline segment. Use of the model in decision-making regarding inspection and repair is illustrated.	Centre for Frontier Engineering Research	Maher Nessim	(403) 450-3300	British Gas plc, U.K.	72,000	active	94-03-31	proprietary
Strain Limits for Oil and Gas Line Pipe	This three-year project is defining local buckling behaviour of line pipe under extreme loads and incorporate this into a reliability-based, limit states framework for the structural integrity of new and existing pipeline systems. The work involves rigorous analyses of local buckling behaviour of tubular members, large-scale testing, finite element analyses, and the development of reliability-based procedures for design, integrity monitoring and safety assessments.	Centre for Frontier Engineering Research	Mark Stephens	(403) 450-3300	C-FER Members	484,000	active	93-12-31	proprietary
Draft Guidelines for the Limit States Design of Pipelines	The purpose of this project was to produce a draft limit states design guideline for inclusion in the new unified oil and gas pipeline code, CSA Standard Z662. The guidelines are intended to be used for the design of pipelines subjected to extreme loads which are not covered by the existing Standard, including slope failures, frost heave, thaw subsidence and seismic faulting.	Centre for Frontier Engineering Research	Tom Zimmerman	(403) 450-3300	National Energy Board, Calgary	30,000	complete	93-09-15	public
Reliability-Based Maintenance of Containment Vessels	This project involved a review of the different maintenance strategies employed by member companies for pressure vessels and pipelines. The collected data was analyzed to develop strategies for implementing reliability-based decision-making for maintenance problems.	Centre for Frontier Engineering Research	Maher Nessim	(403) 450-3300	NOVA Corporation of Alberta, Edmonton	43,000	complete	92-06-25	proprietary
Evaluation of a Liquid Sulphur Pipeline Design	An analytical study and full-scale testing program were conducted to assess the structural performance of a novel design for a dual-pipe liquid-sulphur pipeline system. Full-scale tests were used to simulate field installation and operating conditions of the fully restrained, buried pipeline subjected to significant axial thermal strains, combined with internal pressure and global bending. The study provided information concerning the ability of the system to safely undergo inelastic deformations without impairing the function or structural integrity of the line.	Centre for Frontier Engineering Research	Tom Zimmerman	(403) 450-3300	Shawinigan Integ Ltd., Calgary	205,000	complete	91-08-31	proprietary
Reliability-Based Design of Arctic Pipelines Subject to Thaw Settlement	A probabilistic design approach was developed for an Arctic gas pipeline subject to large deformations due to thaw settlement. A set of graphic design aids relating the probability of exceeding pipe strain limits to the operating pressure and temperature, and to terrain conditions, was also developed. A pipeline design algorithm was developed which uses probability of exceeding strain limits within a decision analysis framework to compare different design options and select an optimum design.	Centre for Frontier Engineering Research	Maher Nessim	(403) 450-3300	Esso Resources Canada Ltd., Calgary	42,000	complete	90-11-30	proprietary

CANADIAN PIPELINE RESEARCH DATABASE

Project Title	Project Summary	Research Company	Contact Person	Phone Number	Client	Budget ($)	Status	Completion Date	Public / Proprietary
Measurement Frequency Analysis for Pipe and Ground Temperatures from the Norman Wells - Zama Pipeline Thermal Monitoring Program.	The reliability of manual monthly temperature measurements made for the Norman Wells - Zama Pipeline Thermal Monitoring Program for adequate characterization of the annual ground thermal regime is being examined by comparisons with measurements obtained with automatic data acquisition systems. This work updates an initial analysis.	Dan Riseborough	Dan Riseborough	(613)741-1393	Terrain Sciences Division, Energy Mines and Resources Canada	4,975	active	Dec. 93	public
Summary ERCB Field Measurement Program and Concord Environmental Corporation Gascon2 and Risk Approach	The report contains a summary of the Field Measurement Program and of the development of the Gascon2 computer model. Nine other volumes are available describing the work in detail. The objective of the Field Measurement Program was to investigate the behaviour of H_2S gas at low wind speeds and under calm atmospheric conditions. Gascon2 is a computer model with flexibility to address a wide range of sour gas well blowouts and pipeline rupture scenarios for different meteorological conditions. It also provides an approach to calculate individual and societal risk given the probability of legthality. The field tests substantiated model results and confirmed that if the worst case failure happens, there can be hazards, the extent of which would depend on the volumes of gas released and population density.	ERCB and Concord Environmental Corporation	Lynda Holizki	(403)297-3697	General Public	$1 M	completed	90-10-23	public
Norman Wells Pipeline Research and Monitoring	Long term research and observations using geothermal, geomorphic, geotechnical, geophysical and meteorological techniques have been underway since 1984 at a series of study sites along the Norman Wells to Zama pipeline right-of-way. The objectives are to monitor and understand the short and long term response of permafrost and terrain, to assess the accuracy of design predictions, to maintain geothermal and geotechnical databases for planning, design and evaluation, and to recommend improvements for this and future pipelines in permafrost.	Geological Survey of Canada	Margo Burgess	(613)996-9317	Federal Government (NRCan, DIAND, PERD) and Interprovincial Pipe Line	134,000 1993-94	active	98/99	mainly public
Development of Controlled Environment Facilities	Following recommendations of Task Force (Report 1991: Assoc. Comm. Geot. Res., NRCC. & C-FER) Carleton University intends to construct controlled environment facilities. These will permit experimental studies of a geotechnical and scientific nature to be carried out at near natural scale but with close control of geotechnical, climatic and other conditions. Meetings are being held with companies and agencies internationally, to consider applications, especially in but not limited to, Russian Arctic. Other climatic conditions may be simulated.	Geotechnical Science Laboratories and affiliates	Peter Williams	(613)788-2564	Various	Undefined	active		public
Movement of oil and other pollutants through freezing and thawing soils.	Using a large volume of initially frozen soil in a controlled environment facility in France, movements of oil and other pollutants in freezing and thawing ground are being investigated experimentally. The effects of temperature and other factors are being determined and the thermodynamic processes involved in pollutant diffusion in freezing conditions will be clarified with a view to prediction and remediation.	Geotechnical Science Laboratories and affiliates	Dan Riseborough	(613)788-2600 Ext. 6622	Department of National Defence	80,000 1993-94	active	Mar. 94 Phase 1	public

Project Title	Project Summary	Research Company	Contact Person	Phone Number	Client	Budget ($)	Status	Completion Date	Public / Proprietary
Effects of freezing soils on gas pipeline	A multi-faceted many-year study with full-scale experiment in controlled environment facility jointly operated in France, including experimental, theoretical and numerical modelling of frost heave processes in soils, resulting pipe deformations and stresses. The study has examined effects of differential heave due to (a) soil differences (b) thermal regime. Clarification of processes involved to allow prediction for design purposes and to ensure geotechnical and environmental reliability in cold regions	Geotechnical Science Laboratories, Carleton University	Director's Office	(613)788-2564	Federal government, NSERC and consortium of 7 major companies	300,000	active		public
Physical and Thermal Property Testing, Norman Wells Pipeline Core Specimens	Physical and Thermal Property tests were undertaken on core specimens recovered for the Norman Wells - Zama Pipeline Monitoring Program. Tests included bulk density, water content, thaw settlement behaviour, unfrozen water - temperature relationships, and thermal conductivity. All cores were classified according to the NRC ice classification system.	Geotechnical Science Laboratories, Carleton University	Dan Riseborough	(613)788-2600 Ext 6622	Terrain Sciences Division, Energy Mines and Resources Canada	NA	complete	1988	public
Analysis of Thermal Data and Core Specimens, Norman Wells Pipeline.	Measurements made for the Norman Wells - Zama Pipeline thermal monitoring program are analysed to obtain estimates of the mean annual ground thermal regime. Comparisons are made between the thermal regimes of the pipe, right-of-way, and undisturbed terrain. This work updates earlier analyses. Additional property testing was also carried out on selected specimens.	Geotechnical Science Laboratories, Carleton University	Dan Riseborough	(613)788-2600 Ext 6622	Terrain Sciences Division, Energy Mines and Resources Canada	NA	complete	1989	public
GeoPig	A smart pig was developed to assist in pipe structural defect detection and maintenance planning the tool is equipped with sonars for measuring the internal pipe geometry and an inertial positioning system to determine pipe curvature. Sophisticated post run processing of survey and structural data is also provided.	Nowsco Well Service Ltd., Research Development and Engineering Dept.	Roy Mathew	(403)531-6752	Nowsco Well Service Ltd.	4 M	completed	Aug/93	proprietary
Autonomous Isolation Packers	A pair of remotely controlled packer pigs is used to isolate a section of large diameter offshore oil or gas pipeline to facilitate maintenance work. The system incorporates sophisticated electro-magnetic and acoustic data transmission and control systems to allow control of the devices from a DSV. Design will concentrate on reliability of the control systems and special placement problems related to gas pipelines.	Nowsco Well Service Ltd., Research Development and Engineering Dept.	Roy Mathew	(403)531-6752	Nowsco UK Ltd., Stolt Comex Seaway Ltd.	2 M	active	Aug/94	proprietary
Remote Pipeline Isolation Packers	A pair of remotely controlled packer pigs is used to isolate a section of oil or gas pipeline to facilitate maintenance work. The system replaces the use of stopples and can significantly reduce repair costs and downtime. The packer pigs are pumped through the line with product and controlled from outside the pipe.	Nowsco Well Service Ltd., Research Development and Engineering Dept.	Roy Mathew	(403)531-6752	Nowsco Well Service Ltd.	1 M	complete	Nov/93	proprietary

CANADIAN PIPELINE RESEARCH DATABASE

Project Title	Project Summary	Research Company	Contact Person	Phone Number	Client	Budget ($)	Status	Completion Date	Public / Proprietary
Thick-Wall Riser Inspection Tool	A multi-component inspection vehicle is being built to measure wall thickness along small (4.25 in. ID) thick walled marine risers to determine the extent of internal and external corrosion. The tool uses ultrasonic measurement techniques and on-board data processing and storage. Display and analysis software is being developed to assist in data interpretation.	Nowsco Well Service Ltd., Research Development and Engineering Dept.	Roy Mathew	(403)531-6752	Nowsco U.K. Ltd. and TOMEC	600,000	active	Jan/94	proprietary
General Projects	Development and improvement of pipeline inspection methods, procedures and instruments	Pipetronix Ltd.	Dr. A. Teitsma	(416)288-0896	N/A		active	continuous	proprietary
Tape Coat Analysis	Recent industry trends indicate that many companies are moving away from field applied tape coating systems to shop applied coating. Since the field applied tape coat is less expensive than alternate coating methods, SaskEnergy is interested in performing a cost/benefit analysis to determine the best practice. Since the cost/benefit analysis will involve comparison of coating and pipeline life, a corrosion consultant will be required.	TBA	G. L. Williams	(306)777-9480	SaskEnergy	25,000	pending	Dec/94	proprietary
Pipeline Integrity	The pipeline integrity team is expected to recommend site investigations, metallurgical analysis and soil analysis for 1994.	TBA	G. L. Williams	(306)777-9480	SaskEnergy	n/a	active	Dec/94	proprietary
Computer Aided Route Pipeline Selection	Pipeline engineering is interested in improving the process of selecting a pipeline route by using computer tools. The overlaying of air-photo information and topographic information over legal surveys will reduce the effort involved in picking a route and significantly speed up the generation of construction and approval drawings. This project will provide valuable insight and experience which will be used to develop the requirements for the subsequent GIS application. The first application will involve the development of the software routines for a short section of line used to tie in a customer. This project is contingent upon a suitable project occurring during 1994.	TBA	G. L. Williams	(306)777-9480	SaskEnergy	25,000	pending		proprietary
Scope Stability of Permafrost Soils in N. Pipeline Corridors	Evaluate potential for slope failure and evaluate methods and materials to ensure the stability of ice rich sensitive slopes.	Terrain Sciences Geological Survey of Canada	Ted Lawrence	(613)995-7644 (613)992-2468	Panel of Energy Research and Development	55,000	active	Mar/1997	public
Geothermal & Geotechnical Studies, Northern Pipelines	Evaluation of geothermal and geotechnical design and environmental mitigative techniques used on northern pipelines	Terrain Sciences, Geological Survey of Canada	Ted Lawrence	(613)995-7644 (613)992-2468	Panel of Energy Research and Development	150/yr	pending to start in April 1995	Apr. 2000	public
Heat & Mass Transfer in Permafrost	One component of the study involves the development and testing of geophysical tools to map freeze: thaw interfaces and soil moisture content. The capability of radar techniques is being evaluated on the Norman Wells pipeline as part of the project. Geophysical techniques are potentially very important aids in route selection and in performance monitoring of pipelines, especially in permafrost terrains.	Terrain Sciences, Geological Survey of Canada	Alan Judge	(613)996-9323 fax (613)992-2468	Panel of Energy Research and Development	50,000	active	Mar/1997	public

Project Title	Project Summary	Research Company	Contact Person	Phone Number	Client	Budget ($)	Status	Completion Date	Public / Proprietary
Risk Analysis Basis for Pipeline Life Cycle Safety	A risk analysis basis is being developed to address public safety and environmental protection from oil and gas pipeline operations. It will be applicable to the complete life cycle of pipeline systems operations in providing the link between design, construction, and operational criteria defined in codes and practices and their associated impacts on public safety and environmental protection. A consistent application of risk analysis is a key requirement for the present development of limit states design criteria and for ongoing operations of pipeline systems.	The Bercha Group	Brian Griffin	(403)270-2221	National Energy Board	25,000	active	94-03-31	public
Life Cycle Risk Management Program for a High Pressure Sour Gas Pipeline	A risk management program was developed for the engineering, construction and operation of new, high pressure sour gas pipeline. Elements of the program included identification of all significant pipeline failure modes from risk analysis results, collation of risk mitigation measures from internal and external practices, criteria for risk decisions, and procedures for implementing risk based decisions and monitoring compliance. The program was reviewed for applicability to other existing and planned pipeline operations.	The Bercha Group	Brian Griffin	(403)270-2221	Shell Canada Resources Limited	30,000	complete	93-6-30	proprietary
Critical Evaluation of Models Developed to Estimate Potential for Pipeline Stress Corrosion Cracking and the Associated Public Risk	Models are being developed to investigate the risk from pipeline SCC based on limited knowledge of both the applicable science and operational impacts. These models were critiqued to determine the validity and adequacy of methods and the reliability of data acquisition and application. At present there is much uncertainty associated with SCC modelling and results from the study were used to examine optimum strategies for managing risks of ongoing operations and for prioritizing research resources.	The Bercha Group	Brian Griffin	(403)270-2221	National Energy Board	25,000	complete	93-06-30	proprietary
Systems Failure Mode Analysis of Oil Production and Pipeline Facilities	This analysis was carried out on a large system of oil facilities in order to identify potential failure modes associated with both the equipment and its operation, and to rank the associated throughput, operating cost, safety and environmental risks. A systems approach was developed to screen high priority risks with an optimum use of operational manpower resources. Results were understood and readily accepted by all levels of staffing as they were applicable to modifying the overall company risk control strategies in addition to prioritizing onsite modifications for managing risk.	The Bercha Group	Brian Griffin	(403)270-2221	Husky Oil	40,000	complete	1992-08-31	proprietary
Optimizing the Implementation of Risk Mitigation Measures for Sour Gas Developments	A risk analysis program was developed and integrated into a risk management program for the design, construction and operation of the Caroline Development Project. One objective of the program was for all staff to better understand and minimize the public risks through practical, cost effective implementation of risk mitigation measures. This risk assessment and control program began at the conceptual engineering phase and continued through to operations. Results from this pioneering work could then be adapted for application to other facilities.	The Bercha Group	Brian Griffin	(403)270-2221	Shell Canada Resources Limited	150,000	complete	93-1-31	proprietary

CANADIAN PIPELINE RESEARCH DATABASE

Project Title	Project Summary	Research Company	Contact Person	Phone Number	Client	Budget ($)	Status	Completion Date	Public / Proprietary
Safety and Integrity Review of High Pressure Natural Gas Regulator Stations	Risk analysis methods were developed and integrated into a gas pipeline distribution system operational safety and integrity assurance program. These methods included formalized audit procedures and structured formal reviews. A pilot program proved the effectiveness of this risk-based approach, and improvements will develop through further research.	The Bercha Group	Brian Griffin	(403)270-2221	Canadian Western Natural Gas Company Limited	30,000	active	93-11-30	proprietary

MTL/CANMET Core Project:

ECA of Pipelines

W. Tyson, G. Shen, D. Mak

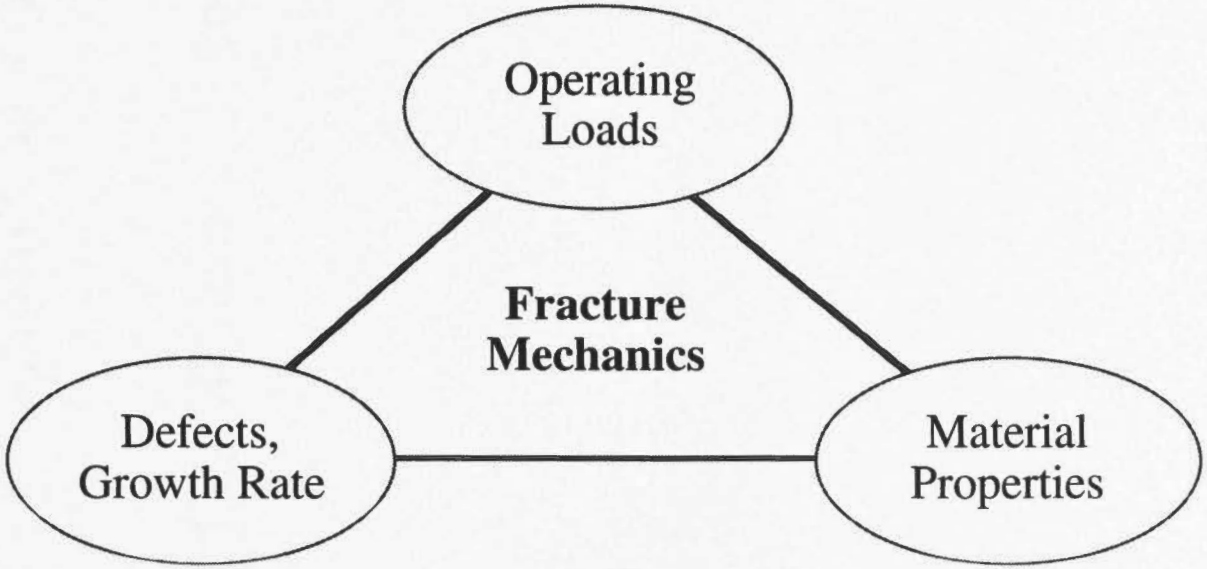
Objective

- To consolidate a state-of-the-art methodology and guidelines for performing reliability assessment of aging pipeline systems

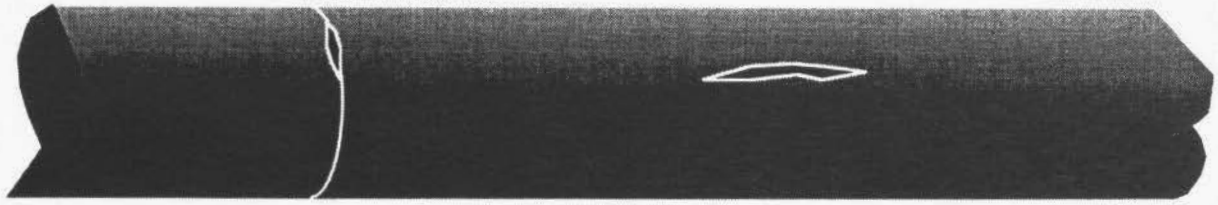
Background

- Need to assure integrity of aging pipeline systems (e.g., assess strength after SCC damage)

ECA - "is it safe to operate this structure?"



ECA of Pipelines



Operating Loads

- internal pressure

Defects (circumferential or axial)

- weld defects
- corrosion:
  - wall thinning (general)
  - cracking (SCC)

Properties

- strength (yield, ultimate)
- toughness (resistance to cracking)

MTL ECA Project

Task 1. Mechanics

- Develop methods to assess sharp axial flaws

Task 2. Materials

- Develop database for strength, toughness of linepipe steels

Task 3. Guidelines

- Summarize recommended ECA approach

Task 1

(a) Review current methods for assessing sharp axial flaws

- Elastic/plastic fracture mechanics: crack growth, plastic collapse

(b) Analyse

- Driving force (stress intensity factor) for surface cracks (variables: R/t, c/a, a/t)

(c) Full-scale tests

- To verify analysis methods

Task 2.

(a) Survey types of steel representative of aging Canadian pipelines

(b) Establish values and variability of toughness properties of linepipe steel of different types

Task 3.

Prepare guide to ECA of sharp axial flaws in pipe.

PRODUCERS'

MATERIALS / CORROSION ISSUES

GROUP

Informal

Open to all Oil / Gas Producers

Formed after the Red Deer Workshop

Impetus

Lack of Producers' voice

Red Deer technical issues the starting point

Reduced staff & resources

PRODUCERS MATERIALS/CORROSION ISSUES GROUP CONTACTS

Company	Contact	Phone No.	FAX No.	Remarks
AEC	Joe Desault	548-8100	548-8140	
Amerada Hess	Parmir Gill	267-6672	267-6915	
Amoco	Ray Price	234-4269	234-4311	
Can Oxy	Phil Bridger	234-6993	263-8673	
Chevron	Dallas Thill Ray Goodfellow	234-5430 234-6310	234-6206 234-6206	
Crestar	Dave Black	231-6721	231-6945	
Esso	Frank Gareau	237-3481	237-4195	
Gulf	David Lingnau	233-3152	233-5518	
Home	Bill Shulak Bob Shapka	232-7100 232-7100	232-7429 232-7429	
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Mobil	Reg McDonald Harold Hadley	260-7910 335-7521	260-7298 335-8623	
Norcen	Gord Tunnecliff	231-0111	231-0877	
Pan Canadian	Dave Kopperson	290-2076	290-2054	
Petro Canada	Norm Flanders Dave Stricker	296-8000 296-5629	296-3356 296-3030	
Rennaissance	Darcy Derdak	267-1400	750-1869	
Sask Oil	Ken Oberg	(306) 781-8200	(306) 781-8364	
Shell	Karol Szklarz	284-6550	284-6662	
Talisman	Doug Helgeland	237-1286	237-1484	

Project Affiliate

ERCB	Tom Pesta	297-8148	297-4117	

KES/hlg
Ref:k:\RT94\RTEN\KES\004.doc

SCOPE

ALL PRODUCTION MATERIALS/CORROSION ISSUES
DOWNHOLE TO PLANT

LEVERED RESEARCH & TECHNOLOGY
Individual companies fund
CAPP / PERD

INFLUENCE CODES & REGULATIONS
CSA / ERCB

EFFECTIVE INFORMATION EXCHANGE

NETWORKS

CAPP

CANMET

CFER

CSA

ERCB

NACE

PERD

SHSG

TOP PIPELINE ISSUES

Starting point Red Deer Workshop

RESEARCH & TECHNOLOGY

1. Internal protection of high water cut pipelines (CANMET)

2. Engineering crtitical assessment of corroded pipelines (CFER)

3. Corrosion under disbonded coatings

4. Long term serviceability of polyethylene liners - water
   sour gas

5. Long term serviceability of frp pipe

(6. Hydrogen-induced cracking of pipelines)

CODES & REGULATIONS

1. Quantitative pipeline risk assessment (ERCB)

Canmet Conference: Managing Pipeline Integrity

Risk Assessment Guidelines

John McCarthy, NEB

June 1994

Risk Assessment Guidelines:

The Age of the Canada's pipeline infrastructure:

Yukon Pipeline:	**52 years**
IPL:	**43 years**
Montreal Pipeline:	**43 years**
Trans-Northern:	**41 years**
TransMountain:	**40 years**
TransCanada:	**40 years**
Westpur:	**39 years**
Westcoast:	**36 years**
Rangeland/Aurora:	**33 years**
ANG	**32 years**

Pipeline Safety is in all of our interests:

Risk Assessment Guidelines:

Risk =

Frequency of occurrences of the hazardous incident

x

Estimated consequences of the incident.

Risk Assessment Guidelines:

Goal:

to develop a tool to assist both industry, regulators and the public to assess the relative risk of a pipeline.

Utilities of the tool:

- **prioritization of maintenance/surveillence**
- **assessment of alternatives**
- **common understanding and acceptance of methodology and results (?)**
- **cost effective use of resources**

Risk Assessment Guidelines:

Work to date:

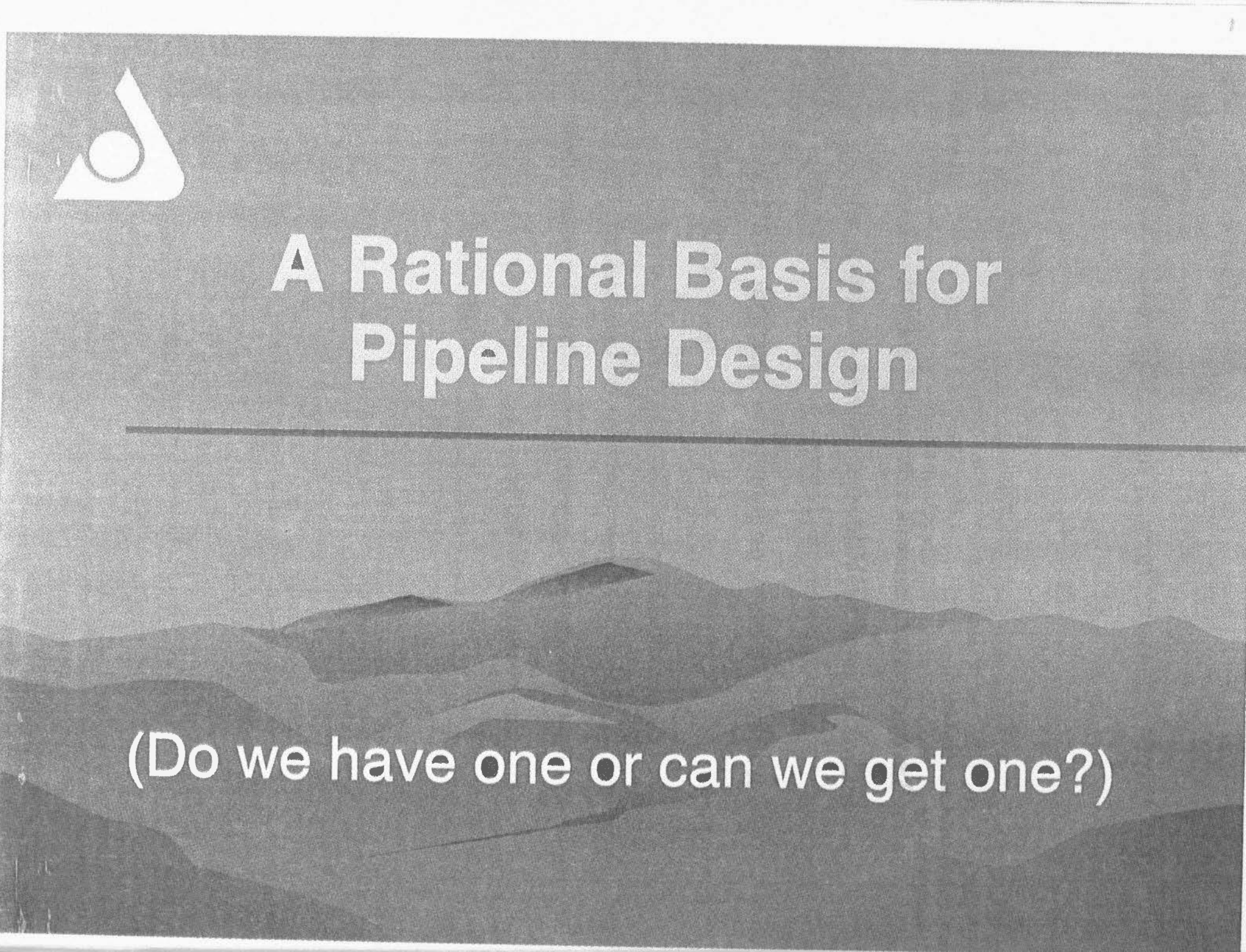
2 scoping studies by Bercha and CFER:

(PERD funded)

preliminary work on long-term research strategy

Proposal:

Industry/regulatory steering committee for research on risk assessment guidelines


A Rational Basis for
Pipeline Design
(Do we have one or can we get one?)

Current Canadian Approach

- CSA Z184-M92 (and Z662-94) use "reference stress" approach
- Origin is in ANSI/ASME B31.8 (1960s)
- Permissible hoop stress from internal pressure related to arbitrary factors which depend on class location etc.
  - $P = (2St/D)*F*\underline{L}*J*T$
  - L depends on occupancy/use of a constant area around the pipeline which does not reflect a real hazard distance

Current Canadian Approach (cont)

- Secondary stresses of thermal origin and combined stresses also handled by arbitrary factors on SMYS
- Consideration of other loadings (e.g. geotechnical) required, but no specific guidance provided

Limitations of Current Approach

- Although the existing approach has generally produced safe designs:
  - there is no consistency in the degree of "safety"
  - there is no relationship between hazard range (which is dependent on pressure, diameter) and class location boundaries
  - there is little relationship between design equations and the way pipelines actually fail
  - treatment of secondary stresses may be over-conservative or non-conservative

Future Development

- First edition of combined oil and gas pipeline standards (Z662-94) imminent
- Non-mandatory limit states design Appendix planned for second edition
- As planned, will not address all the limitations of the current reference stress approach
- Potential major benefit of LSD lies in ability to support risk concepts, but this requires major steps in understanding

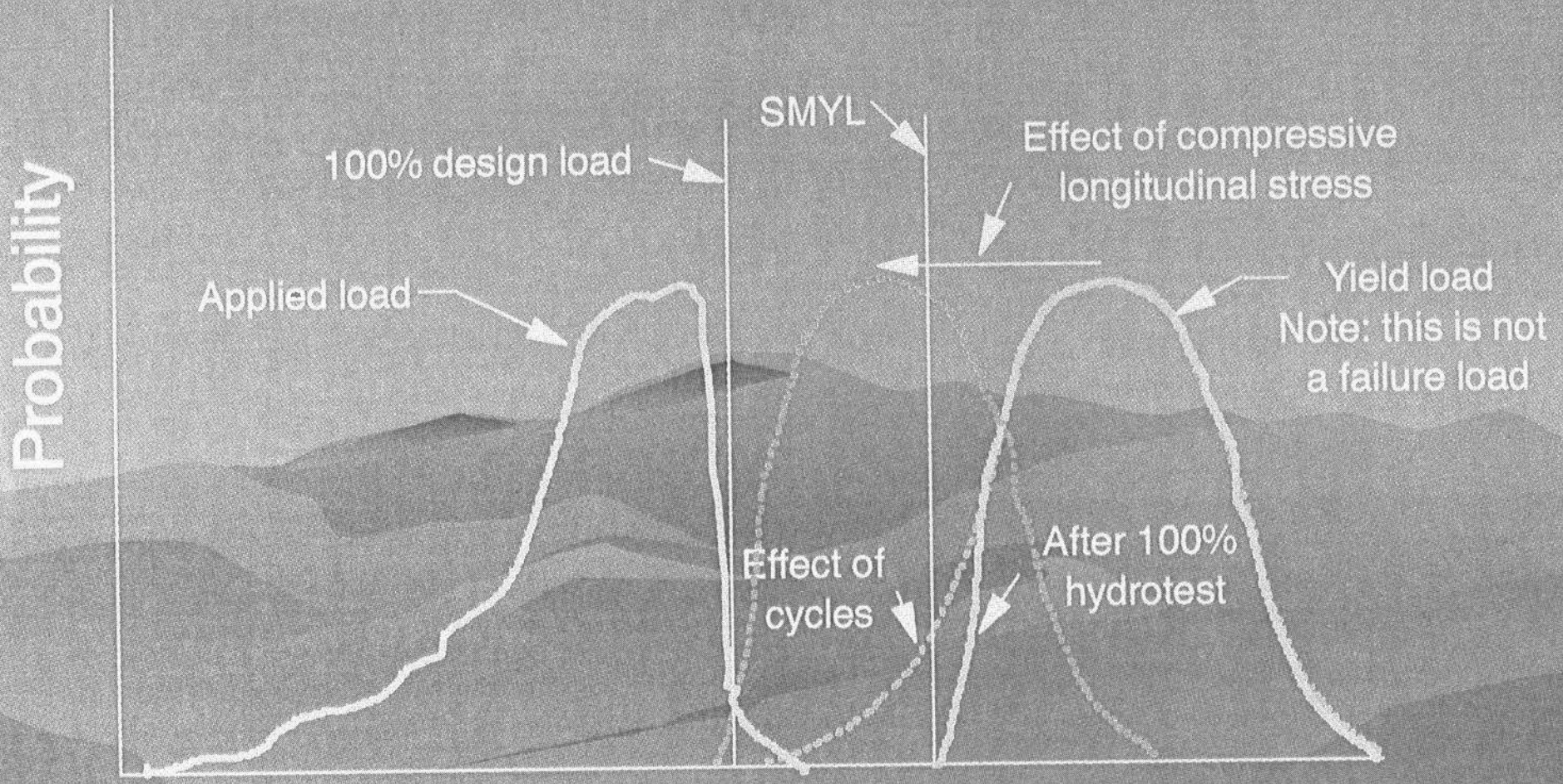
Risk-based Design

- Establish target values of risk
  - a consensus process, many precedents exist
- Depending on the consequences of failure, target reliability can be adjusted to meet risk requirements
- Target reliability can then be used as an input to probabilistic limit states design

The Dilemma of Risk-based Design

- We do not design defective pipelines, but pipelines without defects hardly ever fail (geotechnical effects may be the major exception)
- Design factors influence the probability of failure in ways other than those which are expressed in the design equations
  - e.g. lower design factors lead to thicker walls, but the principal benefit of this does not derive from greater safety against overload-type failure

Pressure Design - Simple Stuff, Eh???



Limit States and Load Categories

- **Limit states**
  - Membrane rupture
    - corrosion, EI, SCC, HIC, fatigue, overpressure
  - Structural instability
    - may or may not lead to early rupture
  - (Major leak)
- **Load categories**
  - Design loads, including permanent loads
    - pressure (incl. cycles), weight, backfill)
  - Environmental loads
    - geotechnical, frost heave/thaw, wind, waves, ice
  - Accidental loads
    - EI, overpressure

Risk-based Design - Why ?

- Need for integrated risk management from design through to operation and maintenance (and retirement)
  - this appears to be the future direction for business, regulators and standards bodies, world-wide
- Inconsistency and potential inefficiency of current approach
- Greater flexibility, allowing more options in achieving the goal of acceptable safety and reliability at minimum lifetime cost

Controlled Environment Facilities: Full-scale Research into Geotechnical and Environmental Problems

Peter J. Williams, Geotechnical Science Laboratories, Carleton University.

The Trans-Alaska oil pipeline was successfully constructed only after the development of unique designs to overcome problems associated with permafrost. When proposals were subsequently developed for a gas pipeline from the Arctic the technical problems proved different. The Canadian government funded a major research project involving a cooperation between Carleton University's Geotechnical Science Laboratories and French government institutions, using a special controlled-environment facility in France. The work centred on a heavily-instrumented section of buried pipe in a specially-built hall in which many environmental factors can be controlled and monitored.

The study gave much information on the deformations and stresses to which a pipe is exposed when surrounding soil freezes. The work was subsequently supported by eight major companies. It has turned out that the problems examined are not limited to the Arctic. The findings have attracted attention with major international applications. The costs of not solving problems such as we have investigated can be enormous as Russian experience has shown.

Controlled environment facilities have many applications and represent a special scientific approach with advantages over both field studies and bench-scale laboratory investigations. Recently we have used the experimental facility in France for a study of fundamental questions of movement of pollutants through freezing and thawing soils.

As a result of the interest and importance of such facilities for geotechnical/environmental studies (a topical issue being Western involvement in solving the problems of gas and oil construction in the former Soviet Union), Carleton University is proceeding with establishing the first Canadian facility of this type. Limited initial projects can already be undertaken in an interim structure. It is intended that contracted research will be international in scope and operation. Currently the initial stages of projects involving the U. K., France, Norway and Russia are being undertaken. Obviously though, priority is attached to studies with major Canadian involvement and for Canadian companies and institutions. The plans allow for extension of the facility as required and the possibilities for research under a range of modelled climatic, soil and other conditions are wide-ranging.

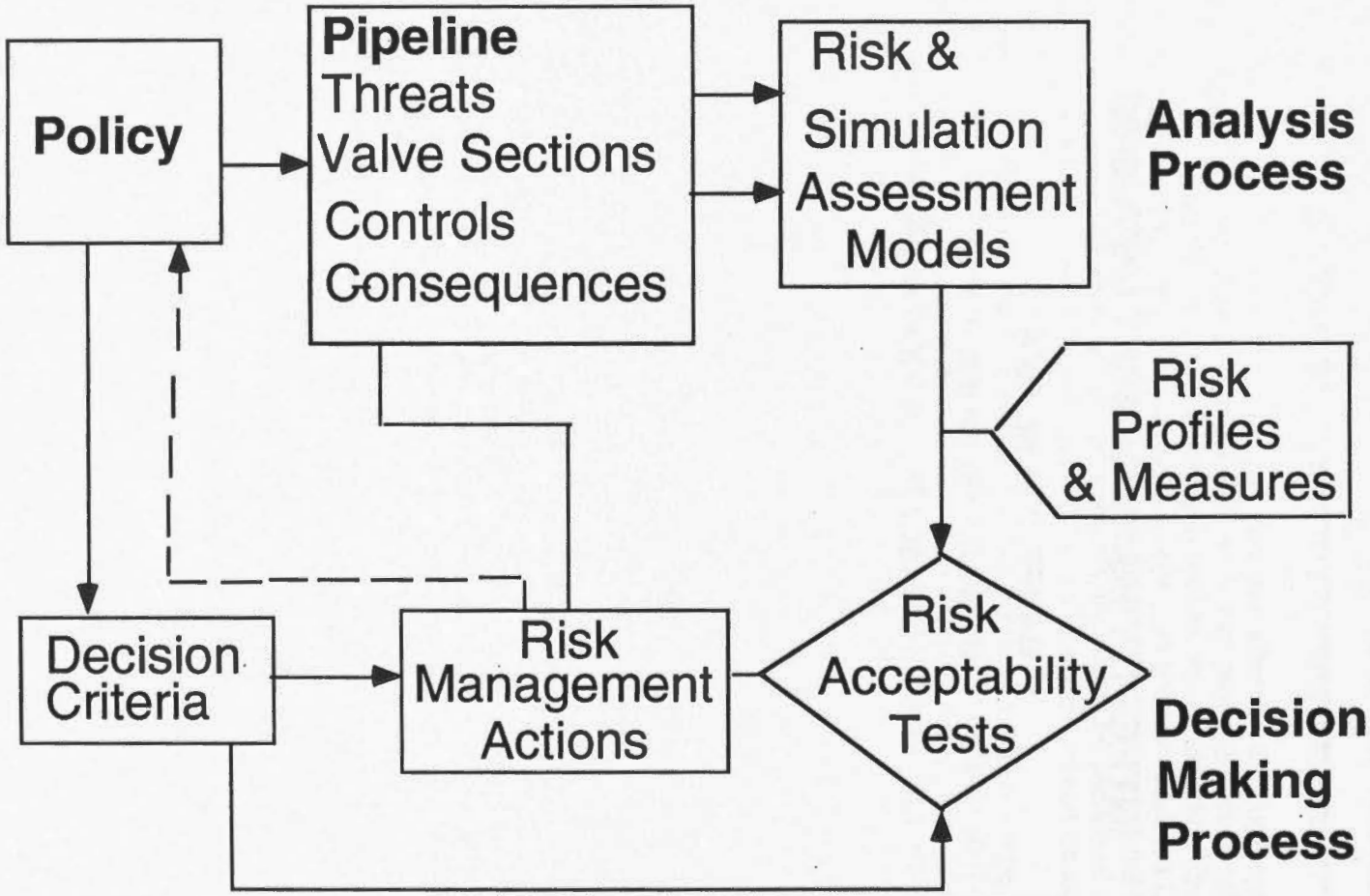
INTEGRITY MANAGEMENT METHODS

- BANFF, 9 JUNE 1994
- by Blaine Ashworth
- TRANSCANADA PIPELINES

INTEGRITY MANAGEMENT METHODS

- RISK ANALYSIS
- DECISION MAKING PROCESS
- TCPL'S PIPELINE MAINTENANCE PROGRAM

INTEGRATED RELIABILITY AND RISK MANAGEMENT SYSTEM



TransCanada PipeLines

RISK ANALYSIS

- 1. THREATS TO PIPELINE INTEGRITY
  - DEFECTIVE WELDS
  - MATERIAL FAILURE
  - THIRD PARTY DAMAGE
  - CORROSION
  - OTHER CAUSES

NEB PIPELINE RUPTURES

- PTC 6" SASK, 1/9/91
- TCPL 30" ONT, 1/17/91
- TCPL 20" ONT, 12/8/91
- TCPL 36" ONT, 7/15/92 fire
- FOOTHILLS, SASK, 2/15/94 fire
- COCHIN, SASK, 5/10/94 fire

NEB PIPELINE RUPTURES

- TCPL PIPELINE IN SERVICE 14,000 km
- NEB PIPELINES IN SERVICE 38,000 km
- FAILURE FREQUENCY FOR LAST 3.5 YEARS
  - 0.00004 / km-yr

RISK ANALYSIS

- 2. PIPELINE COMPONENTS
  - DESIGN POLICIES
  - FRAMEWORK TO SUBDIVIDE PIPELINE SYSTEM
  - METHOD TO QUANTIFY CONSEQUENCES TO BUILDINGS AND PUBLIC AFFECTED FROM A FAILURE
  - PIPELINE SECTION FAILURE RATE PREDICTIONS BY BAYNESIAN METHODS

RISK ANALYSIS

- 3. CONSEQUENCES OF FAILURES
  - PROBABILITY OF IGNITION
  - SIZE AND SHAPE OF FIRE
  - THERMAL RADIATION CONTOURS
  - DAMAGE CRITERIA

RISK ANALYSIS

- 4. METHOD FOR GENERATING RISK RATES (RISK MODEL)

DECISION MAKING PROCESS

- RISK ACCEPTABILITY TEST
- DECISION CRITERIA
- RISK MANAGEMENT ACTIONS

TCPL'S PIPELINE MAINTENANCE PROGRAM

- METHODS OF CONTROLLING RISK
  - ABANDONMENT
  - RELOCATE
  - REPLACE
  - RETEST AND REPAIR
  - IN-LINE INSPECTION AND REPAIR
  - RECOAT

TCPL'S PIPELINE MAINTENANCE PROGRAM

- SCC SOILS MODEL
- SCC CRACK GROWTH RESEARCH
- PERIODIC HYDROSTATIC RETESTING
- SELECTIVE SCC PIPE PROXIMITY REPLACEMENTS
- SCC ULTRASONIC INSPECTION TOOL RESEARCH

COOPERATION, APPLIED SCIENCE AND KNOWLEDGE OF A SPECIFIC PIPELINE CAN MAKE THE DIFFERENCE

CANMET Issues Workshop

on

Pipeline Lifecycle

Banff, 9-10 June 1994

INSPECTION

David Atherton,
Queen's University, Kingston

Magnetic Flux Leakage Tools

MFL signals depend on:

Tool

Defect type and geometry

Running conditions (velocity, **stress**)

Magnetic properties of pipeline steel

Conventional

Inexpensive

Maybe suitable for preliminary inspections

High resolution

Available from several vendors

Give very detailed logs

??? Interpretation to obtain accurate defect sizes

Limitations are knowledge of:

Stress effects

Magnetic properties

Magnetic Flux Leakage (contd)

Customer needs

Greater range of small diameter tools

Speed control without reduced throughput

Less expensive

Disbonding and crack detection!!

R&D

Improved tools, reliability and reporting

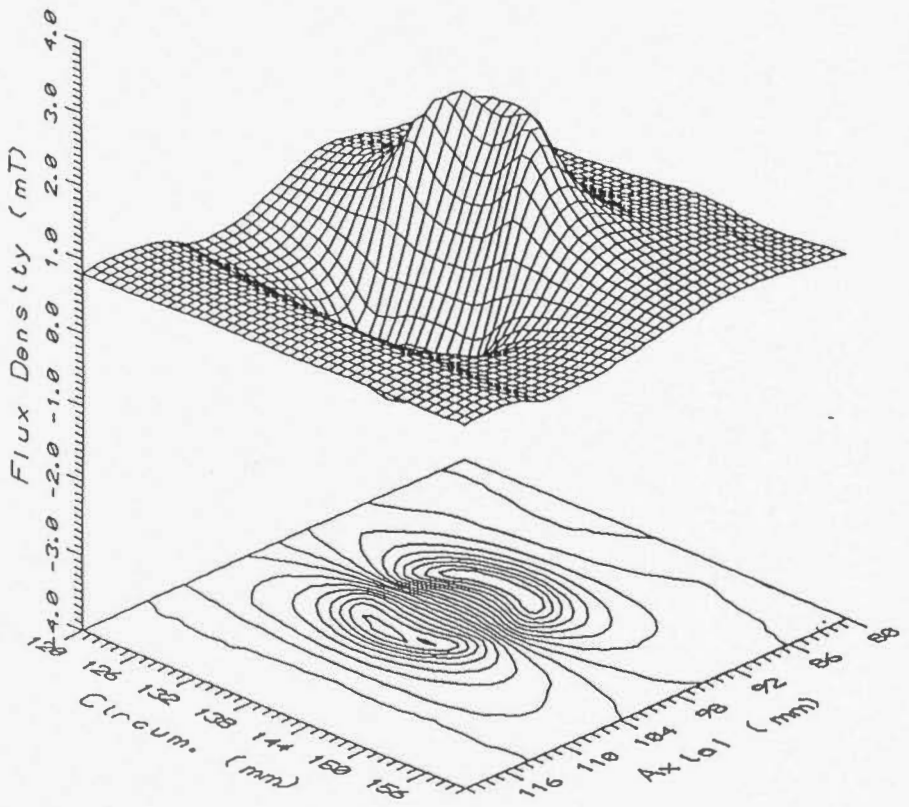
Defect sizing (stress effects, magnetic properties)

GRI PSF flow loop

great learning experience

own line tests

Research on magnetic properties needed soon



igure 5.5. Surface and contour plots of radial magnetic flux leakage from 13 mm diameter all milled defect in the composite beam at zero applied stress during a 'normal cycle' scan.

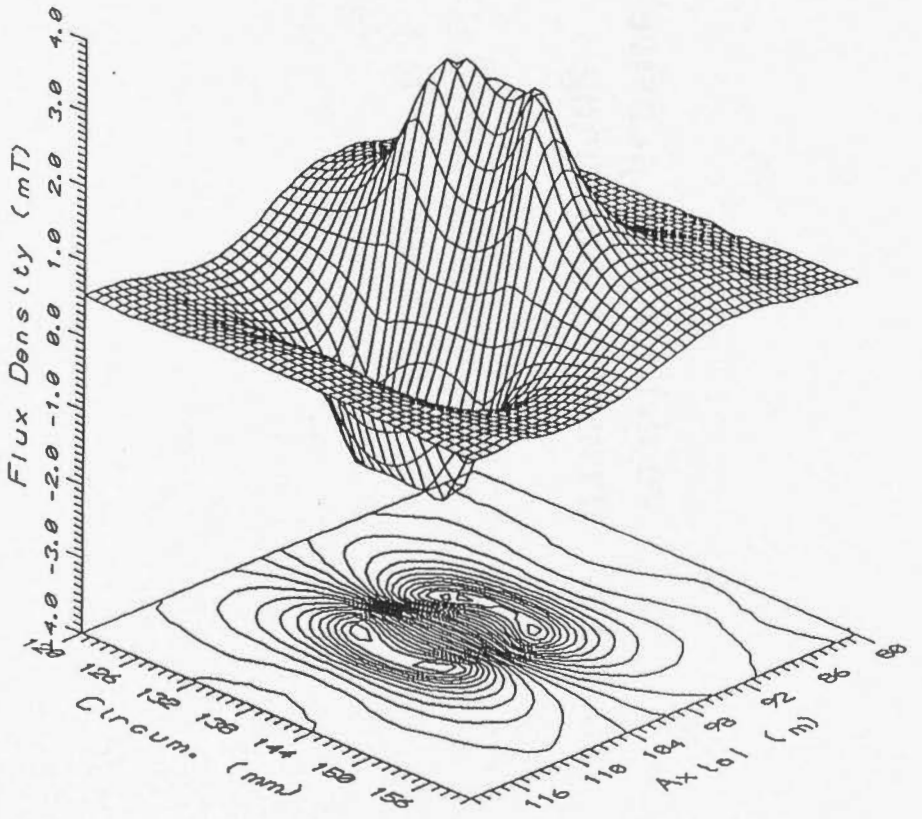


Figure 5.6. Surface and contour plot of radial MFL from 13 mm diameter ball milled defect in the composite beam at 340 MPa applied tensile stress during a 'normal cycle' scan.

SCC

Much, much more difficult (expensive) than MFL corrosion monitoring

Ultrasonic	Electromagnetic (Remote Field)

Oil / Gas (Coupling)

detection / measurement

problems

discrimination	only R&D stage for SCC
EMATs ?	how tight is "tight"?

On board power generation, Speed control
Selective inspection

SCC (contd)

R&D

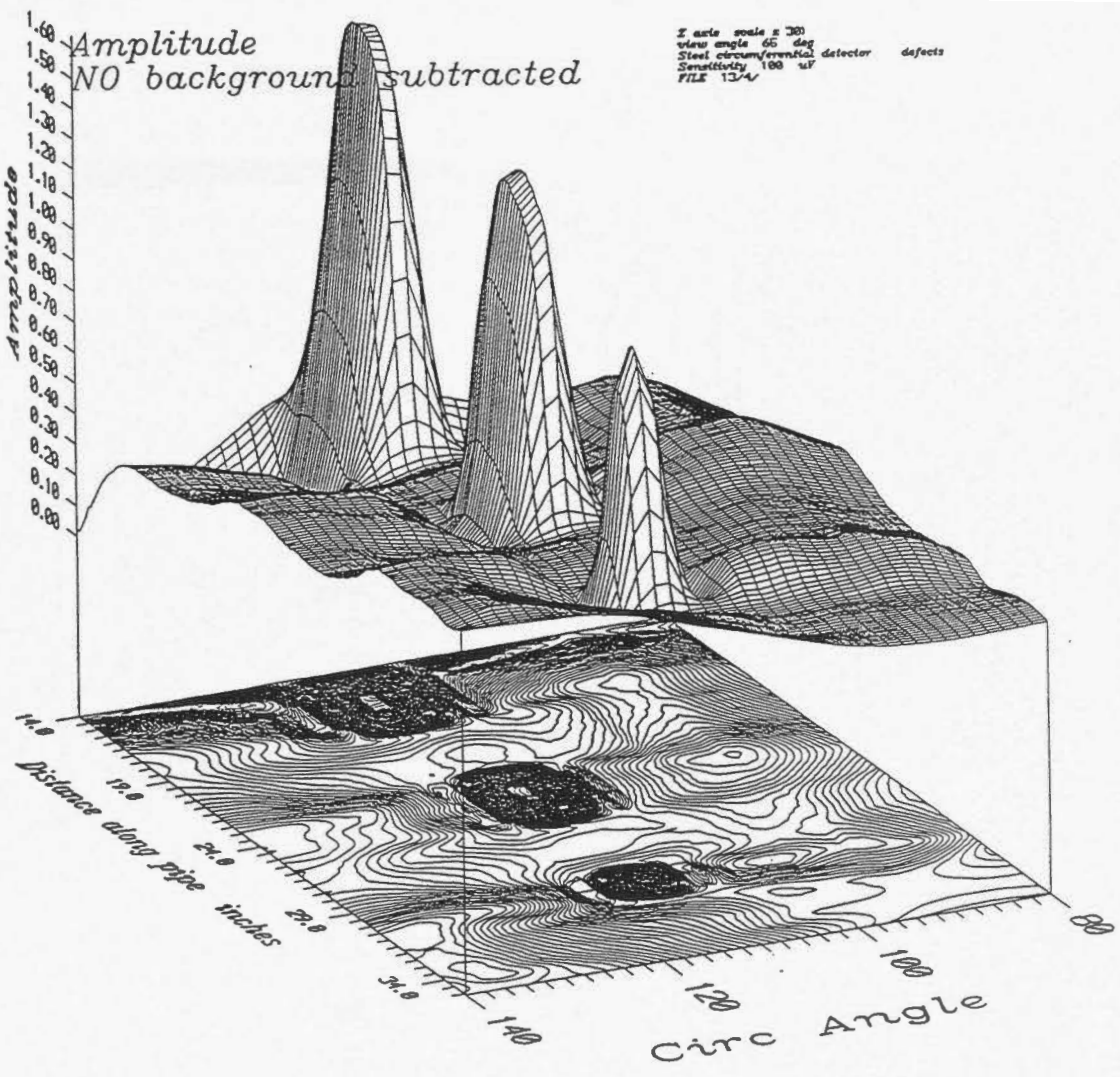
Ultrasonic: Signal processing, Coupling systems (gas)

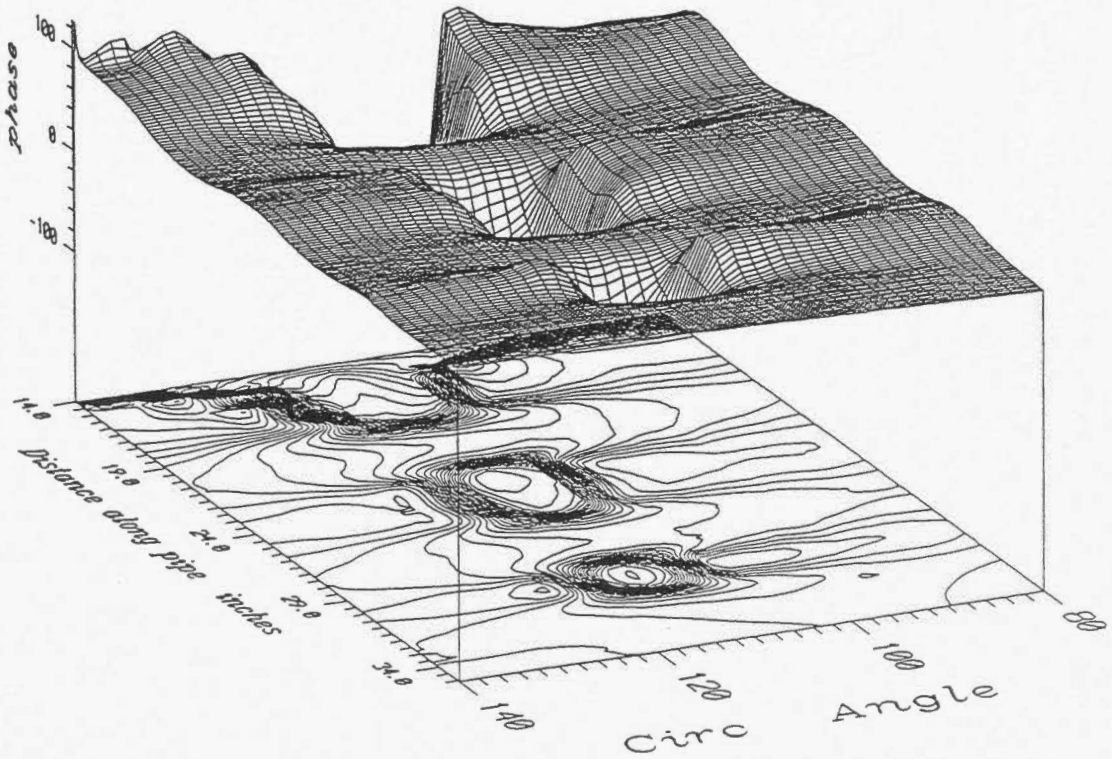
Remote Field Defect interactions, Crack signal enhancement, Small signal pigs

GRI

Development is expensive

RESEARCH INVESTMENT NEEDED


Amplitude
NO background subtracted
X axis scale = 300
view angle 65 deg
Steel circumferential detector defects
Sensitivity 100 uV
FILE 13/4
Amplitude
Distance along pipe inches
Circ Angle


Phase
Distance along pipe inches
Circ Angle

SUMMARY

Pipelines have an enviable safety record

Huge investment to protect
and an immense amount of material to inspect

Regulations should recognize R&D as investment

Long term R&D needed
both collaborative (GRI) and in house

Improving inspection logs
INTERPRETATION

MFL: Stress effects
Materials research

SCC: No miracle solution
Long term R&D effort
Invest in research first

Pipe #2
Defect Positions.

REPORT ON THE

INTERNATIONAL COMMITTEE

ON

REGULATORY AUTHORITY R&D

(ICRARD)

BY: RAY SMITH, ENGINEERING BRANCH

NATIONAL ENERGY BOARD

JUNE 9, 1994

MEMBERSHIP IN ICRARD

(BASIC REQUIREMENTS)

- **OPEN ONLY TO NATIONAL OFFSHORE REGULATORY AUTHORITIES**
- **EACH AUTHORITY MUST BE SUPPORTING, THROUGH FUNDING, AN OFFSHORE R&D PROGRAMME**

NATIONAL ENERGY BOARD **JUNE 9, 1994**

CURRENT ICRARD MEMBERSHIP

- U. K. HEALTH AND SAFETY EXECUTIVE (HSE)
- U. S. MINERALS MANAGEMENT SERVICE (MMS)
- NATIONAL ENERGY BOARD OF CANADA (NEB)
- DANISH ENERGY AGENCY (DEA)
- NORWEGIAN PETROLEUM DIRECTORATE (NPD)
- NETHERLANDS STATE SUPERVISION OF MINES

TERMS OF REFERENCE (ICRARD)

- TO EXCHANGE, ON A REGULAR BASIS, PERTINENT INFORMATION ON CURRENT R & D PROGRAMMMES
- TO MAKE AVAILABLE TO OTHER ICRARD MEMBERS, REPORTS FROM COMPLETED R & D STUDIES
- TO SEEK OPPORTUNITIES FOR CO-SPONSORSHIP OF R & D PROGRAMMES
- TO MONITOR R & D ACTIVITIES JOINTLY FUNDED BY ICRARD MEMBERS
- TO EXCHANGE INFORMATION ON R & D POLICIES AND STRATEGIES

NATIONAL ENERGY BOARD **JUNE 9, 1994**

1 st ICRARD MEETING

- **THE 1 st MEETING OF ICRARD WAS HOSTED BY THE OFFSHORE SAFETY DIVISION OF THE U. K. HEALTH AND SAFETY EXECUTIVE (HSE) IN LONDON, ENGLAND ON MARCH 18 th, 1994**

MEETINGS OF ICRARD

(FORMAT)

- HELD ANNUALLY
- HOSTED ON A ROTATING BASIS BY THE MEMBER REGULATORY AUTHORITIES
- CHAIRED BY THE HOST AUTHORITY
- HOST AUTHORITY TO PROVIDE SECRETARIAT FOR THAT MEETING

HSE R & D PROGRAMME

- CURRENT PROGRAMME - 286 PROJECTS
- HSE 1993/94 ANNUAL BUDGET - $14 M
- 1993/94 INDUSTRY CONTRIBUTION - $74 M
- ALL MAIN TECHNOLOGIES RELEVANT TO OFFSHORE HEALTH AND SAFETY
- RISK BASED STRATEGY IS USED FOR SETTING PRIORITIES FOR R & D

MMS R & D PROGRAMME

- CURRENTLY MORE THAN 50 PROJECTS
- MMS 1994 ANNUAL BUDGET - $5.7 M
- REGULATORY & SAFETY RELATED TECHNOLOGIES, DISASTER EMERGENCY (HURRICANE ANDREW), OIL SPILL
- R & D STRATEGY EMPHASIZES SAFETY OF LIFE, PROPERTY, AND THE ENVIRONMENT

NPD R & D PROGRAMME

- CURRENTLY MORE THAN 90 PROJECTS
- NPD 1994 ANNUAL BUDGET - $1 M
- 1994 INDUSTRY CONTRIBUTION - $10 M
- RESOURCE MANAGEMENT, FIELD DEVELOPMENT, PRODUCTION, SAFETY AND WORKING ENVIRONMENT
- R & D STRATEGY IS PART OF LICENCEE'S INTERNAL CONTROL SYSTEM

NEB R & D PROGRAMME

- CURRENTLY MORE THAN 55 PROJECTS
- NEB 1993/94 ANNUAL BUDGET - $1.6 M
- ICE/STRUCTURE INTERACTION, STRUCTURAL SYSTEMS RELIABILITY, EVACUATION TECHNOLOGY, PIPELINE SYSTEMS RELIABILILTY
- R & D STRATEGY INVOLVES REGULATORY AND INFORMATION INFRASTRUCTURE FOR RESOURCE DEVELOPMENT

2 nd ICRARD MEETING

- THE 2 nd MEETING OF ICRARD WILL BE HOSTED BY THE MINERALS MANAGEMENT SERVICE (MMS) OF THE U. S. DEPARTMENT OF THE INTERIOR IN RESTON, VIRGINIA IN APRIL OF 1995

5-Minute Prepared Discussions

(copies of overheads used)

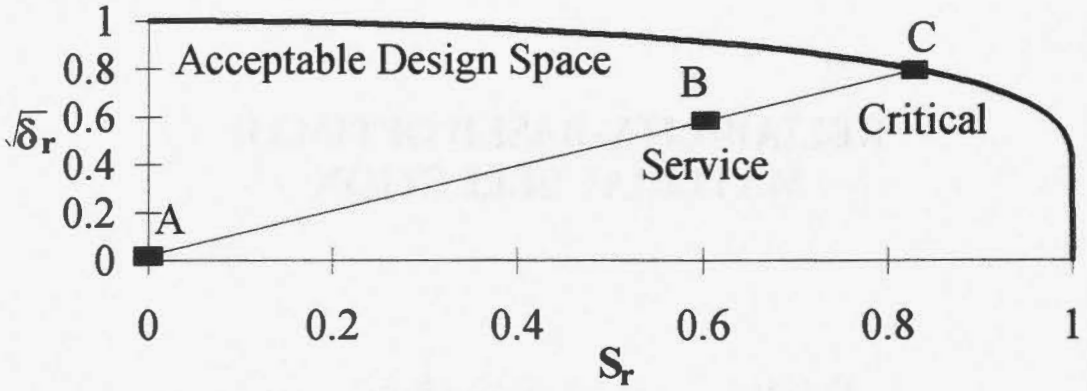
RELIABILITY-BASED OPTIMAL MATERIAL SELECTION

- **Pipeline Cost Optimization**
- **Reliability Optimization**
- **Under-Matching Weld Metals**

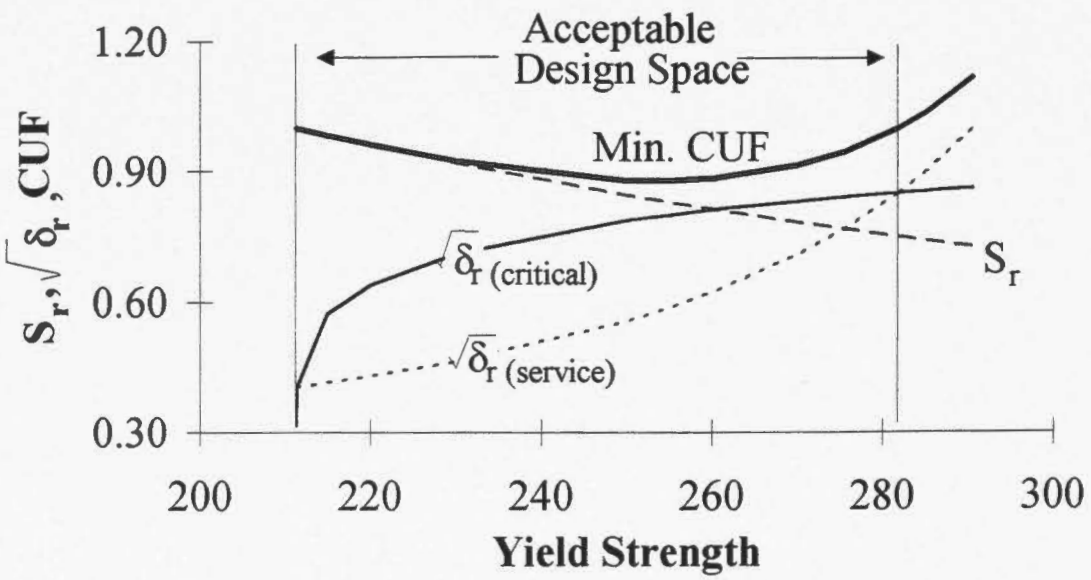
FTL FLEET TECHNOLOGY

Optimal Safety or Reliability (PD6493 Level II)

$$\text{Capacity Utilization Factor (CUF)} = \frac{\text{Applied Load}}{\text{Allowable Load}} = \frac{\overline{AB}}{\overline{AC}}$$



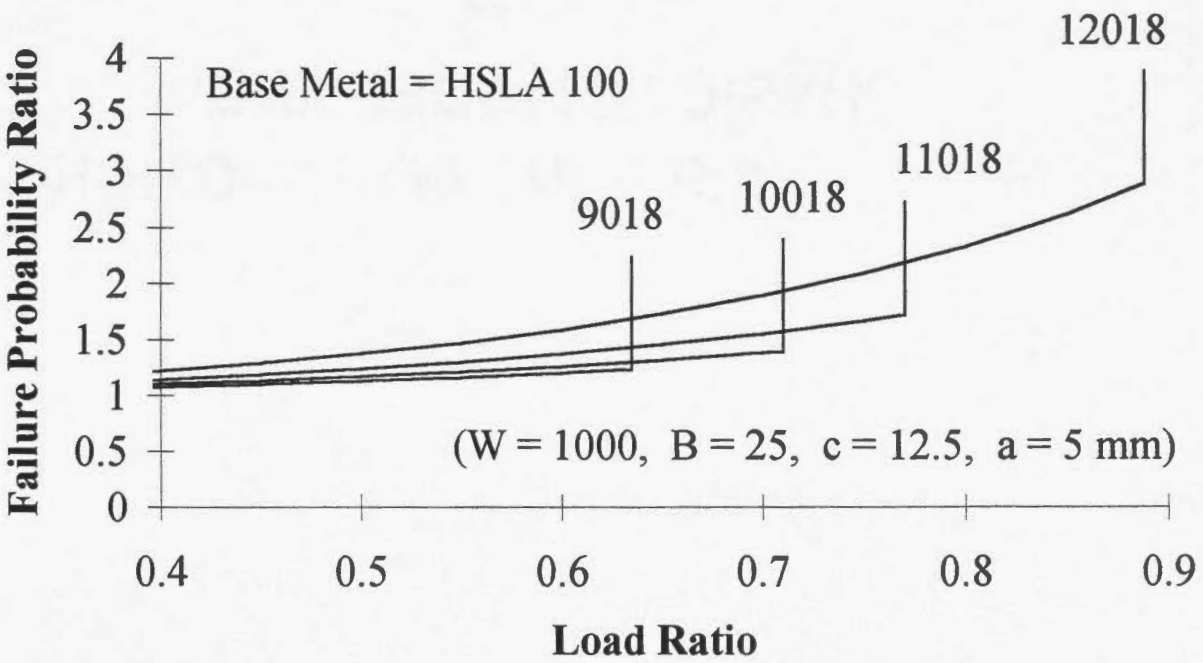
- Incorporating a yield strength and toughness trade off



- When inverse relationships between material characteristics (i.e. strength, toughness, cost, etc..) exist, optimization techniques can be effectively employed to identify optimal materials

Behavior of Under-Matching Weld Metals

- Ensure acceptable safety for under-matching weld metals



- Based on actual, but limited weld test data, under-matching welds can provide lower failure probabilities below certain design loads

CANMET

MANAGING PIPELINE INTEGRITY, JUNE 1994

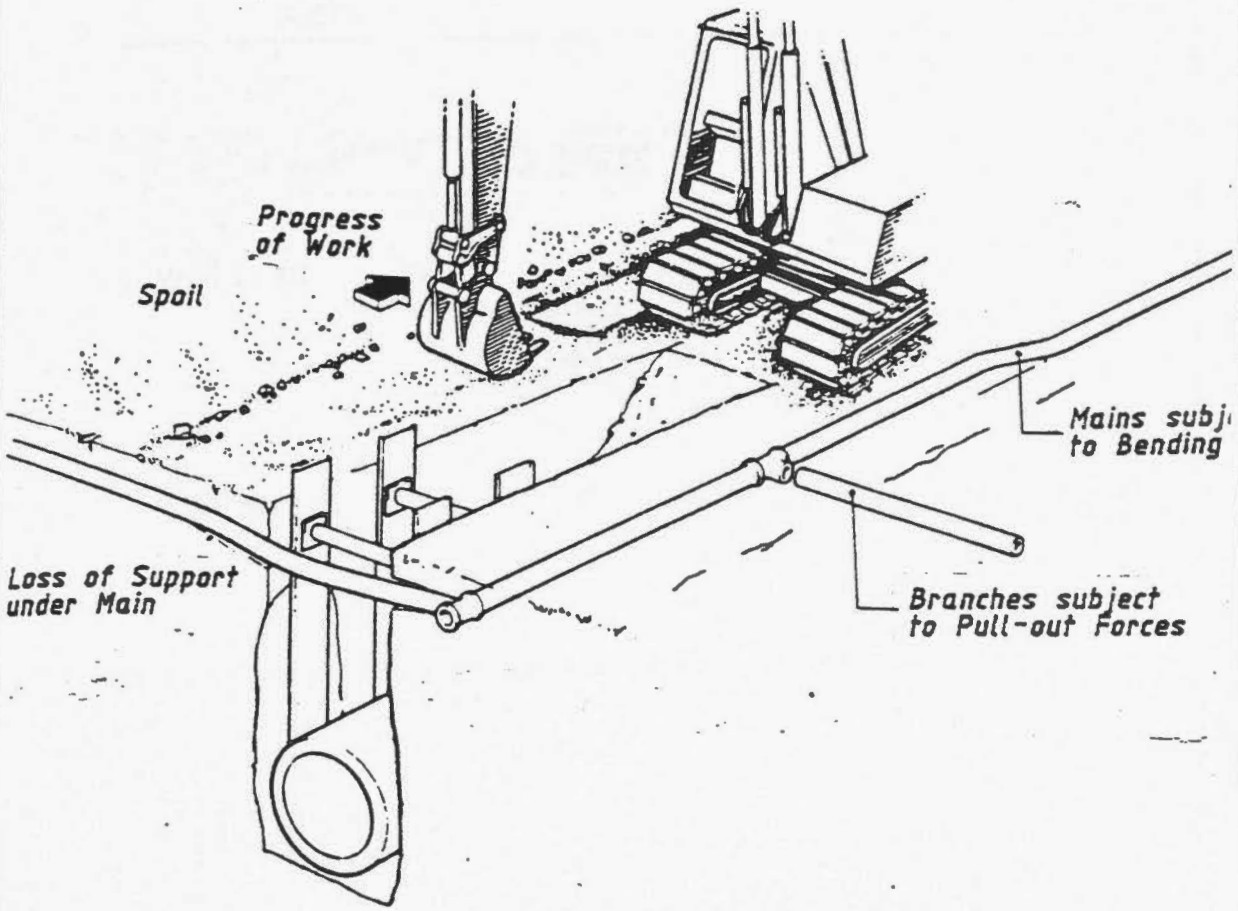
PHYSICAL MODELLING OF SOIL / PIPELINE INTERACTION

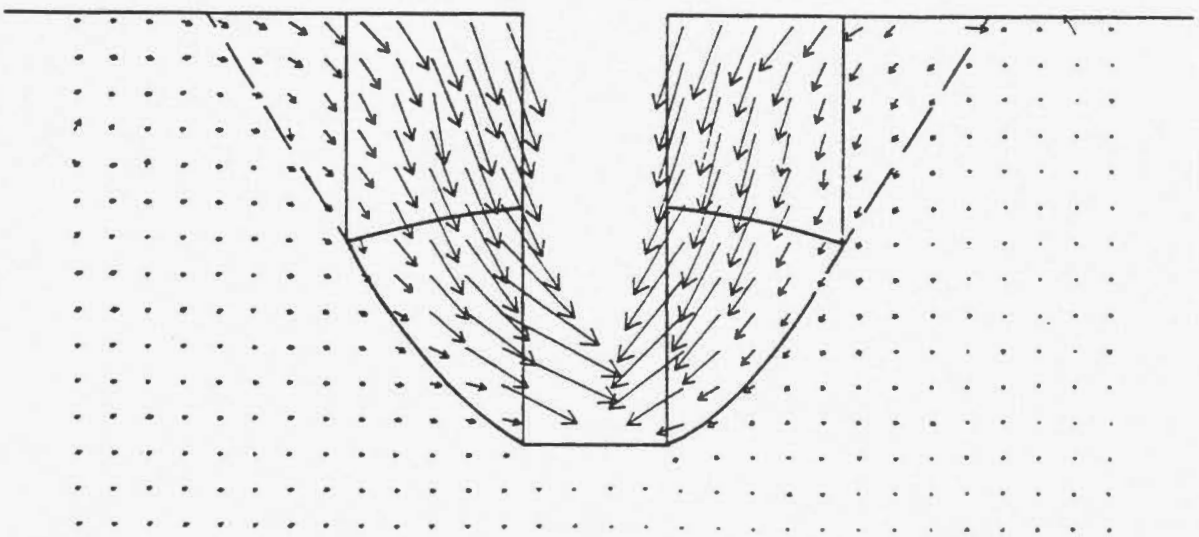
RYAN PHILLIPS

1. URBAN PIPELINES
2. PIPELINES IN PERMAFROST
3. PIPELINES IN SLOPES
4. PIPELINES UNDER ICE SCOURS (PRISE)

C-CORE

CANMET - URBAN PIPELINES





C-CORE

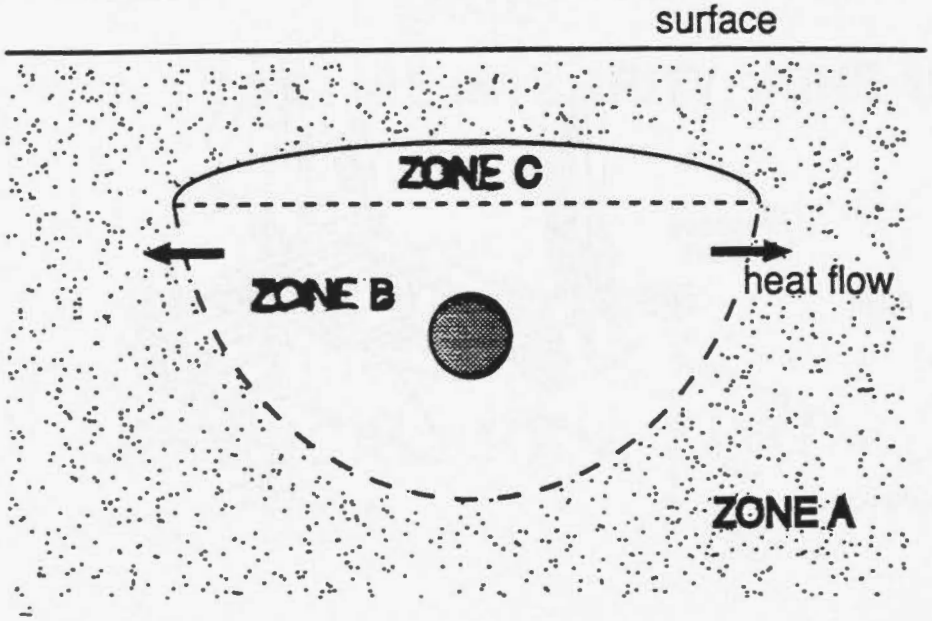
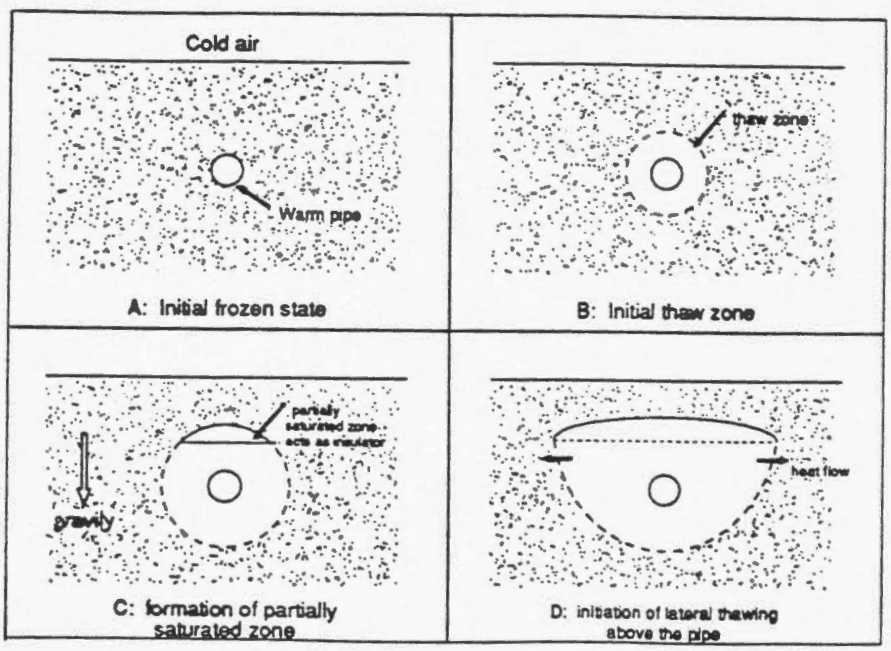
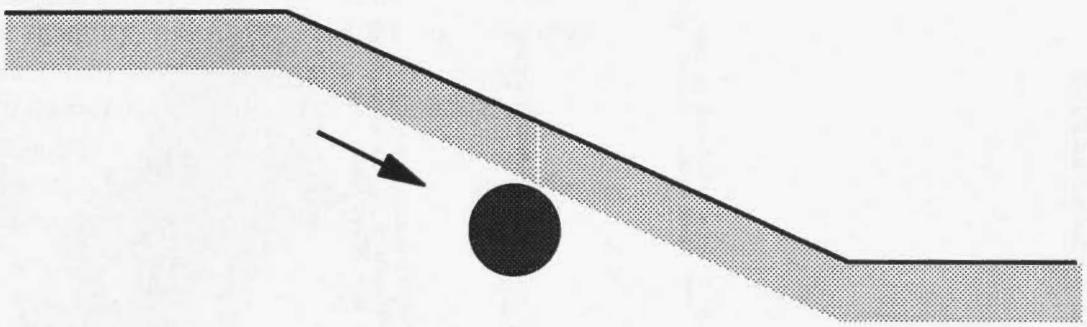


Figure 5.10: Modes of heat transfer around a warm pipe buried in permafrost.



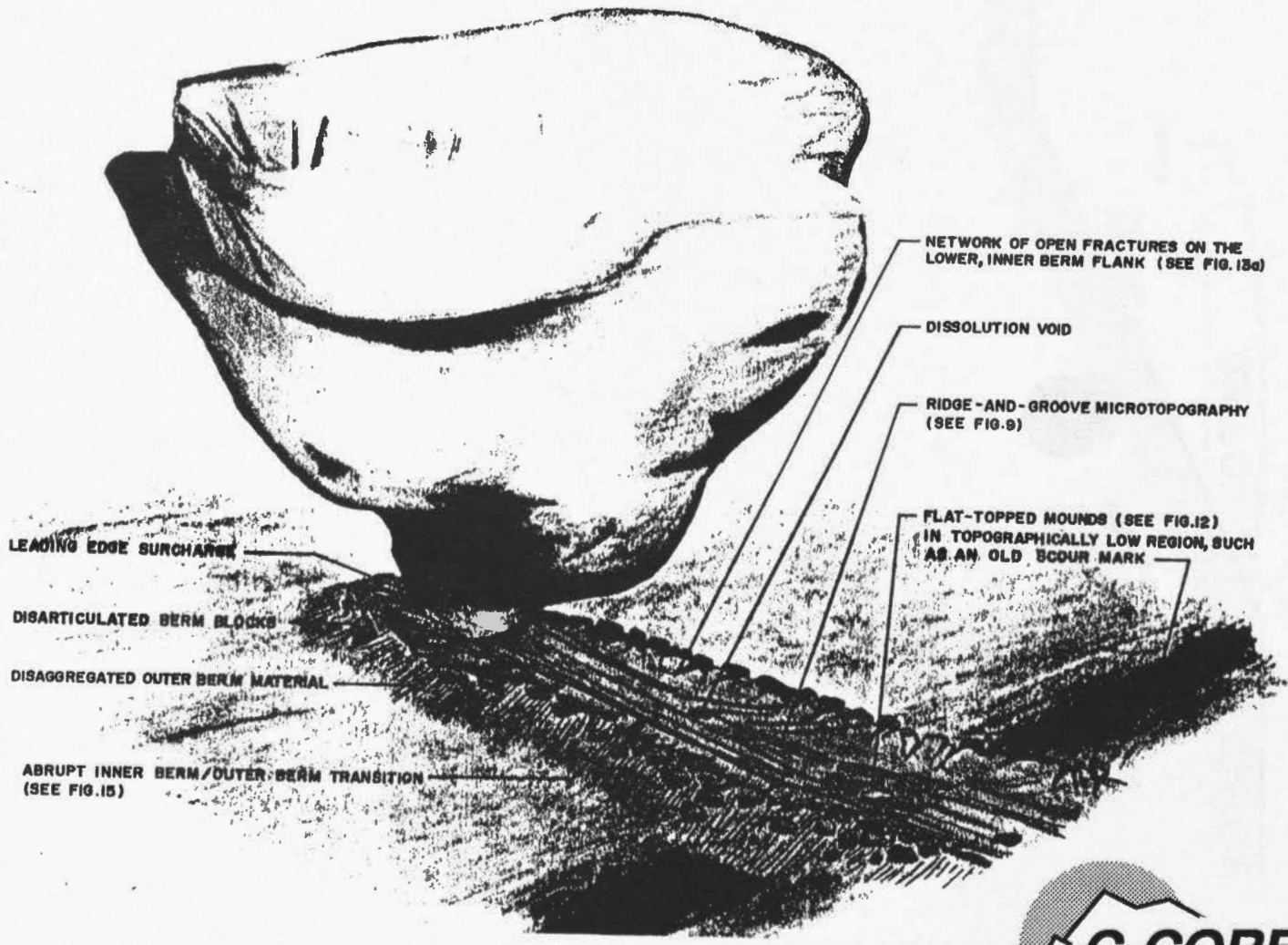
CANMET - PIPELINES IN SLOPES



Ref: Yin et al (1993) OMAE

C-CORE

CANMET - PIPELINES UNDER ICE SCOURS



C-CORE

Managing Pipeline Integrity, Issues Workshop on Pipeline Lifecycle, 1994, BANFF.

"Application of the GEOPIG to Computation of Pipeline Strains"

Jarek Czyz, Nowsco

The subject of this presentation is the application of the Geopig to structural evaluation of pipeline integrity, with an emphasis on measurements of bending strain. The Geopig, developed and patented by Nowsco, has been active in pipelines around the world since 1989. It has been used for successful monitoring of both oil and gas lines in both on-shore and off-shore environments.

The Geopig is equipped with several types of sensors:

- odometer wheels
- weld detectors
- temperature and pressure gauges
- ultrasonic callipers
- inertial system.

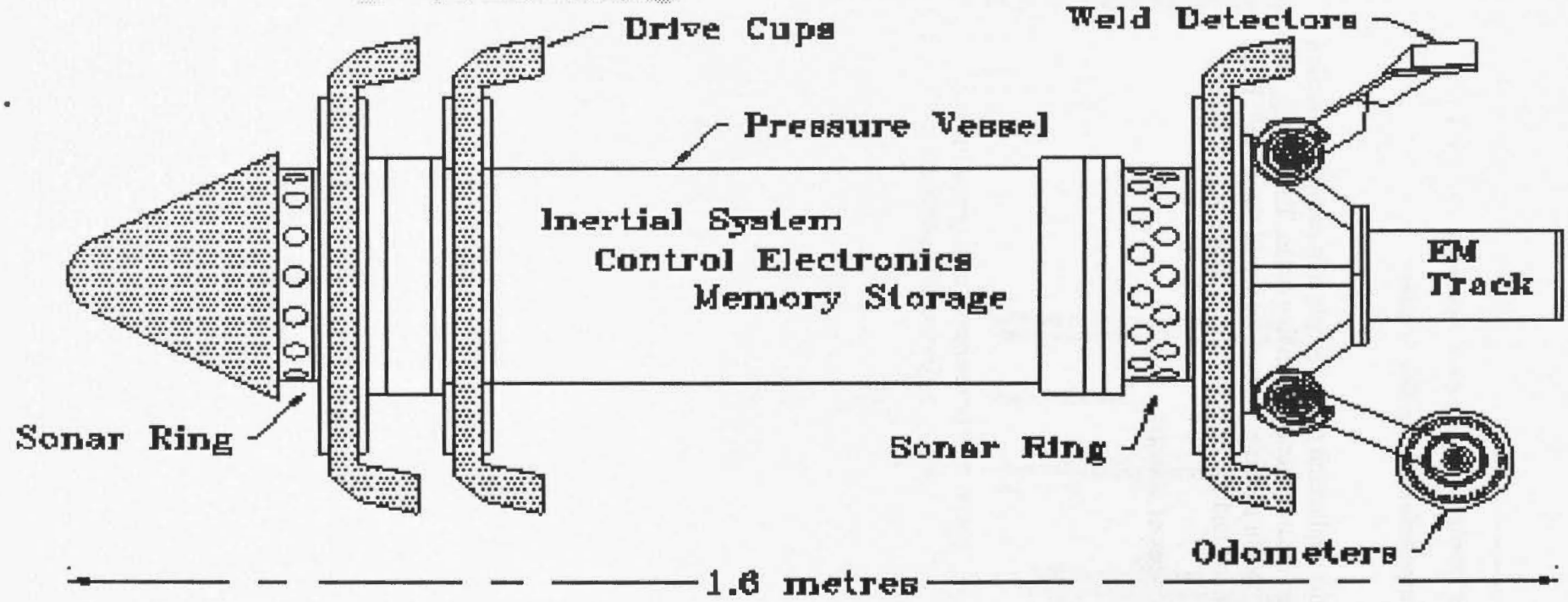
The heart of the Geopig is the inertial system, which consists of orthogonal triads of accelerometers and gyroscopes. The measurements from the inertial system are the basis for computation of the coordinates of pipeline centreline.

The ultrasonic transducers are equally spaced around two sonar rings. Each individual sonar measures the distance between the sonar ring and the pipe wall. Having measured that distance around the whole sonar ring the shape of the pipe cross section can be determined. The caliper sonar data is used not only for mapping the pipewall deformations, but also for rectification of the coordinates of the pipe center line.

The Geopig inspection provides the following pipeline surveys:

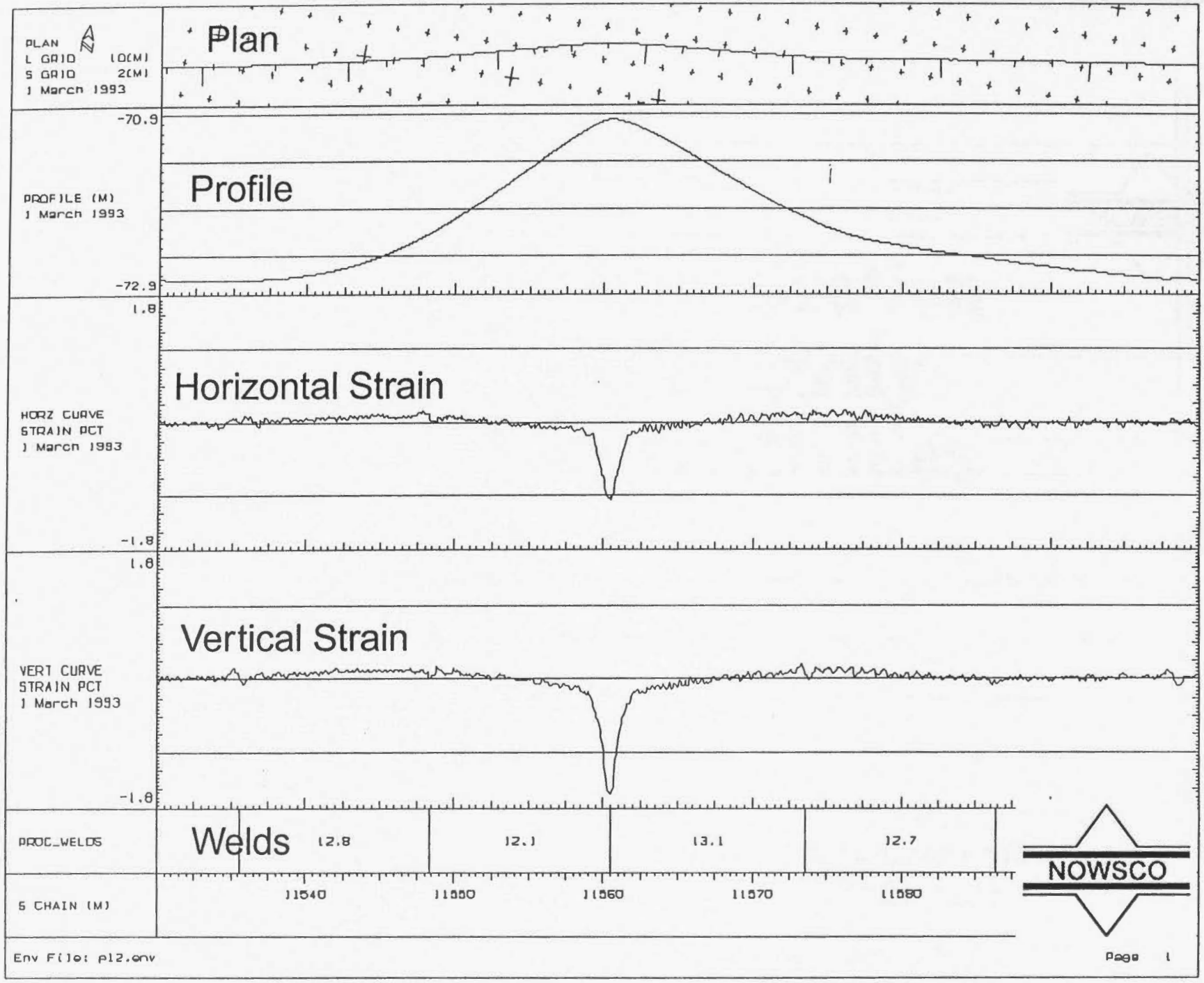
- Detection of pipewall deformations: the Geopig accurately measures the size, shape and clock position of dents, ovalities, wrinkles and other anomalies as well as pipe restrictions. The sonar calipers and inertial system provide independent and complimentary measurements of those anomalies.
- Pipeline mapping: plan, profile and location of features such as bends, valves, heavy wall, etc., provided by the Geopig can be used to generate accurate as-builts, or to confirm the accuracy of existing drawings. All that data can be integrated into a GIS data base, which allows for positioning of pipeline with respect to roads, buildings and other landmarks. Any information in the possession of the pipeline operator, including the results of the survey of other inspection tools, can also be integrated into the GIS. This data base can than be used, for example, to eliminate the use of magnetic markers during a corrosion inspection.
- Structural integrity monitoring and evaluation, based on continuous measurements of pipe centreline coordinates, bending strain, displacement and bend radius. The bending strain is computed from the curvature of the center line of the pipeline with an accuracy of 0.02% strain. The coordinates of the pipe center line can also be used for modelling with the Finite Element Method. This model provides all components of strain and stress tensor, and is also used for simulation of pipeline response to a change of loading conditions. The effect of the following conditions on pipeline integrity can be analysed, predicted and monitored: settlement, slope instability, frost heave, oil field subsidence, temperature and pressure change, free spanning, overburden, impact of new construction, etc. Buckling, wrinkling, excessive yielding, rupture and fatigue are taken into consideration.

Geopig System



24 Inch Geopig

NOWSCO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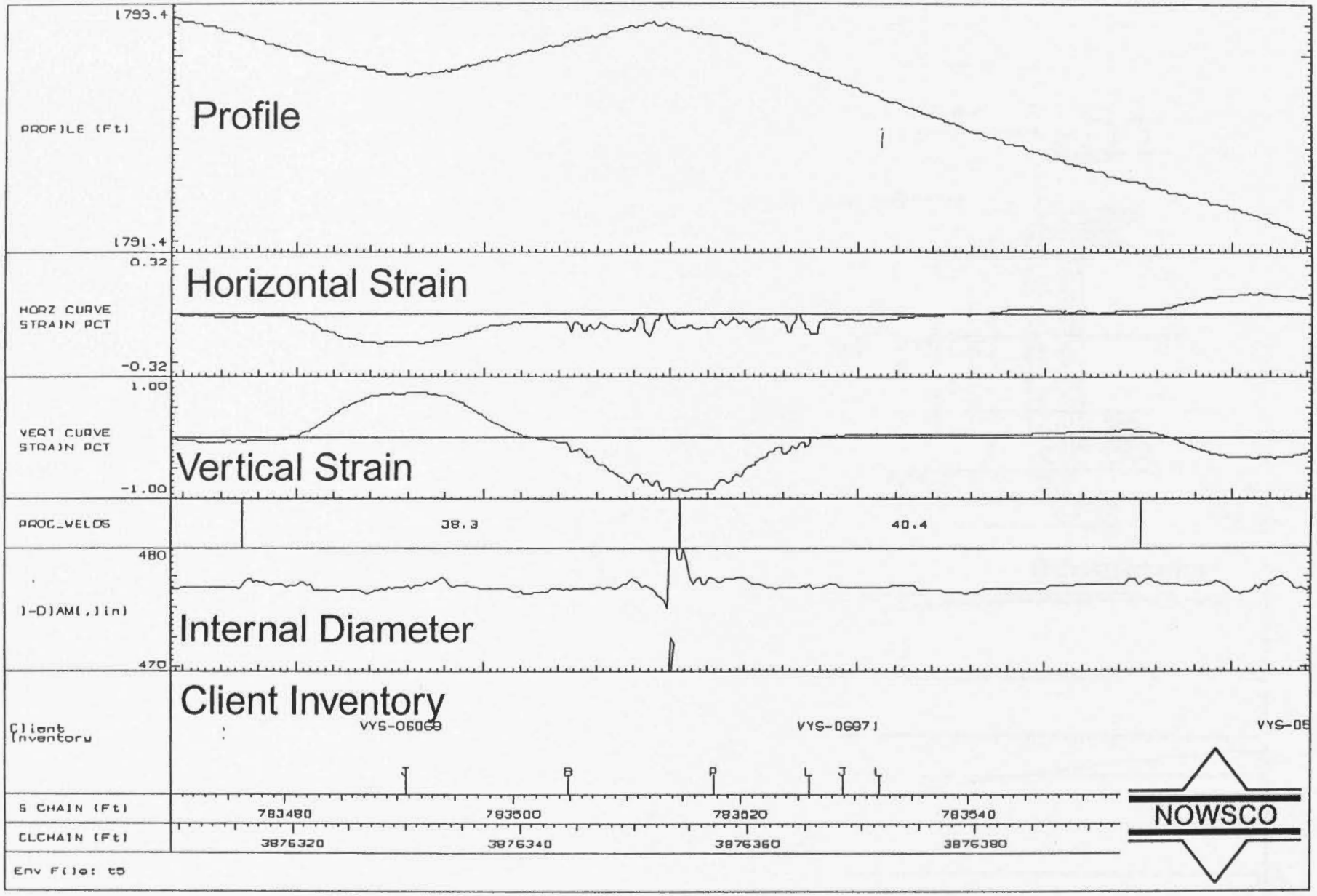
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Risk-Based Optimization of Pipeline Integrity Maintenance Activities

Centre for Frontier Engineering Research

Integrity Maintenance Optimization

Program Objective

- To develop risk-based methodology to optimize:
  - pipeline integrity monitoring programs, and
  - pipeline maintenance activities

Integrity Maintenance Optimization

Program Deliverables

- **Risk-Based Models and Software Tools for:**
  - **estimating risk levels for pipeline segments**
  - **quantifying risk reductions associated with different line inspection and maintenance activities**

1. Existing Pipeline Risk Analysis Approaches

- **Qualitative index approaches (Muhlbauer & AGA)**
  - Define risk as a function of a number of indexes that take into account the pipeline attributes

$$\text{e.g. Safety Index} = \frac{\text{Failure resistance factor}}{\text{Failure impact factor}}$$

where

Failure resistance factor = Corrosion factor + Third party factor + Design factor + Operations factor

Index Systems

- **Advantages**
  - Simple and easy to implement
  - Useful for preliminary ranking of pipeline segments
- **Limitation**
  - Relative index magnitudes are subjective and inaccurate

    e.g. Muhlbauer (1992)

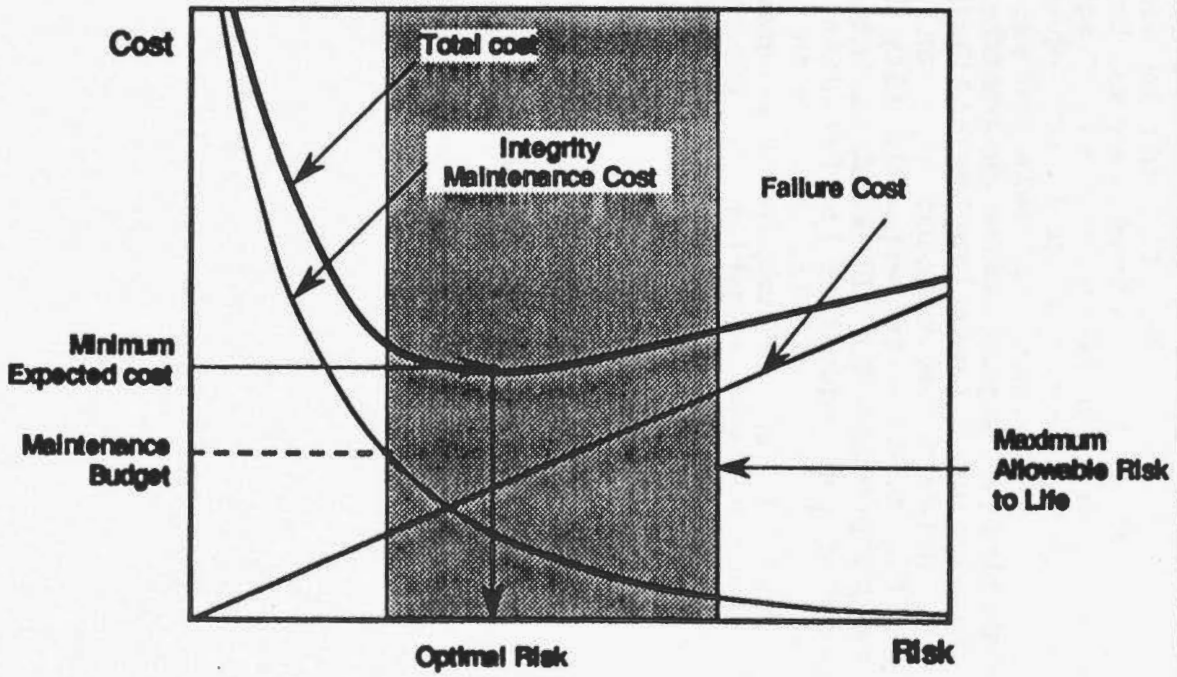
    High res. pigging assigned 8 out of a possible 400 points in the failure resistance index (2%)

    Corrosion accounts for 30 to 40% of all failures

Measure for Consequences

- Economic – Total cost in dollars (C)
- Life safety – Number of fatalities (N)
- Environmetal–Residual spill volume (V)

Constrained Cost Optimization



Optimal choice meets life safety criterion and maximum budget

Therefore

Choose optimal cost

The Transportation Safety Board of Canada - An Overview

Background

In 1973, in a report titled "Report on a Proposed Independent Canadian Transportation Accident Investigation and Safety Board", Brigadier General H.A. McLearn recommended that an independent board be established in Canada with the responsibility for accident investigation and safety promotion for all modes of transportation. This report was prepared at the request of the Canadian government.

In 1975, Cabinet approval in principle was given to the establishment of an independent investigation organization. Nearly 20 years later, the recommendation for an independent board was finally implemented with the establishment of the Transportation Safety Board (TSB) as an independent multimodal accident investigation agency.

Mandate

The mandate of the TSB is to advance transportation safety in the marine, pipeline, rail and air modes of transportation. The TSB carries out this mandate: i) by conducting independent investigations, and if necessary public inquiries, into transportation occurrences in order to make findings as to causes and contributing factors; ii) by reporting publicly on its investigations and public inquiries; iii) by identifying safety deficiencies as evidenced by transportation occurrences; iv) by making recommendations to eliminate or reduce safety deficiencies identified during its investigations; and v) by conducting special investigations and studies on transportation safety matters.

The legislation administered by the TSB relates to advancing transportation safety through the investigation of transportation occurrences. In making findings as to cause and contributing factors of a transportation occurrence, it is not the TSB's function to assign fault or to determine civil or criminal liability.

The key feature of the TSB is its independence from all federal departments and agencies responsible for regulating the transportation industry.

Products

The products of the TSB are its reports, its safety studies and analyses and its recommendations to help alleviate potential safety deficiencies. In the case of pipelines, recommendations are usually made to the National Energy Board. Particular circumstances may also be brought to the attention of the National Energy Board through safety advisories, safety information letters and hazard notifications.

Occurrence Classification Response System

The TSB has developed policies by which it responds to occurrences so that resources can be focused on those occurrences with the greatest potential for advancing transportation safety. Occurrences are classified as either Class A - level I or II response; Class B - level II response; or Class C - level III, IV or V response.

A Class A occurrence is one with the highest need and potential for Board safety action. In general, it is the most serious and complicated and tends to generate the highest level of public interest. Such occurrences do not necessarily involve fatalities or serious damage to property or the environment. A level I response would involve a full investigation in conjunction with a public inquiry. A level II response would involve a full investigation but without a public inquiry. Both would focus on the identification of contributing factors and causes of the occurrence and any safety deficiencies requiring safety action. A comprehensive report would be prepared for both levels of response.

A Class B occurrence is one in which a concern for public safety or a potential for significant safety action has been identified. There is only one level of response for a Class B occurrence. The response is similar to that for a Class A occurrence in that a full investigation is carried out and is directed at the collection and analysis of all relevant facts. An intermediate report would be prepared for this class and level of occurrence.

A Class C occurrence is one in which a reasonable concern for public safety or need for safety action has not been identified. A response to a Class C occurrence would be to gather data to support long-term trend analysis or to identify and support a worthwhile safety lesson.

There are three possible levels of response to a Class C occurrence; levels III, IV or V.

An investigator would be sent to the site of an occurrence classified as a level III response to conduct a preliminary examination. Following this preliminary examination, depending on whether or not a reasonable concern for public safety or reasonable potential for TSB safety action has been identified, the C classification would be retained. Although level III response has little potential for safety action, the TSB has decided that it will report the facts and findings from those occurrences to the public.

A level IV response would be given to an occurrence in which the facts do not indicate a need for TSB safety action but where the circumstances are sufficiently complicated to require more detailed information.

A level V response is reserved for relatively minor occurrences where the information provided at the time of notification does not indicate a need for TSB safety action. However, sufficient data would be collected at the time of notification to enable long-term trend analysis.

For all occurrence classification and response levels, applicable data is entered into the data base to enable long-term trend analysis, and to provide data for specific safety studies.

Organization within the TSB

The Engineering Branch is the TSB's resource centre dedicated to material failure analysis. The technical experts of that Branch use a wide variety of test equipment and analytical instruments to help determine the cause of occurrences. Research projects may also be undertaken on special safety problems related to material deficiencies. The Engineering Branch has also developed expertise in document restoration, image analysis, and new investigation techniques based on photogrammetric and remote sensing technology.

Investigations are conducted by the Investigations Operations Directorate; safety action in the form of safety advisories, safety information letters and hazard notifications is the responsibility of the Safety Analysis and Communications Directorate.

In order to fully understand the safety hazard and to resolve it in a timely fashion, staff from the Safety Analysis and Communications Directorate consult with staff from the Investigations Directorate before a safety notification is issued.

Human factors must be investigated to fully understand the "whys" of occurrences. The Human Performance Division of the Safety Analysis and Communications Directorate provides TSB investigators with the necessary tools and expertise to properly investigate these factors.

The TSB recognizes that safety lessons are not always the result of individual occurrence investigations but may arise out of occurrence trend analysis or targeted research. The Safety Studies Division of the Safety Analysis and Communications Directorate is responsible for identifying and analyzing systemic deficiencies in the transportation system that may not be apparent through individual occurrences. In other words, the Investigations Directorate approaches occurrences from a micro point of view; the Safety Studies Division from a macro point of view.

The Safety Studies Division welcomes suggestions from industry or other government agencies concerning areas where in-depth studies may be required.

Review Commission

Following the experience gained from the operation of the Canadian Aviation Safety Board, the government created the TSB by pulling together the accident investigation function of four transportation modes. As part of the creation of the TSB, Parliament directed that an independent review commission of inquiry be created to assess the effect of the operation of the Act on transportation safety. The Review Commission's (Commission) report was submitted to Parliament in January 1994.

The Commission interpreted its mandate broadly - to assess the impact on safety not only of the Act by also of the TSB.

The Commission reviewed the current organization, processes and products of the Board and performed a detailed analysis of the legal and philosophical underpinnings of the Act.

Many of the Commission's observations were known by the TSB and corrective action is being taken. For example, efforts have been under way to improve timeliness and, whenever possible, to complete public investigation reports within one year of the occurrence.

The TSB has set up a Review Commission Response Group (RCRG) to review the 66 recommendations put forward by the Review Commission and to develop a plan of action to address and implement the recommendations.

The RCRG is composed of members of the Senior Management Committee, the three Directors of Investigation, and the Director of the Accident Prevention Branch.

The RCRG has identified 21 strategic issues which should be addressed by the Board. All 66 recommendations have been embodied in these issues. The issues have been ranked according to their relative priorities taking into consideration the Commission's "Implementation Plan".

The TSB agrees with many of the recommendations and, where feasible, is implementing them. It should be remembered however that changes to the Act are for Parliament to decide. The TSB is willing to provide its views on those changes and will comply with the decision.

While the recommendations are being discussed and evaluated, the TSB will continue to serve the public interest and earn credibility by doing its work in a quiet and professional manner.

Presented at:

Managing Pipeline Integrity - An Issues Workshop on Pipeline Lifecycle

Donald Cameron Hall, Banff Centre for Continuing Education
Banff, Alberta

June 9-10, 1994

June 9, 1994 Luncheon

Speaker:
R. A. Hill
Vice-President, Technology & Operations
Canadian Energy Pipeline Association

CANADIAN ENERGY PIPELINE ASSOCIATION

CANMET

MANAGING PIPELINE INTEGRITY

An Issues Workshop on
Pipeline Lifecycle

Banff, Alberta
June 9-10, 1994

WHY CEPA WAS FORMED ...

- Pipelines Have Unique Requirements and Need Association that Represents Their Common Interest with Governments, Public and Industry.

- Many Current and Emerging Issues Requiring Collective Response, Including Safety, Regulatory, Technical and Environmental.

CEPA is a New and Growing Association

- Founded in 1993
- Members Transport 90% of Canada's Natural Gas and Petroleum Production
- Annually Transport $10 Billion Worth of Product to Export
- Supply 10% of the U.S. Natural Gas Market
- Combined Assets Total $15 Billion

CEPA Membership is Growing

- 11 Regular Members
  - Alberta Natural Gas Company Ltd.
    Canadian Utilities Gas
  - Foothills Pipe Lines Ltd.
  - Interprovincial Pipe Line Inc.
  - NOVA Gas Transmission Ltd.
  - TransCanada PipeLines
    TransGas
  - Trans Mountian Pipe Line Company Ltd.
    Trans-Northern Pipeline Inc.
  - Westcoast Energy Inc.
    Westspur Pipe Line Company (1985) Inc.

- Founding Members

CEPA Membership is Growing

- 25 Associate Members

  Major Law Firms
  Chartered Banks
  Industry Suppliers
  Other Pipelines

CEPA's Mission

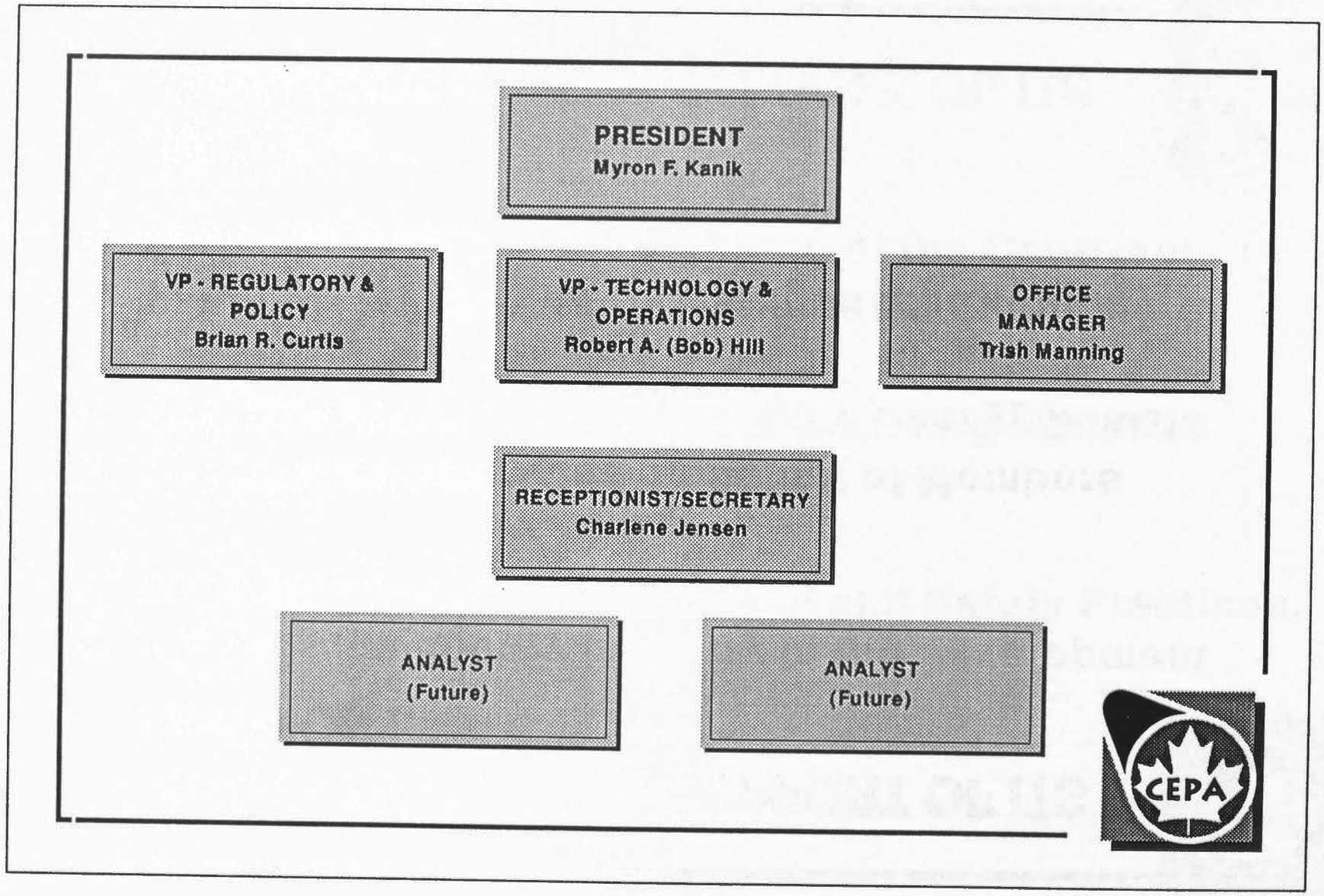
- Promote the Common Interests of Members
- Communicate to Stakeholders and Public that Pipelines are Safe, Reliable and Cost Effective
- Position the Pipeline Sector of the Petroleum Industry as a Key Stakeholder in Canada's Economy

CEPA's MANDATE IN SUPPORT OF ITS MISSION ...

- Enhance Public Understanding of the Contribution of Energy Pipelines to the Canadian Economy
- Share Data and Information Promoting Effective and Safe Pipeline Operations
- Promote Sound Environmental and Safety Practices, Legislation and Regulation

CEPA's MANDATE IN SUPPORT OF ITS MISSION ...

- Support the Energy Industry in the Development of Supply and Markets
- Speak With One Voice on Behalf of Members Before Regulatory Agencies and Energy Boards
- Focus on Issues and Challenges Identified by CEPA Members


PRESIDENT
Myron F. Kanik
VP - REGULATORY & POLICY
Brian R. Curtis
VP - TECHNOLOGY & OPERATIONS
Robert A. (Bob) Hill
OFFICE MANAGER
Trish Manning
RECEPTIONIST/SECRETARY
Charlene Jensen
ANALYST
(Future)
ANALYST
(Future)
CEPA

CEPA COMMITTEE STRUCTURE

CEPA MEMBERSHIP

BOARD OF DIRECTORS

BOARD COMMITTEES

- EXECUTIVE COMMITTEE
- INDUSTRY LIASON COMMITTEE
- NOMINATIONS COMMITTEE
- RATE REGULATION COMMITTEE

MEMBER COMMITTEES

- OPERATIONS & ENGINEERING COMMITTEE
- ENVIRONMENT & SAFETY COMMITTEE
- ACCOUNTING & TAXATION COMMITTEE
- COMMUNITY & ABORIGN. AFFAIRS COMMITTEE

CEPA

ENGINEERING AND OPERATIONS COMMITTEE

- Stress Corrosion Cracking (scc)
- Pipeline Risk Assessments
- Operating Statistics
- Research and Development
- Pipeline Integrity / Reliability
- Pipeline Abandonment
- 1995 Joint Technical Conference CAPP / CEPA / CGA

ENVIRONMENT AND SAFETY COMMITTEE

- CEPA Safety and Environment Guiding Principals
- CEPA Safety Statistics / Awards
- Canadian Environment Assessment Act (CEAA)
- Canadian Environment Protection Act (CEPA)
- CEPA Climate Change Strategy
- Clean Air Strategy Alberta (CASA)
- Pipeline Water - Crossings
- Pipeline Abandonment

RATE REGULATION COMMITTEE

- NEB Multipipeline Hearing
- NEB Guidelines for Filing
- NEB Long Term Export Licenses
- Incentive Regulation
- Negotiated Settlement Guidelines

COMMUNITY AND ABORIGINAL AFFAIRS COMMITTEE

- CEPA Advocacy Role
- Community Benefits
- Right of Way Issues
- Wilderness / Protected Areas
- Aboriginal Interests

ACCOUNTING AND TAXATION COMMITTEE

- Property Tax Assessments
- Negative Salvage
- Reclassification of Compression from Class 8 to 1
- Machine Taxes
- Tax Treatment of Land Rights
- Potential Change in Interest Deductability

CEPA 's VISION

- Membership Growth
- U.S. Affiliations
- Staff Growth - Developing Expertise in Key Areas
- Respect and Credibility

THE CEPA ENERGY
pipeline
JUNE 1994

CEPA's origins

CEPA was formed in June 1993 by seven major oil and gas pipeline companies: Interprovincial Pipeline and Trans Mountain (oil); and Alberta Natural Gas, Foothills, NOVA, TransCanada PipeLines and Westcoast Energy (gas).

Since that time, four new regular members have joined: CU Gas, TransGas Limited, Trans-Northern and Westspur Pipe Line. About 25 associate members, including the chartered banks, major law firms, other pipeline companies and suppliers to the industry, have also become CEPA members.

Regular CEPA members are companies whose primary business is the transportation of hydrocarbons by pipeline.

Associate members are companies, other associations, partnerships or individuals with a bona fide interest in the energy pipeline business whose lines of business may include other areas of focus.

CEPA's mission is threefold: to promote the common interests of members; communicate to stakeholders and the public that pipelines are safe, reliable and cost effective; and establish the pipeline sector of the petroleum industry as a key player in Canada's economy. CEPA's mandate in support of its mission turns on six areas of focus.

- Enhance public understanding of the contribution of energy pipelines to the Canadian economy.
- Share data and information promoting effective and safe pipeline operations by member companies.
- Promote sound environmental and safety practices, legislation and regulation.
- Support the energy industry in the development of supply and markets.
- Speak with one voice on behalf of members before regulatory agencies and energy boards.
- Focus on issues and challenges identified by CEPA members.

CEPA welcomes two new staffers

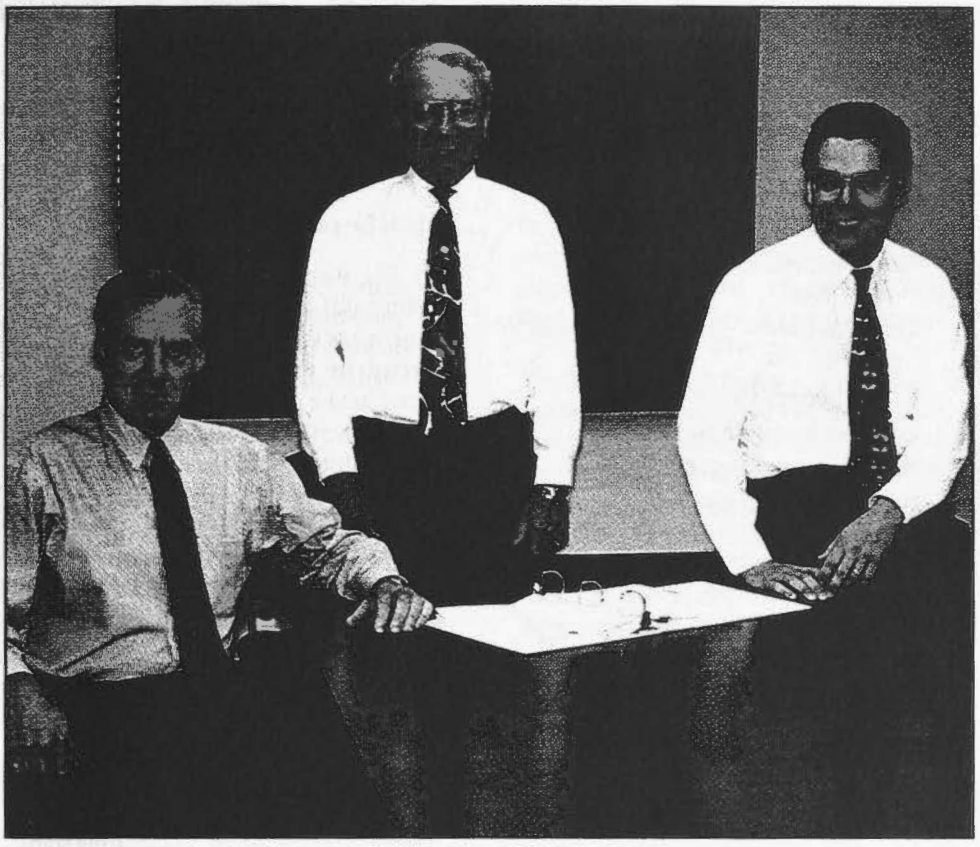
CEPA President Myron Kanik has recently announced two new staff additions.

Bob Hill is Vice President, Technology & Operations. He joins CEPA from Imperial Oil where he served for nine years as Manager, Pipelines. Bob is responsible for pipeline operations, technology, the environment, occupational health and safety and community and aboriginal affairs.

Bryan Curtis is Vice President, Regulatory & Policy. Bryan is from NOVA Corporation where, for eight years, he was Manager, Rate and Contract Administration, and, most recently, Manager, Customer Accounts.

In making these announcements, Mr. Kanik noted that CEPA intends to operate with a minimum of staff. Secondments of additional personnel from member companies for a one- to two-year period is a key staffing strategy. This will help to ensure that operating costs are as low as possible. CEPA committees will rely significantly on member companies' resources as they pursue their mandates. This will also ensure that operating costs remain in check.

CEPA will focus on issues of direct value and benefit to member companies, Mr. Kanik said. ○



(Left to right) Bob Hill, Myron Kanik and Bryan Curtis.

Your Board of Directors

CEPA's Chairman is **Brian MacNeill**, Chairman and Chief Executive Officer, Interprovincial Pipe Line Inc. of Edmonton. Vice-Chairman is **Bruce Simpson**, President and Chief Operating Officer, NOVA Gas Transmission Ltd. of Calgary. Both of these gentlemen will remain in their positions on the Board after the June 1 Annual General Meeting.

Other members of CEPA's Board are: **John Beddome**, President and Chief Executive Officer, Alberta Natural Gas Company Ltd., Calgary; **Bob Pierce**, Chairman and Chief Executive Officer, Foothills Pipe Lines Ltd., Calgary; **George Hugh**, Chief Operating Officer, TransCanada PipeLines Limited, Calgary; **Steve Bellringer**, President and Chief Executive Officer, Trans Mountain Pipe Line Company Ltd., Vancouver; and **Art Willms**, President and Chief Operating Officer, Westcoast Energy Inc., Vancouver. ○

CEPA committees are hard at work

CEPA enjoys excellent support from its members. Five existing committees are already dealing with issues unique to the pipeline segment of the petroleum industry. The committees are the Rate Regulation Committee, Operations & Engineering Committee, Accounting & Taxation Committee, Environment & Safety Committee, and the Community & Aboriginal Affairs Committee.

These committees are all formed, have a chair and vice chair and have had several meetings. The following is a chart of the chairs/vice chairs of CEPA's standing committees. ○

Committee	Name	Position	Company Represented
Community & Aboriginal Affairs	Doug Halverson	Chair	Westcoast Energy
	Bob Seager	Vice Chair	NOVA
Accounting & Taxation	Bob Samels	Chair	Trans Mountain
	Ray Smith	Vice Chair	TransCanada PipeLines
Environment & Safety	George Kirkwood	Chair	IPL
	Terry Klatt	Vice Chair	NOVA
Operations & Engineering	Pat Anderson	Chair	Foothills
	Bob Vergette	Vice Chair	Trans Mountain
Rate Regulation	Terry Cameron	Chair	Foothills
	Liisa O'Hara	Vice Chair	Trans Mountain

Current issues

The committees have identified the following issues for their first year of operation.

ENVIRONMENT & SAFETY COMMITTEE

- CEPA Safety & Environment Guiding Principals
- CEPA Safety Statistics/Awards
- Canadian Environment Assessment Act (CEAA)
- Canadian Environment Protection Act (CEPA)
- CEPA Climate Change Strategy
- Clean Air Strategy Alberta (CASA)
- Pipeline Water–Crossing
- Pipeline Abandonment

ENGINEERING & OPERATIONS COMMITTEE

- Stress Corrosion Cracking (SCC)
- Pipeline Risks Assessment
- Operating Statistics
- Research and Development
- Pipeline Integrity/Reliability
- Pipeline Abandonment
- 1995 Joint Technical Conference CAPP/CEPA/CGA

COMMUNITY & ABORIGINAL AFFAIRS COMMITTEE

- CEPA Advocacy Role
- Community Benefits
- Right of Way Issues
- Wilderness/Protected Areas
- Aboriginal Interests

ACCOUNTING & TAXATION COMMITTEE

- Property Tax Assessments—Tax Competitiveness
- Negative Salvage
- Reclassification of Compression from Class 8 to 1
- Machine Taxes
- Tax Treatment of Land Rights (Lump Sum or Annual Payments)
- Potential Change in Interest Deductibility

THE RATE REGULATION COMMITTEE

The Rate Regulation Committee is currently reviewing a list of short-term and strategic issues. We will keep you informed in future issues of *The CEPA Energy Pipeline*. ○

Regulatory Affairs

Streamlining appears to be a National Energy Board (NEB) priority. A number of initiatives are underway.

Multi-pipeline hearing

The Multi–Pipeline Cost of Capital Hearing (RH–2–94) is a key area of NEB focus. All of CEPA's regular members are affected. For the first time, the NEB will review in one proceeding eight pipelines' capital structure and rate of return on equity and establish a multi–year adjustment mechanism. This is not a generic hearing but, rather, could be viewed as eight separate proceedings under one umbrella. The Board feels this structure may be more efficient while providing an effective forum for addressing the issues. The companies will still be required to file their annual rate application for approval of their tolls. CEPA's role initially relates to pipeline co-ordination and helping to articulate positions on issues of common interest to the companies involved. The hearing starts on September 12, 1994 and could last several months.

CEPA input on other NEB initiatives

The NEB has also invited comments on its Guidelines for Filing Requirements and comments on its Negotiated Settlements Procedures. These are due within the next month. Again, CEPA will assist, where possible, in providing input.

Other current issues

A review of some recently granted long-term export licenses has been ordered by the NEB as a result of a recent Supreme Court of Canada ruling. The NEB requested written submissions by the affected parties. Pipeline companies, provincial governments and environmental groups have responded. We are now awaiting the NEB's decision. The Rocky Mountain Eco System Coalition has also filed with the federal court for Leave to Appeal the original NEB decision awarding the export licenses.

The Board has also called a public hearing on July 26 to hear six new long-term export applications on behalf of Canstates, Chevron, Renaissance and Western Gas Marketing. There is a good chance that environmental groups will intervene in this proceeding as well.

The Alberta government is in the midst of a legislative review which will have an impact on the pipeline segment of the industry. Intenco Energy Consultants has been retained to lead Phase 2 of this effort. We will keep our members informed. CEPA was active on behalf of members in Phase 1. Bob Snyder of Nova has been the lead contact on this issue.

Other regulatory developments

Imperial has tabled a presentation called "Price Driven Efficiency" with the industry. This is an incentive rate proposal that suggests price caps. Imperial would like to assemble a task force from industry to work toward an incentive-based rate scheme for pipelines. ○

The Inaugural Annual General Meeting

CEPA is holding its first Annual General Meeting on June 1 at the Palliser Hotel at 10:00 a.m., followed by a luncheon at noon. This is the first chance for associate members to meet the CEPA regular members and CEPA staff.

A Board of Directors meeting follows the luncheon. Four new Directors are joining the Board.

The Environment

Climate change

CEPA staff and committees are involved with numerous industry and government initiatives addressing climate change and greenhouse gas emissions.

CEPA is a member of the Clean Air Strategy for Alberta (CASA) working group. This is a multi-stakeholder initiative including industry, government and environmental groups. The group is developing a strategy defining Alberta's contribution to Canada's commitment to reduce greenhouse emissions. CEPA is also participating in a broadly based energy industry task group led by the Canadian Petroleum Products Institute (CPPI). The Canadian Association of Petroleum Producers (CAPP), the Canadian Coal Association (CCA) and the Canadian Electrical Association (CEA) are also represented. The task group will develop a position paper by August which will be the basis of presentations to senior government officials.

CEPA is also interacting with the federal government's National Air Issue Coordination Committee (NAICC) through its contact with CAPP and through direct consultation with the senior officials of the Department of Natural Resources. Because climate change is a key issue for the pipeline industry, the CEPA Environment and Safety Standing Committee has established a Climate Change Task Force to address these matters.

Ontario rumoured to have requested restrictions on natural gas exports

Apparently, Ontario has written to Anne McLellan, the federal Minister of Natural Resources, criticizing the level of gas exports to the U.S.. The letter refers to the obligation under the Free Trade Agreement (FTA) and the North American Free Trade Agreement (NAFTA) to proportionately share Canada's energy supplies with the U.S. should shortfalls develop. Ontario relies almost exclusively on gas produced in western Canada. Ontario had demanded that the federal government act on those concerns. Presumably, the federal Minister is being asked to refer this issue to the National Energy Board for review and comment.

On May 26, Richard Dicerni, Deputy Minister of Energy & Environment from Ontario, will be visiting our office and we will verify whether, in fact, Ontario has written such a letter.

Federal Task Force on Economic Instruments and Disincentives to Sound Environmental Practises

Federal Finance Minister Paul Martin and Environment Minister Sheila Copps have announced the formation of a task force to seek input on the mandate of an Economic Instruments task group. The group will be composed of representatives from business, environment, labour, government and academic communities. About 16 to 20 members will be given the task of identifying barriers to sound environmental practises and economic measures that will encourage Canada to achieve stabilization of greenhouse gas emissions at 1990 levels by the turn of the century.

The energy sector will likely be confined to one member. CEPA, the Canadian Association of Petroleum Producers, the Canadian Gas Association and the Canadian Petroleum Products Institute are currently discussing which group might best represent the industry. ○

CEPA's commitment to communications

This is our first issue of *The CEPA Energy Pipeline*, CEPA's official newsletter. Our plan is to publish it quarterly as a means of informing our members, prospective members and opinion leaders of developments in the industry which are impacting us and to demonstrate how we are interacting with events so as to have a beneficial effect on the outcomes.

The idea is to serve our members. We can accomplish that goal if readers become directly involved. Please contact Bryan Curtis, Editor of *The CEPA Energy Pipeline*, with your comments on this issue and your suggestions for changes and additions. We have tried to create a publication with high visual impact that will be read. Please let us know if we're on the right track. ○

Myron Kanik
President

***The CEPA Energy Pipeline* is published quarterly on behalf of its members and associates.**

Editor: Bryan Curtis

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We wish to thank TransCanada PipeLines Limited of Calgary for our cover photograph and the photograph on this page.

Group Discussions

June 9, 1994

OBJECTIVE

Review the Priorization of Issues and the Action Plans from the Red Deer Workshop on Pipeline Lifetime in June, 1993, discuss them in the light of new developments over the past year, and agree on follow-up that is over the past year, and agree on follow-up that is required.

MATERIALS

Priorized Issues/Action Plans 1993

Notes from Group Rooms June 9, 1994

Summary Overheads from Group Rooms

MATERIALS

PRIORIZED ISSUES

1. CORRELATION OF LAB TESTING WITH REAL WORLD
   - coatings
   - inhibitors
   - sour service
   - SCC
2. INTERNAL PROTECTION OF HIGH WATE CUT PIPELINES
   - coatings
   - inhibitors
   - C.P.
   - liners
3. FAILURE ASSESSMENT OF CORRODED PIPE
   - E.C.A.
4. HYDROGEN-INDUCED CRACKING (HIC)
   - no predictive capability
5. EXTERNAL SCC
   - need to establish SCC mechanisms
   - lab tests for SCC
6. STABLE ELASTOMERS

MATERIALS

ACTION PLANS

1. CORRELATION OF LAB TESTING WITH REAL WORLD
   - more field testing
   - loops to simulate field conditions
   - modelling

2. INTERNAL PROTECTION OF HIGH WATER CUT PIPELINES
   - identify protection methods
   - develop economics
   - evaluate successes
   - prepare tool kit of current information
   - identify industry champion

3. FAILURE ASSESSMENT OF CORRODED PIPE
   - develop a tool kit on methodology
   - risk management analysis
   - identify pipe failure work in progress

4. HIC
   - more R & D on specific aspects
   - ECA on pipelines containing HIC
   - use operating environment in lab tests
   - establish a Forum to develop details and implement plan

5. EXTERNAL SCC
   - more R & D
   - database on SCC in pipeline industry
   - coordinate SCC R & D
   - TCPL to lead SCC effort with help from CANMET

6. STABLE ELASTOMERS
   - consider standardizing tests for elastomers
   - develop information on lifetime performance as function of T, P and other environmental variables
   - industry champion to be identified

MANAGING PIPELINE INTEGRITY:

AN ISSUES WORKSHOP ON PIPELINE LIFECYCLE

GROUP: Materials

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MATERIALS

GROUP DISCUSSIONS JUNE 9/94

Expectations

- Get all companies involved in lowering failure rates
- Gain experience from pipeline industry
- contacts to better evaluate materials and failures
- getting involved in practical problems
- keep the ball rolling
- Find out what others are doing and bring own work to the table
- Share experience on SCC to find out industry problem (biocorrosion)
- Information on R & D
- Better understanding of existing networks and involvement
- Update on ongoing development
- Influence issues identified
- Information exchange and better understanding
- Form flexible business network on materials development and AIM
- What industry doing on HIC and coordination of the activities
- Identify industry emphasis and how C-FER can help
- Update on concerns - bring awareness of ARC
- Have influence on where issues go
- Expand contacts with industry

Issues

• Materials property database	**A**
• Clod line pipe	**E**
• Wear/erosion of production equipment	**D**
• Database for SCC to allow for modelling	**A**
• Failure assessment of HIC	**C**
• Development of testing equipment	**D**
• Data for long-term assessment of reliability and decommissioning	**A**
• On-line monitoring of pipelines particularly SCC	**D**
• Practicality of higher strength line pipe	**E**
• Weld metal properties	**F**
• Microbial effects on SCC	**C**
• Parameters to identify where to find external SCC (database)	**C/A**
• Nonmetallic liners to add life	**E**
• Pitting or localized corrosion	**D**
• Mechanisms for information exchange	**B**
• Application of ceramics	**E**
• Metallic coating application	**E**
• Alternative materials	**E**
• ECA considered of multiple crack lining	**D**
• Method for obtaining ref pipe	**D**
• Maintenance/welding and ECA	**D/E**
• Reduction of corrosion by CP	**G**
• Corrosion under disbonded coatings	**G**
• Welding practice on flowing lines	**F**
• Use of FRP	**E**
• Accuracy of interpretation	**D**

- Evaluation of pipeline integrity with MOP increases **D**
- Consistent Failure Analysis Methodology **D**
- Inhibitor evaluation **G**

Issues - Summary

A. Database generation/availability
   SCC - Martin Wilmott
   HIC

B. Information exchange/networking "FRIDAY"

C. Environmental Cracking

   C1 HIC
   - more R & D on specific aspects
   - ECA on pipelines containing HIC
   - use operating environment in lab tests
   - establish a Forum to develop details and implement plan
   - sharing information
   - define mechanism of HIC (science)

   C2. External SCC
   - more R & D
   - database on SCC in pipeline industry
   - coordinate SCC R & D
   - TCPL to lead SCC effort with help from CANMET
   - sharing information

D. Assessment and evaluation of materials

E. Alternative materials

F. Welding

G. Corrosion mitigation

Action Plans 1994

1. Environmental Cracking
   - HIC
     - last year (+)
     - share information
     - science/mechanism define
   - SCC
     - last year (+)
     - share information

1. Assessment/Evaluation of Materials
   - Corroded Pipe
     - last year (+)
     - assess accuracy of inspection data and interpretation
     - share information
   - Cracked Pipe
     - develop methodologies
     - size defects
     - assess information from related industries - aircraft, nuclear

2. Corrosion Mitigation
   - High Water Cut
     - last year
     - scope defined
   - Disbonded Coating
     - define methodology for dealing with sunk cost methodology
     - assess what is available and needs for further work

3. Alternative Materials
   - Polymer Liners
     - producers group to define program and share information on what they are doing
   - High Strength Steels
     - assess economic and technical viability
   - FRP
     - develop group by producers to develop research plan
     - transmitters to assess economic and technical viability

4. Database
   - SCC
     - Martin Wilmott NOVA to scope
   - HIC
     - ?

Friday Issues

1. Information Sharing
2. Mechanism for Network
3. Creation of Issue Groups - Environmental Cracking
4. Increase Rep by owners/suppliers

1994 Issues & Priorities

1. Environmental Cracking
   - HIC
   - External SCC
1. Assessment and Evaluation of Materials
   - Failure of corroded pipe
   - Cracked pipe
2. Corrosion Mitigation
   - Internal protection of high water cut pipeline
   - Corrosion under disbonded coatings
3. Alternative Materials
   - polymer liners
   - high strength steels
   - FRP pipe
   - composite wrap pipe
4. Database
   - SCC
   - HIC

Reliability Analysis & Risk Assessment

Priorized Issues/Action Plans 1993

Notes from Group Rooms June 9, 1994

Summary Overheads from Group Rooms

RELIABILITY ANALYSIS & RISK ASSESSMENT

PRIORIZED ISSUES

1. DEVELOPMENT OF PIPELINE RISK ASSESSMENT GUIDELINES
   - quantitative or qualitative levels of analysis
   - formulation of limit state criteria
2. DATABASE DEVELOPMENT
   - pipeline characteristics
   - operating parameters
   - inspection/testing history
   - modelling data for consequences and prediction of risk
3. ESTABISHMENT OF ACCEPTALBE RISK LEVELS
4. DEVELOPMENT OF A TOOL KIT FOR RELIABILITY ANALYSIS AND RISK ASSESSMENT
5. EDUCATION

RELIABILITY ANALYSIS & RISK ASSESSMENT

ACTION PLANS

1. PIPELINE RISK ASSESSMENT GUIDELINES
   - C.S.A.
   - D.E.
   - PERD priority
   - C.G.A.
2. DATABASE
   - to support the guidelines
   - to include: operating/historical data
     failure data
3. ACCEPTABLE RISK LEVELS
   - MIACC
4. TOOL KIT
   - identify available tools
   - guide the development
5. EDUCATION
   - CEPA
   - CGA
   - CAPP

MANAGING PIPELINE INTEGRITY:

AN ISSUES WORKSHOP ON PIPELINE LIFECYCLE

GROUP: Reliability Analysis & Risk Assessment

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Guidelines for Risk Management

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DATA BASES

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RELIABILITY ANALYSIS & RISK ASSESSMENT

GROUP DISCUSSIONS JUNE 9/94

- Risk management/assessment
- Cost/benefit
- Consequences
- Pipeline design/LSD
- Measures of performance
- Monitoring the success of the Rin program
- Common method of express risk - all players - all types of consequences
- Completely interpreted
- Lifecycle partners - others involved in process
- Risk? What is acceptable/to whom
- There are some definitions of "acceptable" risk; Netherlands etc.
- Risk is broader than health
  - economic, life, safety
- Risk type and perception
  - public rage
  - involuntary vs voluntary
  - news media
- Careful how we use quantitative risk NC
  - public need
  - regulatory need
- Risk Options
  - quantitative
  - target
- Need a multilevel screening process which keeps checking risk/consequences balance (risk management); risk acceptable purpose, audience
- need for vehicle for coordinating all groups locally, internationally working in risk management area

Harmonize all ciradurs working in RM

- CSA Z662 Pipeline standards / setting up Task Force

John McCarthy offered to host a meeting on RM - one objective setting up a steering committee

- Chemical industry has been there (multilevel approach) - pipeline can take advantage
- Parameters which propagate through model
- Consider temporal issues / growth rate

Promised Land

- Integrated (common scale for sliff. consequences risk analysis
- The Process
  multilevel union risk/acceptability balance economic

Risk & Reliability

GOAL

Common widely accepted process for risk assessment/management.

HOW

Find a vehicle to accomplish this.

NEXT STEPS

National Energy Board suggested a Steering Group meeting in late summer.

Steering Group Meeting Agenda

1. Define scope: How far into risk management?
2. Representation: How do we ensure that all the right players are included? (large/small/outside industry?)
3. The Vehicle: What group will formulate process? How to give the process appropriate weight? Do we need a national standard?
4. Credibility/Education: Partly related to #3 but includes our own organizations since financial support my be required.

Risk Management Database

1. What input is needed?
   - Detailed Event Information
     - metallurgical, cause, impact, etc.
   - Pipeline Characteristics Data
     - pipe information
     - operating information, etc.
   - Quality Criteria for Input Data
     - accuracy, completeness
   - Annual Operating Data
   - Installation Data
   - General and Specific Maintenance
     - Hydro, pig runs, recoating, etc.

2. What outputs are needed?
   - Measurements of Performance
     - frequency
     - consequence
   - Trends in any parameter
   - Analysis of sub-sets
   - Identification of factors for statistical input to risk assessment

3. Who, what, when?
   - GRI developing database for gas systems under AGA sponsorship
     Features
     - anonymous input
     - includes
       - base pipeline data
       - annual reports
       - incident reports
       - non-reportable leaks
       - expanded data collection
     - quality control features
     - open access (but anonymous)
     - database includes total costs (remedial, final, etc.)
   - TSB trying to establish comprehensive database

4. Action

- CEPA contact GRI (Terry Boss)

- Goals
  - utilize work of GRI
  - join forces with GRI
  - establish common database vs. Canadian database
  - determine course of action

Design & Construction
Geotechnical Science & Engineering

Priorized Issues/Action Plans 1993

Notes from Group Rooms June 9, 1994

Summary Overheads from Group Rooms

DESIGN & CONSTRUCTION GEOTECHNICAL SCIENCE & ENGINEERING

PRIORIZED ISSUES

1. NEW TECHNOLOGY/CONSTRUCTION METHODS
2. IMPROVE/DEFINE GEOTECHNICAL FRAMEWORK
   - baseline information
   - models for predicting behaviour
3. COLLECTION/DISSEMINATION OF INFORMATION
   - design requirements
   - databases for design
   - reporting of post-construction experience
4. ONE-STOP SHOPPING
   - use existing networks
   - use consortia for specific issues
5. TECHNOLOGY IMPROVEMENTS
   - more cost-effective joining methods
   - consumables
   - higher strength components
   - optimize d/t ratios
   - unique requirements in cold regions of offshore

DESIGN & CONSTRUCTION GEOTECHNICAL SCIENCE & ENGINEERING

ACTION PLANS

1. IDENTIFY FOCUS TO
   - distill the issues
   - discuss with stakeholders
   - identify facilitator to help build consortia among:

     pipeline owners

     contractors

     research labs

     etc.

MANAGING PIPELINE INTEGRITY:

AN ISSUES WORKSHOP ON PIPELINE LIFECYCLE

GROUP: Design & Construction/Geotechnical Science & Engineering

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DESIGN & CONSTRUCTION GEOTECHNICAL SCIENCE & ENGINEERING

GROUP DISCUSSIONS JUNE 9/94

Expectations

- Understand what's behind design - are there better ways
- How to design reliability into the system
- Find out what's happening on the design stage "Limit States"

  Pipeline Operators thinking re steel suppliers
- Get up to date science - engineering applied to operating pipelines (assess longevity)
- How to make it work - failure probability
- Continued ACC of Bringing young people - problems
- Identify problems - apply science, etc.
- Pick up other views - how do different companies do things
- Learn about pipeline design - geotechnical - capacity problems

Issues

- Cleaning/recoating
  - assess where required - lots of pipes with poor coatings
  - fusion bond epoxy - future life - residual stress proper prep
- Coating - how to select
  - info from others
- Sqn to SCC - coating
  - what replaces old coatings
- L in design - does not reflect reality
  - failure modes to be incorporated
- consortia for e.g. risk assessment
- Changing services increase temp for pipelines
- Higher strength materials x 90 - x 100
- Weldability
- Limit States Design
- Ice scouring terrain
- Long-term performance
- Pipeline size - esp arctic related
- High pressures increased
- Site/route selection
  - public consultation
  - corridors (common)
  - "reduced" setbacks
- Geotech - slope stability - frost heave?
- How do reliability numbers in code reflect into practice (integrity assessment) - repair design

Issues - Summary

A. Coatings - Particular Applications	**M**
SCC	
B. Limit States Design (reliability, new codes . . .)	**R&R**
C. Consortia	
D. Changing Pipeline Service Demands	
E. Technical Strength Welding Improvements	**M**
	Alternatives to Hydrostatic testing
F. Design for Optimum (Minimum?) Size	
G. Site/Route: Consultation	
H. Geotechnical	

Construction

- Trencher less pipeline - deformation (stress calls on pulling - coatings)
  New Technology for construction and test (Boeing 777) - crossings
  Pressure-less pipeline testing

Task Force

- Industry - driven/led
- CEPA/CAPP/CGA
- Pipeline research committee

Actions

- Construction Issue:

  Consortium (gov't, industry, universities)
- Activity in US
- Major improvement in direction drilling
- Driven pies don't need CB
- Collectively: High Capability
- Task Force to define issue/opportunities

Inspection

Priorized Issues/Action Plans 1993

Notes from Group Rooms June 9, 1994

Summary Overheads from Group Rooms

INSPECTION

PRIORIZED ISSUES

1. RELIABILITY OF INSPECTION RESULTS
   - crack detection and sizing
   - reproductibility of data
   - criteria for interpreting data
2. CROSSINGS AND RIGHT-OF-WAY ENCROACHMENT
   - public awareness
3. INSPECTION
   - in mill
   - during construction
   - in service
4. ECONOMICS
   - multi-function tools
   - smart pigs
   - cost/benefit analysis

INSPECTION

ACTION PLANS

1. RELIABILITY OF INSPECTION RESULTS
   - group to identify capabilities and limitations of existing tools
   - R & D on criteria for calibration standards
2. CROSSING/RIGHT-OF-WAY ENCROACHMENT
   - public education
   - legislation
   - guidelines for inspection
3. INSPECTION DURING CONSTRUCTION
   - keep steel samples permanently
   - geographical information service (GIS) to predict defect growth during service
4. ECONOMICS
   - vendors/users should collaborate in tool development
5. RESEARCH ON SCC
   - group to evaluate new tools for crack detection
   - develop/model mechanisms
   - define critical crack size
   - develop repair procedures

MANAGING PIPELINE INTEGRITY:

AN ISSUES WORKSHOP ON PIPELINE LIFECYCLE

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ALEX ALVARADO — US DOI / MMS

[illegible] — Husky oil

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INSPECTION

GROUP DISCUSSIONS JUNE 9/94

Issues from Red Deer

- more or less agreed that these still relevant
- ROW encroachment was talked out fully last year
  - first call program
  - motion detectors, etc. (new technologies)
  - education/public awareness

What is inspection?

- identification of future problems
  - prevention
- one component of QC system
  (detection of deviations from spec)

To what extent should be inspect?

- possibility of deciding in 'risk vs cot' framework
  - cost now vs probably future benefits or cost avoidance
- use "available" technology vs "best available" (e.g. due diligence) and need to document due diligence
- consensus: inspection during construction is most critical (mill quality is fairly reliable)
- in-service inspection
  - vary according to history of the line and according to potential problems (e.g. laminations)
  - maintenance practices
  - product composition (increasing water cuts)
  - external loads (increasing)
  - population density environmental sensitivity

Reliability of Results

SCC (but no great progress - R & D way behind, tool development cots are enormous)

Hydrostatic Test - not necessarily perfect methodology - especially for pinholes - frequent

ERW Seam Welds - lack of fusion ~ 1964 vintage - what techniques available?

Hot DAPS & Other - how do we inspect

Correlate Results of Different Inspection Tools

- common database
- identify which information is available from which tool (select appropriate tool)
- more accurate characterization of defects
  (run low sensitivity tools first - see if there are problems or not - run sophicated tools where needed)
- is there a way in which the tool companies can pool this information? Some moves are afoot to do this. Owners need to define what they need - tool manufacturers need to make higher technology available at reasonable costs to clients.

Interpretation of Data

Test Loop (Comparable Tools)

- many limitations: best tool in loop may not be the best tool in a particular line (different operating conditions)
- pig owners avoided comparisons made in GRI loop at Battelle
- pipeline owners must make this a pre-requirement for bidding
- also some owners are preparing their own test loop

Inspection During Construction of Other Lines

- "free" opportunity to inspect some bare pipes (at other's expense)
- pipeline companies should stick closely to Z183 or Z184

Inspection During Construction

- does not seem worthwhile to keep one joint per section for future calibration testing [maybe don't need a joining - 2 - 5 x 3 foot sections per heat]
- database of information on corrosion rates in different areas, different soil conditions
- need education on SCC causes, progression rates, etc. (SCC school) CANMET to organize

Research on SCC

- British Gas and Piptronix have developed tools to detect SCC
  - basic research stage (RF EMAT Gas Coupled UT)
- common evaluation of tools is premature at this stage
- SCC has taken on its own momenture, don't need to push from this group
- there are no criteria w.r.t. what comprises a "critical" crack
  many different circumstances: crack colonies, sharp-ended cracks
  much work already ongoing

New Issue

Balance between hydro testing and internal inspection.

Repair Procedures for Cracks

What do you do with them when you find them (R & D - CANMET?)

Can some of these problems be placed in an international context?

- other solutions?
- share costs of solving?

Do we leave o subdivide these problems into "liquid" lines and "gas" lines.

1994 Issues & Priorities

- Inspection results - reliability
  - SCC detection #1
  - "tool school"
  - combined tools
  - risk assessment criteria
  - correlation re: tools
- ROW Encroachment
  - use of technology - X
  - public education

- When to inspect?
  - mill-X
  - construction - #1 due diligence
  - in service - *
- How much?
  - amount/sophistication vs risk
  - owners & vendors define criteria
- Research on SCC
  - owners and vendors define needs
  - basic research - X
  - repair procedures
  - "SCC school"

Other Inspection Issues

- hydrostatic tests
  - balance with internal methods
- ERW seam welds (mid 60's)
- hot taps, etc.
- common database, pooling of information
- need to subdivide) O & G?

Repair & Rehabilitation

Priorized Issues/Action Plans 1993

Notes from Group Rooms June 9, 1994

Summary Overheads from Group Rooms

REPAIR & REHABILITATION

PRIORIZED ISSUES

1. SYSTEMATIC FRAMEWORK FOR DECISIONS
2. UNDERSTANDING MECHANISMS AND MODELLING
   - user-friendly modelling techniques
3. INFORMATION MANAGEMENT
   - develop industry-wide database
4. REPAIR TECHOLOGIES
   - in-situ rehabilitation technology
   - sleeving
   - internal reinforcement
   - directly applied coatings
5. PUBLIC AWARENESS

REPAIR & REHABILITATION

ACTION PLANS

1. BASIC RESEARCH ON MECHANISMS & MODELLING
   - defect growth rates
   - critical defect sizes
   - effect of defect shape
   - develop user-friendly modelling techniques

   work to be carried out by: CANMET
   C-FER
   and other groups

2. COMMERCIALLY DRIVEN APPLIED RESEARCH
   - advance R & R technologies to minimize costs and downtime
   - continuous rehabilitation technology

3. CHANGE ATTITUDES AND BEHAVIOURS
   - influence public expectations

4. DATABASE DEVELOPMENT
   - merge existing databases
   - group-sponsored investigations
   - establish Task Group to develop recommended practice/standards

MANAGING PIPELINE INTEGRITY:

AN ISSUES WORKSHOP ON PIPELINE LIFECYCLE

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3.	MARC SPENCER	MAGI ENGINEERING Ltd
4.	PHILIP EVANS	PIPETRONIX LTD CALGARY
5.	COLIN DUNCAN	C & M ENG CALGARY
6.	ALASDAIR CLWG	BRITISH GASPLC, NEWCASTLE, UK
7	JOHN HOLGATE.	PROACTIVE TECHNOLOGIES INTERNATIONAL, INC.
8	TOM PESTA	ERCB
9.	Bob Smyth	PETRO-LINE UPGRADING
10.	Mark Offem.	Trans Mountain
11.	CHRISTA CHORNEY	AEC PIPELINES.
12.	DAVE MURRAY	U OF ALBERTA.
12.	ROD KYLE	ALBERTA NATURAL GAS.

REPAIR & REHABILITATION

GROUP DISCUSSIONS JUNE 9/94

Changes

- SCC more prevalent than previously thought **A**
- Hydrostatic testing is risky for rehabilitation **B**

Review Last Years Recommendations

- Replacement versus repair (cut-out) **C**
- Decisions for "What If Questions"
- When are defects serious? **A**
- Code should accept "fithess-for" purpose assessment of cracks (also for ARC burns?) **A**
- Who makes decision (owner/contractor/regulator?)
- What defects are serious enough? **A**
  Model for making these decisions.
- Who makes the decision?
  * owner
  - consultant
  - regulator
- Service change in criteria **D**
- Cost-effective repair coatings **C**

Action Plans

DECISIONS

- Understand mechanisms which leads to decision framework
- Most important - SCC
- Benign vs. active defects
- Small operators
  Small diameter — PROBLEM
- Accepted repair technology incorporated in code
- Groups based on mechanisms

Timeline

A. Hydrotest: Water Cleanup?

B. New Technology - TOO SLOW - Code

B. Information Management - computers?
   - problems of "reluctance" still remain

C. Alternative Repair: Avoid Cutouts?

C. Line "Piggable"?

1994 Issues & Priorities

1. Systematic framework for decision
   Understand mechanisms which leads to decision framework
   Basic research on mechanisms
   Group(s) discuss repair approaches for mechanisms
   Objective - code responsive to accepted repair techniques

2. Repair technologies

   Back to groups commercial driven from suppliers (common interest)

3. Information management
   "Bank" of
   failure bases,
   merge databases,
   protocol for testing and reports
   NEEDS CHAMPION
   Co. or organization?

4. Service change criteria driven by producers (people with the problem)

Group Discussions

June 10, 1994

OBJECTIVE

Focus the action plans agreed to the previous day and consider recommendations for a process to advance specific action plans.

Information Management

Priorized Issues/Action Plans 1994

Notes from Group Rooms June 10, 1994

Summary from Group Rooms

INFORMATION MANAGEMENT

GROUP DISCUSSIONS JUNE 10/94

Expectations

1. Issue: communications between organizations (e.g. NACE similar org - each with own focus); more pro-active involvement
   IMPROVE FLOW OF INFORMATION
2. Secretariat with national power authority
   direction of industry
3. Building database - information on particular line(s)
   G.I.S. - contain full geometry of pipe overlaid on mapping system
   Inspection history
   correlation of inspection data
   how pipe built magnetic characteristics
   all information in one database
4. Help create flexible business networks secretariat - coordinate/follow-up on activities of Banff groups Quebec has just $5M into this type of activity N. S. has just put $40M into this type of activity. Ken Ball has some money for this type of activity
5. Networking of all information available
   Coordination
   Many databases - not consistent
   Better networking - tie into anybody's database
   Standardization of database
6. Compiling a database - constancy would help
7. Provide infrastructure to help support the other groups
   Standardize database
   Interdisciplinary work - spread information to other interested groups
   Distribute abstracts.
8. Thoroughly assess existing networking activities before creating anything new
   Harmonize networking activities before starting anything
   Group must be multi-disciplinary
   Reach out to absentees - they need simple tools - orientation

Define rules for coordination (e.g. organization - link with existing systems technological
Define objective

9. What mechanisms are in place for coordination/networking so that can keep our R & D effective.
10. Method of quantifying value of information in private companies - develop method of trading information in other companies.
11. Company has database - other companies would like to continue database.
    Communicate information we have within present system.
    What presently-available performer/worker could go forward with this.
    Flexible business network - based on trust, goodwill.
    Give information to get information

    INFORMATION EXCHANGE - limits
    Company to regulator - could put in "tight spot"
    Company to company could comprise one company's situation

    Database on all companies in Montreal exists
    - know high risk companies
    Building a culture
    "Right to know"
    "How do we effectively communicate information that is available?" Use infonet?
    We need a process to facilitate communication.

Actions

1. Evaluate existing networks
   MIACC, CAPP, CEPA
   and associations - ASTM, CSA, CGA
2. Gather issues from workshop and approach agencies
3. Be contact for (the groups that have formed)
   supporting
   driving
   coordinating
4. Train people on how to network effectively.

Solid Common goal

Information database - one of the groups secretariat / network to drive.

- support for groups formed today
- secretariat - coordinating group for these activities
  on-the-ground follow-up
  steering committee - need see money
  process to link the network

INFO. MANAGEMENT

Name	Organization
David Boteler	Geological Survey of Canada
WALLY FRIESEN	CANMET
ALBERT JOHNSON	E.R.C.B
KEN BALL	ALBERTA ECONOMIC DEVELOPMENT
Ralph Mayer	Union Gas Limited.
IVAN ANDERSON	I.O.L. - ENERGY CHEMICALS
Janek Czuri	NOWSCO
Ryan Phillips	C-CORE
PIERRE BRIEN	MONTREAL URBAN COMMUNITY

Risk Management Framework

Priorized Issues/Action Plans 1994

Notes from Group Rooms June 10, 1994

Summary from Group Rooms

RISK MANAGEMENT FRAMEWORK

GROUP DISCUSSIONS JUNE 10/94

• Need for common language	A
• Concentrate on public safety/environmental risk with focus on public safety	G
• Environmental risk aspect is important re influence on public	B
• Decision on looking at probabilities and consequences	G
• Use target reliability levels which can account for safety/environmental issues	F / G
• Consider division into prudential (economic/cost) and ethical good to do)	D
• Objective action(s) to reduce risk	E
• Weakest link (how to increase participation) living up to standards	B
• First step education/dialogue on vies of risk management/analysis amongst work group related to common language	C
• Risk can't be eliminated only managed	C / E
• Broad participation by all stakeholders - acceptance of principles of RM	C
• Benchmark where we are now	F
• Process analyze/control/communicate safety - inverse of risk	G
• Attentive to and minimize worst case failures/frequency consequence (visibility)	B
• Measurement of performance - columns in newspaper	F
• Perception vs reality - reputation	B
• Understanding of why's related to economics/public good - costs for decision making - PR firm - perception - safety - real	D
• Prevention /accident red~ / mitigation of release / distribution of risk / equity - pay before or after FRAM OIL FILTER	E
• Acceptance of higher level of risk for existing systems - two benchmarks needed for existing / new	G/E/F
• Increased inspection / maintenance to reduce risk	E / F
• What is acceptable to public - stop calling it risk / start calling it reliability	B
• Comparison to other forms of transportation	F

Summary Issues

A. Language

B. Perception of Public

C. Education / Knowledge

D. Morals

E. Reduction Mitigation

F. Benchmarking

G. Scope / Composition

Methodology / Actions

1. NEB / CAPP / CSA / CEPA / MIAC / ERCB / etc.
   Summit to:
   a) define scope
   b) put into place vehicle (on-going)

   Organization / individual of primary responsibility
   Champions
   Bob Vergette
   Ray Smith
   Jim Frane
   - kickoff meeting next week

2. Create high level permanent Steering Group ($'s)

   To direct and strategize

3. Create (working groups) to deal with issues identified A - G above

4. Possible champions for summit scope and agenda

   NEB - John McCarthy
   CSA - Duncan Kent
   CEPA - Bob Vergette
   CAPP -
   ERCB -

RISK MANAGEMENT

Name	Organization
Doug Clark	Gulf Canada
Tom Zimmerman	C-FER
Rob Power	NEB.
Bob Verge the	Trans Mountain Pipe Line
BRUCE HARRIS	PLUMBING CORP.
LORNE SANBORN	Mobil Oil Canada
Blaine Ashworth	TCPL
IAN DONSETT	ERCB
JOE WOLF	USDOT/OPS
Ray Smith	NEB.
JACK ONDRACK	BOREAL LASER INC.
CHRIS BILLINTON	NORTHWESTERN UTILITIES LTD.
Vic Standish	Petro-Canada - P.T.C.
GLEN STALKER	NORTHWESTERN UTILITIES LTD.
Aaron Thoutour	Fleet Technology Ltd.
DUNCAN KENT	CONSUMERS GAS
GORD BEYNON	WESTCOAST FOREST INC.
BRIAN ROTHWELL	NOVA GAS TRANSMISSION
Rudy Wartlik	Westcoast Energy Inc.
HARRY MAEKELBURGER	CANAD WEST. NAT. GAS.
JOHN HOLGATE.	PROACTIVE TECHNOLOGIES
Hans Skrzypek	University of Calgary
Wayne Feil	Imperial Oil
BRIAN GRIFFIN	BERCHA GROUP
Francis Jeglic	National Energy Board
Susan Miller	Interprovincial Pipe Line.

Fundamental Research Priorities

Priorized Issues/Action Plans 1994

Notes from Group Rooms June 10, 1994

Summary from Group Rooms

FUNDAMENTAL RESEARCH PRIORITIES

GROUP DISCUSSIONS JUNE 10/94

- SCC characterization
  a) detection
  b) sizing
  c) remediation

  colonie growth
- Corrosion - tools
  assessment - quality / responsibility
- Improved technology
- Geotechnical aspect
  - origin of failure
  - pipe operation, stress
- Flow characterization and effects
- Research organization
  - university vs. private vs. gov't organization
- Canadian Funding Practices
  - too much privatization?
- Universities to talk to industry more
- Perceived reputation
  - should do more P. R.
- Concentrate on SCC & HIC
  short time line
  MTL leading CANMET's efforts
  Lack of coordination / industrial guidance
- CEPA developing R & D strategy
- Sponsor SCC & HIC
  - workshop and seminar
  - student's participation
  - University - seed money / neutral ground / response time / contact point
- University should have funds available for R & D publicity and organization

ACTION PLAN

Workshop SCC - HIC

Bob Hill will consult CEPA members

John will function as secretariat

John, Winston, Peter, Bob, Dick, ray will form steering committee

Actions

1. "SCC & HIC are the most important, pressuring, short-term focus (see action plan)
2. Funding problem
   mechanism of funding strategies (contracts vs. grants)
   consider grants to students (Maters, Ph. D., longer term)
3. Networking between University
   - gov't and industry
   - not inverted here
   - consider special funds for networking
   - Universities usually neutral - good slats for Consortia
4. Company have traditionally for short-term in outlook
   - University are usually long-term
   - company should help in formulating on supporting long-range plan

Fundamental R&D

Name	Organization
R. H. (Dick) Simons Fx 284-7178	SAIT. Calgary.
Wenyue Zheng	CANMET/MTL, Ottawa
Jason (Shaisheng) WANG	University of Alberta
ALBERT TEITSMA	PETROMIX LTD.
Peter Williams FAX 613 788 4301	Geotechnical Science Laboratories Carleton University
Bob HILL	C-CORE. Fax 221 8760
Roy Pick FAX 519-888-6197	UNIV OF WATERLOO

New Technologies

- construction
- testing
- inspection
- hydro-testing

Priorized Issues/Action Plans 1994

Notes from Group Rooms June 10, 1994

Summary from Group Rooms

NEW TECHNOLOGIES

GROUP DISCUSSIONS JUNE 10/94

Approaches to Repair

- Anomalies are formed - think ahead - what if you find?
- Options - temporary fix
- Assessment - priorizing (field quality of inspection)
- Decision-making process - what was done
  What's in the tool box
  What's optimum - repair vs maintenance
  Least cost
  Adequate security
  Risk optimization
- Time value of money - referred is value? - quality assurance of repair
- Time frame of repair
- Time lag
  - leading edge repair techniques - incorporating into codes (2 yrs - fast track?)
- Big $$
  Feasible
  information
  responsive

New Technologies for Construction / Testing

- In-situ pipeline rehabilitation - information dissemination wish list
  - recoat
  - $, management
- New equipment - technical conferences
  - high pressure jets
  - ultrasound
- Surface pipelines in geotechically sensitive areas (slopes)
- In-situ evaluation of pipe characteristics (steel specs?) - welding procedure

Hydrostatic Testing

- resolves integrity repeated (single test can compromise the integrity
- Novel approaches - which materials
  - air for H_2O
  - tracer gases?
- air - explosive failure
- Pigs over hydro?
- Hydro methodology

Actions

1. September Meeting - Calgary
   Champion: Bruce Gray
   Subject: Approach to Repair

   Who: owners / trans. companies / regulatory people
   By invitation (size level of rep.)

(Need time, knowledge)

(Consultants?)

PIM Service Groups

(restrict to users?)

Approaches to Ryan

Name	Organization
ARNOLD BELL	HOME OIL [illegible]
DARIUS BOUCHER	PROACTIVE TECHNOLOGIES.
Jim Walling	Beta Corp.
BRUCE GRAY	HOME OIL
Ken Paulson	Canadian Western Natural Gas
KEN KRAUSE	B.C. GOV'T (PIPELINE INSPECTION)
ALASDAIR CLYNE	BRITISH GAS ON-LINE INSPECTION CENTRE, UK
BRUCE DUPUIS	FOOTHILLS PIPE LINES
MARK OTTEN	TRANS MOUNTAIN
SATHISH RAO BALA	WELDING INSTITUTE OF CANADA
GERRY HILL	BETA CORP
Bob SMITH	PETROLINE UPGRADING
MARC SPENCER	MAGI ENG. LTD.
TOM PESTA	ERCB
IVAN [illegible]	HUSKY OIL
ALEX ALVARADO	US DOI / MMS
BILL TYSON	CANMET
Reg MacDonald	Mobil Oil Canada
Dave Murray	U. of A.

Environmental Cracking and Inspection Thereof

Priorized Issues/Action Plans 1994

Notes from Group Rooms June 10, 1994

Summary from Group Rooms

ENVIRONMENTAL CRACKING AND INSPECTION THEREOF

GROUP DISCUSSIONS JUNE 10/94

Actions

THE ISSUES:

- Mechanism not well understood in "real" situations enough work going on
- Enough work going on - information exchange is needed / database possible need for anonymity: 3rd party broker?
- Without grinding, how deep are SC cracks?
- Operating pipeline:
  - now I've found it, what to do until shutdown?
  - what is critical?
- Cut out is $
- What do you need to know about a colony >30% is cut out?

SCC Action

- Form Group
- Bruce Lawson (Westcoast) will contact others at CANMET presentation
- M. Willmot (NOVA) will discuss results with Bruce

HIC

ISSUES

- Surface reactions not understood
- Need to characterize environment factors
- How much is dangerous?
- Large body of knowledge, but ø industrial group
- "Medium" priority

ACTION PLAN

- Needs champion none in this room (?)

- Producers' Group will consider raising priority

Inspection

ISSUES

- Reliable identification of cracks
  - software problem
- Present technologies
  - ultrasonics
  - electromagnetics
  - Are there others?
- Co-funding
- No action plan from this group

CRACKING

Name	Organization
Linda Gray	Alberta Research Council
Martyn Wilmot	NOVACOR RESEARCH.
Iwona Swiatek-Otto	C-FER
JASPER PRICE	CANLOCYMPIC
FRANK Christensen	F.H. Christensen MCI
Bruce Lawson	Westcoast Energy
PHILIP EVANS	PIPETRONIX LTD.
SUSIE SENGUPTA	BRITISH GAS (CANADA)
DAVID ATHERTON	Queens University
Eoleen Mackintosh	Ecological Services
Doug McCutcheon	Dow Chemical
JIM WALLBRIDGE	CONSULTANT
Peter Sheng	University of Alberta
Richard Lee	Fleet Technology
CHRISTA CHORNEY.	AEC PIPELINES
Dpime Snelgrove	Transportation Safety Board
Murray D. Swayze	Canspec Group Inc.
KAROL SZKLARZ	SHELL CANADA
LARRY STAPLES	RUSSELL TECHNOLGIES
John Davis	CANADIAN WESTERN NAT. GAS.

June 10, 1994 Luncheon

Speaker:
G. R. Yungblut
Special Advisor
National Energy Board

LUNCHEON TALK

WORKSHOP - MANAGING PIPELINE INTEGRITY

BANFF, ALBERTA - JUNE 10, 1994

By: Glenn R. Yungblut
Special Advisor
National Energy Board

Luncheon Talk

Workshop - Managing Pipeline Integrity

Banff, Alberta - June 10, 1994

Glenn R. Yungblut
Speical Advisor
National Energy Board

It is a pleasure and an honour to speak to you today and it is especially a pleasure to have an excuse to come to Banff on a Friday (usually it is only those of you who work for oil companies that have that opportunity).

I am sure that I do not need to convince to you of the importance of your workshop. The fact that the work shop has been organized and the fact that you are here is certainly evidence of that.

There are a number of things I would like to comment on today with respect to the subject of this workshop "pipeline lifecycle". I would also like to bring you up to date with some changes taking place at the National Energy Board both in terms of organization and of focus.

Starting with "pipeline lifecycle". It was only after I started working for the Board some three years ago that I came to realize the extent and importance of the pipeline transmission systems in Canada. I expect the general public know very little and just as likely cares very little about the system. That is the problem with a well functioning safe system, it only attracts attention when something goes wrong. This is human nature - in fact a philosopher made an observation around the turn of the century that "the less frequently an event occurs, the more attention it will attract when it does occur." What this means is that any evidence, particularly any rupture, that the integrity of a pipeline has or is declining, is likely to attract attention that is far out of proportion to the event. This could lead to public demands for action on the part of the regulator or the company to do things that neither make technical nor economic or environmental sense. More importantly things that do not add to overall public safety.

To digress for a moment -- CAPP in its 1991 Oil pipeline performance review calculated that the amount of oil transported by pipeline in that year was equivalent to 39,830 tandem truck loads per day or 11.8 unit trains per day running from Calgary to Toronto.

A similar calculation for gas -- if the gas had been transported as LNG from Alberta to Toronto would be 15,000 truck loads per day. The safety consequences of adding this much traffic on our highways or railways I will leave to your imagination. However, these are the alternatives to the pipeline transportation system now in place.

Another fact that has impressed me is that the major pipeline systems in Canada range in age from 31 years to 51 years - with largest four i.e. TCPL - 39 years, Westcoast - 37 years, IPL - 44 years and Trans Mountain - 41 years. The remaining oil and gas reserves in the Western Basin plus the frontier discovered reserves in the Beaufort Sea and MacKenzie Valley would suggest that the pipeline system will be required for at least that long again. That is, ideally, the most efficient and desirable situation would be, to be able to continue to use and confidently rely on the present system, with additions where justified, for another 40 - 50 years. The cost of duplicating the system now in place would place a very substantial strain on the Canadian economy. In fact, I suspect that Canadian gas could not compete in the Eastern Canadian market if it had to pay the cost of a new system.* How to maintain the integrity of pipelines that far into the future has been the focus of your workshop in Red Deer last year and this workshop in Banff.

* Also mention environmental disruption

At the same time the public and particular the landowners are becoming more aware, more cautious and more demanding. Any failure is seen as evidence that pipelines by their nature are unsafe or at least are not as safe was we all claim them to be. In order to allay concerns that may develop with respect to pipeline safety particularly in the after math of a rupture we need to do a number of things. First, we must maintain a regulatory agency and regulations in which the public has confidence. Second, there should be a clear understanding of the technical reasons of a failure. Third, there should be clear evidence that the pipeline operators move quickly to deal with potential problems as soon as they become aware of them. Fourth, a continuous effort must be made to make the public aware of the importance of the pipeline system.

Pipeline comparison

In working towards the goal of keeping the pipelines operating safely for another 50 years it strikes me that there are a number of problems to address - some strictly technical some of a public relations or educational nature and some of a regulatory nature - that sort of falls between those two.

From the technical / scientific standpoint we need to know or find out as much as we can about how the characteristic of steel in pipelines and the coatings change over time. In this respect, how those changes may be initiated or accelerated by the soil conditions adjacent to the pipeline, by the characteristics of the steel originally used in the making of the pipe and by the conditions under which the pipe was installed. We need to know more about things such as stress corrosion cracking, about long time effects of defects in the pipe wall and effects of cyclic loading in general. Ideally if tools could be developed that could reliably detect and measure every potential failure condition in the pipe - this would be of great help to the pipeline companies and to the regulators and would as a result reduce the causes of public concern.

One of my hobby horses is the potential use of risk analysis to assess in a more formal way the integrity of a pipeline in service. Such an assessment would give the regulator and the pipeline companies a tool that would help them concentrate their efforts on the sections of the system that have the highest potential for causing significant damage to the environment, property and most importantly to the public. Such a tool could also have some public relations spin offs, in that, in the event of a serious incident it could be used to explain the probability of a reoccurrence or as a technique in comparing the risks associated with the continuing to operate the pipeline with the alternatives that might be proposed.

In summary (in relation to pipeline lifecycle or integrity) the 90,000 kilometres of oil and gas pipelines in Canada is a very valuable national asset. I am tempted to compare it to the railway system - but I am not sure whether it is more important or less important in terms of the economic service it provides. Certainly for the oil and gas industry it is far more important. In terms of the overall GNP and its role in future economic development it might make any interesting study in itself. In any event it is very important and any thing that collectively we can do to extend the useful life of the system will benefit all Canadians.

Turning briefly to the National Energy Board and changes there, that could have some bearing on pipeline integrity - the first and perhaps the least important is a minor re- organization which has removed a layer of management. I and Peter Miles who headed up Energy Regulation will be retiring shortly and as a result the Board will have six Branches (Engineering, Environment, Financial Regulation, Economics, Oil & Gas and Law) plus the Office of the Secretary and Administration reporting directly to the Executive Director - this change by itself will not likely change in any fundamental way the Board does its business.

Second, as a result of the passage of Bill C-6 on May 12 the Board became legally responsible for administering the Canada Oil & Gas Operations Act. That Act governs all oil and gas activities in the frontier regions not covered by an Accords (ie. Offshore Newfoundland, Offshore Nova Scotia). In the past, these responsibilities were the more closely associated with the Panel for Energy Research & Development than were those covered by the NEB Act, and much of the support and rational for involvement in that program flowed from the COGOA responsibilities. Of course, the staff that was transferred to the Board from the COGLA organization to support those responsibilities, was actually transferred three years ago and has been working as part of the NEB since that time. During those three years one result of the merger of the responsibilities was greater involvement by the pipeline engineers in PERD activities. In the past, the Board was both reluctant and some what uneasy about getting directly involved in research work related to pipeline technology. This attitude to research has changed substantially over the three years and I expect that with the heightened concern for the environment and safety it will continue to change.

Third, the Board and industry are both interested in moving towards some form of incentive regulation - of the economics side of the business - that is pipeline companies would benefit directly from more efficient operations as would their customers. The flip side of such incentives is that there will be more internal pressure to cut costs which will mean that regulators will have to be more vigilant in ensuring that pipelines are maintained in a fully safe condition - I would suggest that this will also require regulators and governments to put more resources into research designed to maintain the integrity and to extend the safe lifecycle of the pipeline network.

In closing I want to thank you for inviting me to meet with you today and wish you continued success in your efforts to maintain Canada's pipeline system in a safe efficient condition.

Other Information

PIPELINE LIFECYCLE
Banff, Alberta
June 9 & 10, 1994

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Alvarado, Alex P.	US Dept of Interior, MMS	1201 Elmwood Park Blvd., New Orleans, LA 70123-2394	(504) 736-2547	(504) 736-2426
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PIPELINE LIFECYCLE
Banff, Alberta
June 9 & 10, 1994

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PIPELINE LIFECYCLE
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INTERNAL PROTECTION OF HIGH WATER CUT PIPELINES

INTRODUCTION

Internal corrosion of high water cut emulsion gathering pipelines is an increasing concern. Within the province of Alberta there are in excess of 700 pipeline failures per year. Emulsion gathering pipelines account for 33% of these failures (second highest after water pipelines at 42%) with over 60% of these failures due to internal corrosion.

RESEARCH STUDY SCOPE

1. Identify and report on success of current technology/remediation.

2. Development and proving of a predictive model for relating corrosion rate to service conditions such as water cut, water chemistry, oil chemistry, flow regime, wetability etc.

3. Evaluation of the effectiveness of alternative methods for remediation of internal corrosion on emulsion gathering pipelines.

4. Evaluation of the effectiveness of alternative technologies for corrosion monitoring in emulsion gathering pipelines.

DISCUSSION

Notes from Producers Materials/Corrosion Issues Group brainstorming session on this topic attached.

ENGINEERING CRITICAL ASSESSMENT OF CORRODED PIPE

INTRODUCTION

Engineering Critical Assessment (ECA) is recognized as integral to risk-based assessment and risk-based management of operating pipelines. ECA of a corroded pipeline requires information from various sources, including inspection (defect sizing), material properties (strength, fracture resistance etc.) and operating conditions (environment, loading etc.). This information is used to assess current damage, resistance to failure and to estimate lifetime through an understanding of failure modes and mechanical/fracture behaviour of the pipeline.

The desired goal of this research would be to provide operating personnel with simplified, not overly conservative assessment methods and criteria that allow cost effective decisions on whether to leave in operation, repair or replace internally or externally corroded pipelines.

RESEARCH STUDY SCOPE

1. A review of existing technology with respect to inspection and ECA methodology of pipelines.

2. The study would be limited to inspection of and damage resulting from weight loss corrosion. Cracking damage initiating from weight loss corrosion should be considered.

3. The pipeline sizes of interest are NPS 2 to NPS 16 which are typical for producing companies.

4. Since an accurate sizing of damage is important for any ECA, the capabilities of existing inspection tools need to be validated.

5. The effect of internal vs external damage, sweet vs sour environments and small vs large diameter lines on ECA methodology needs to be determined.

6. Proposed ECA methodologies (eg. estimations, formulae) should be validated through laboratory and field testing and experience. For example, a portion of a line or materials from the line may be inspected and taken to failure under simulated operating conditions.

DISCUSSION

Notes from Producers Materials/Corrosion Issues Group brainstorming session on this topic attached.

CORROSION UNDER DISBONDED COATINGS

INTRODUCTION

External corrosion under disbonded coatings has been identified as a cause of several significant failures in pipelines. This problem has not resulted in a large number of failures but is becoming a growing concern as producing fields age.

RESEARCH STUDY SCOPE

1. Detection of disbonded coatings. Evaluation of effectiveness of current technology. Identify areas for improvement.

2. Identification of the mechanism of corrosion under disbonded coatings.

3. Prevention of corrosion under disbonded coatings. Identification / development / evaluation of alternative technologies for preventing corrosion under disbonded coatings.

DISCUSSION

Notes from Producers Materials/Corrosion Issues Group brainstorming session on this topic attached.