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# Pipeline Integrity Reviews - A Holistic Approach

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Paper presented at:

*Pipeline Pigging, Integrity Assessment and Repair  
Conference. February 2001, Houston.*



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## Presentation Structure

- Background to paper
- Change
- Safety of Ageing Pipelines
- Move to Risk Management
- Pipeline Integrity Reviews and Their Benefits
  - Conducting a Pipeline Integrity Review (PIR)
  - Fitness for purpose
  - Risk analysis
  - Who should conduct a PIR
  - Pipeline Management Systems
- Ten key considerations for all pipeline engineers when considering your pipeline's safety and integrity

**Background**



## Background

The USA pipeline industry is about to commence integrity management programs, encouraged by regulations. The core of these programs will be detailed reviews of pipeline integrity

Andrew Palmer & Associates have been conducting integrity reviews (baseline assessments) for clients worldwide:

- UK - upgrading of 25 year old system
- Asia - assess safety & rerating of 40 year old pipeline
- Africa - third party commercial reasons
- General - pipeline management systems

We've learnt that:

- Not sufficient just to look at 'integrity'
- Not sufficient to focus on the pipeline alone
- You must look at the whole pipeline system, as all aspects contribute to safety - a 'holistic' approach.
- You must have a pipeline management system

We'd like to share our experiences/expertise with you, as you start complying with the 'final rule' and using API 1160

## Background

You will be needing to thoroughly review your integrity in USA  
You may call this review a 'baseline' assessment, and  
You may call the overall framework 'integrity management' and  
You may call you integrity assessments or the procedure for  
obtaining a plan to reduce risk 'direct assessment',  
But all this is accommodated in the Pipeline Integrity Review.  
The major difference is that the Pipeline Integrity Review is  
explicitly...

# HOLISTIC

Change



## Change in our world... the family.

• The whole world is changing, not just the pipeline business. Consider the effects of technology on our family:

■ Central Heating - we no longer need to sit together for warmth

■ Microwave cookers - we no longer have to sit together for eating

■ Electronic games - we no longer have to sit together to play

■ Cell phones - we no longer have to be together at all!



## Change in people....

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I think I look  
er. Sadly, I'm  
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onsider how  
hour is  
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mb squad....



# Change in pipeline construction... little change.

OLD



Corbis.com

● NEW



● Remember... Pipeline Engineers are like surgeons...

## Change in pipeline testing....



- We have seen major changes in testing our lines.
- From limited gas testing, to
- high level water testing (1960s) to
- low resolution smart pig inspection (1970s) to
- high resolution smart pig inspection (1980s)



# Pipeline Safety



# Pipeline safety... recent USA failures



● Images taken from OPS website: [ops.gov.com](http://ops.gov.com)

# Pipeline safety... not confined to USA



taken  
ers  
e

## Pipeline failures... why?

CAUSES	US GAS	EUROPEAN GAS	CANADA GAS	US OIL	EUROPEAN OIL	HUNGARIAN OIL & GAS
THIRD PARTY	40.4	28.2	12.6	21.5	47.5	56.5
CORROSION	20.4	15.7	11.6	21.7	27.7	17.6
MATERIAL AND CONSTRUCTION DEFECT	12.7	9.5	34.3	11.5	23.4	12.9
HUMAN ERROR	26.4	46.5	41.5	45.4	4.3	12.9
INCIDENTS/ 1000 M YR	0.26	1.85	2.93	1.33	0.83	4.03

- You MUST have an holistic approach to integrity, to prevent all these failures, AND
- Smart pigging, risk management programmes, correct routing

# Pipeline safety... why are we having 'more' failures?

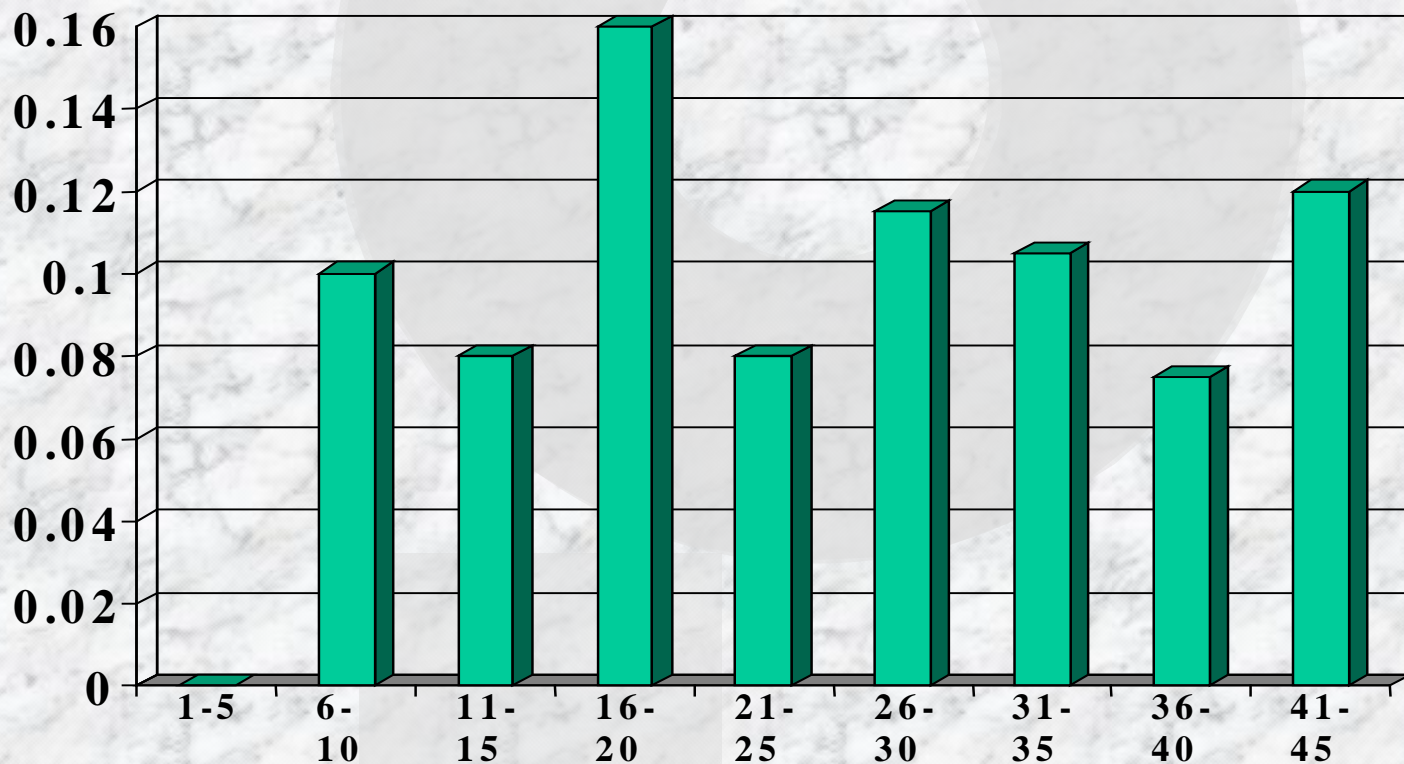
- Our pipelines are getting older, and we expect the same/more performance.
  - But we still treat them the same...?
  - This cannot be a decision from an engineer!
- USA system oldest in the world
  - If it's going to happen, it will happen here first....
- More buildings/activities around pipelines; increased consequences
- We are increasingly treating engineering as a 'commodity'
  - Commodities (e.g. sugar) are price-driven, and not perceived as complicated or having variable quality
    - This may be true of, e.g. linepipe, in our industry
    - But it is not true of anything related to safety and environment
- Some of our operators have downsized
  - losing the 'grey hairs',
  - under-strength or under-trained or 'under-experienced', and
  - losing 'corporate memory', and engineering objectivity.
- Our regulators are under pressure to reduce size... the 'more for less' pressure is on our civil services



# Safety of Ageing Pipelines

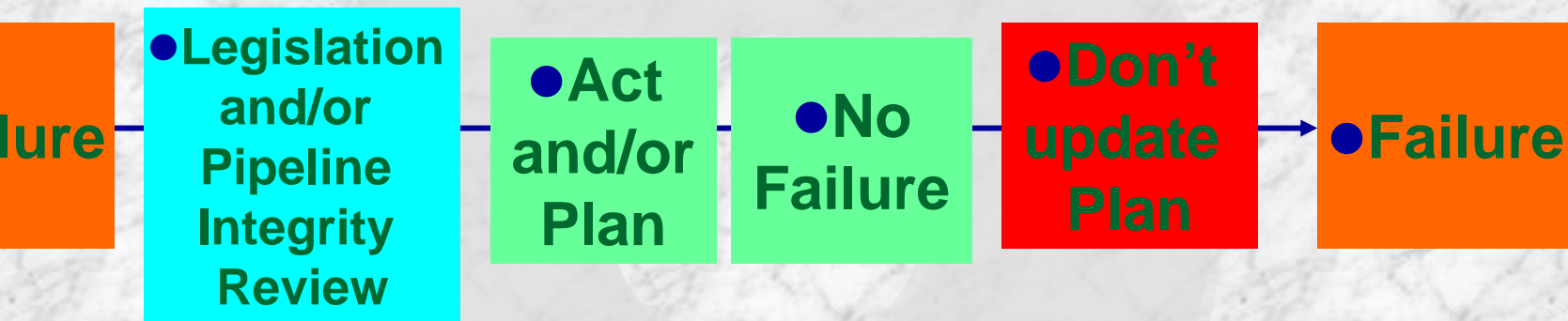
Good maintenance and management of ageing pipelines allows them to be operated safely for many years. FAILURES NEED NOT HAPPEN!

Corrosion Spills/year/1000km



## Change in approach to pipeline safety....

● Old Style... Reactive... from failure to failure....



● New Style... Proactive... no failure philosophy



# Change to Risk Management



## Change to Risk Management - 'Proactive'

The change to 'proactive' safety requires formal identification and management of risk. This is an international movement:

- **USA Office of Pipeline Safety** has a risk demonstration programme, and see risk management as a potential method of producing equal or greater levels of safety in a more cost effective manner than the current regulatory regime
- **UK Pipelines Safety Regulations:**
  - ③ Goal-setting, not prescriptive
  - ③ The Regulations require a 'major accident prevention document', including safety management system.
- **Canada** has non-mandatory 'Guidelines for Risk Analysis of Pipelines' in its pipeline code.
- **The European Commission** is reviewing 'major accident' pipelines, and are likely to require operators to have a 'major accident prevention policy and a pipeline management system'

# Pipeline Integrity Reviews



# Pipeline Integrity Reviews

- **IN THE USA YOU WILL HAVE:**

- **'FINAL RULE' + API 1160 = INTEGRITY MANAGEMENT**

- **This can be simply represented by:**

- **Pipeline integrity review**

**+**

- **Pipeline management system**

**=**

- **Integrity management**

# The Need For Pipeline Integrity Reviews, and Their Benefits

**There are six main reasons why an operator may need to review the integrity of a pipeline:**

- **Continuing safety, security and compliance.**
- **Cost effectiveness.**
- **Poor documentation.**
- **Change or extension of use.**
- **Revalidation.**
- **Change of ownership or third party access.**

# The Need For Pipeline Integrity Reviews, and Their Benefits

The benefits of conducting an integrity review include:

- Compliance with regulations
- Factual demonstration to all stakeholders of pipeline safety and corporate commitment to safety
- Pipeline health check.
- Confirmation of safe operating limits.
- Independent review of design and operation.
- Identify and justify any requirement for remedial action.
- Identify any weaknesses in management procedures.



# Conducting a Pipeline Integrity Review

A Pipeline integrity review is a review of a pipeline system that, as a minimum, includes analysis of:

- The pipeline's design, construction and commissioning,
- Pipeline route and hazards (e.g. proximity of housing, subsidence areas or seabed profile),
- Operating history, practices and management,
- Current condition via inspection records, failures, downtime, etc.,
- Practices for inspection and maintenance of the pipelines,
- Hydraulic/compression, including delivery forecasts and expansion plans,
- Product quality; both current and future quality is considered,
- Safety and environmental procedures and systems,
- The critical parts of the pipeline system (pipelines, SCADA systems, gas conditioning stations, valve stations, pig

# Pipeline Integrity Review - Execution plan

ITEM	DESCRIPTION
1. PIR Objective, Scope and Overview of Programme.	<ul style="list-style-type: none"> <li>i. Descriptions, and</li> <li>ii. Timetable</li> </ul>
2. Overview of Activities	<ul style="list-style-type: none"> <li>i. Office Set Up (if needed),</li> <li>ii. Mobilisation of Review Teams,</li> <li>iii. Kick-Off Meetings/Documentation Review,</li> <li>iv. Data Gathering and Analysis by Discipline (Item 4),</li> <li>v. Integrity and Risk Review (Item 5),</li> <li>vi. Reporting, with Corrective Actions.</li> </ul>
3. Activity Schedule	<ul style="list-style-type: none"> <li>i. Pre-Data Gathering Reviews,</li> <li>ii. Data Analysis &amp; Report Preparation,</li> <li>iii. Review Report Submission,</li> <li>iv. Clarification Meetings on Draft Review Report,</li> <li>v. Final Report and Corrective Actions Report.</li> </ul>
4. Scope of Data Gathering Activities by Discipline (many disciplines may be needed during the review)	<ul style="list-style-type: none"> <li>i. Process,</li> <li>ii. Mechanical,</li> <li>iii. Electrical,</li> <li>iv. Instrumentation/Control,</li> <li>v. Risk and Integrity (Item 5),</li> <li>vi. Pipeline Engineering,</li> <li>vii. Cathodic Protection,</li> <li>viii. Safety and Environment.</li> </ul>
5. Pipeline Fitness for Purpose and Risk Review	<ul style="list-style-type: none"> <li>i. See Section 4.3.4.</li> </ul>
6. Additional Information Required from Integrity	<ul style="list-style-type: none"> <li>i. CVs of Key Personnel,</li> <li>ii. Organigram,</li> <li>iii. HSE Plan,</li> </ul>

## **Fitness for Purpose and Risk Review**

**One part of the Pipeline Integrity Review is the FFP and Risk Review. This is a major topic of this conference, so it is worthy of mention.**

**These reviews will:**

- **Contribute to the overall expert opinion on the integrity of pipeline system.**
- **Identify critical sections of the pipeline system (e.g. in terms of security of supply).**
- **Assess the remnant life of the pipeline, and its ability to withstand either its existing duty, or change of duty.**
- **Provide a review of the risks associated with the pipeline in both its current and future condition.**

# Fitness for Purpose and Risk Review

- The 'fitness for purpose' review will usually focus on any defects (e.g. corrosion) or damage (e.g. dents) recorded/anticipated in the pipeline, as these will be the results of the major hazards to the pipeline (e.g. mechanical damage, or deteriorating coating). This review will help us determine the PROBABILITY (LIKELIHOOD) of a failure; however, this review does not take account of the CONSEQUENCES of any failure.
- The 'risk' review will take account consequences, as:
  - **RISK = PROBABILITY OF FAILURE x CONSEQUENCES OF FAILURE**
- But don't forget, we also need to take account 'GAIN'. We balance our risk with our gain. This is controversial and usually avoided in public, but ESSENTIAL.
- Why? Because it is often the operator who gains by increasing risks, and the public who loses.

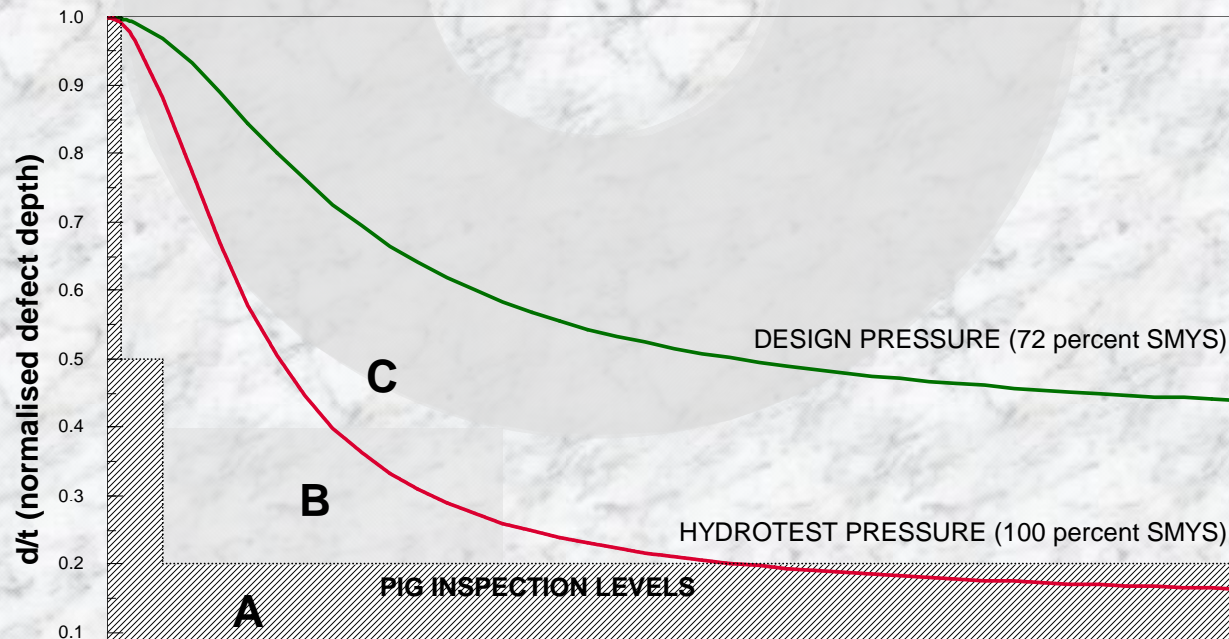
# Fitness for purpose assessment of defects

Fitness for Purpose - defect assessment.

When this is a mature subject and you can assess existing defects, you can evaluate future defect occurrence and growth using these methods.

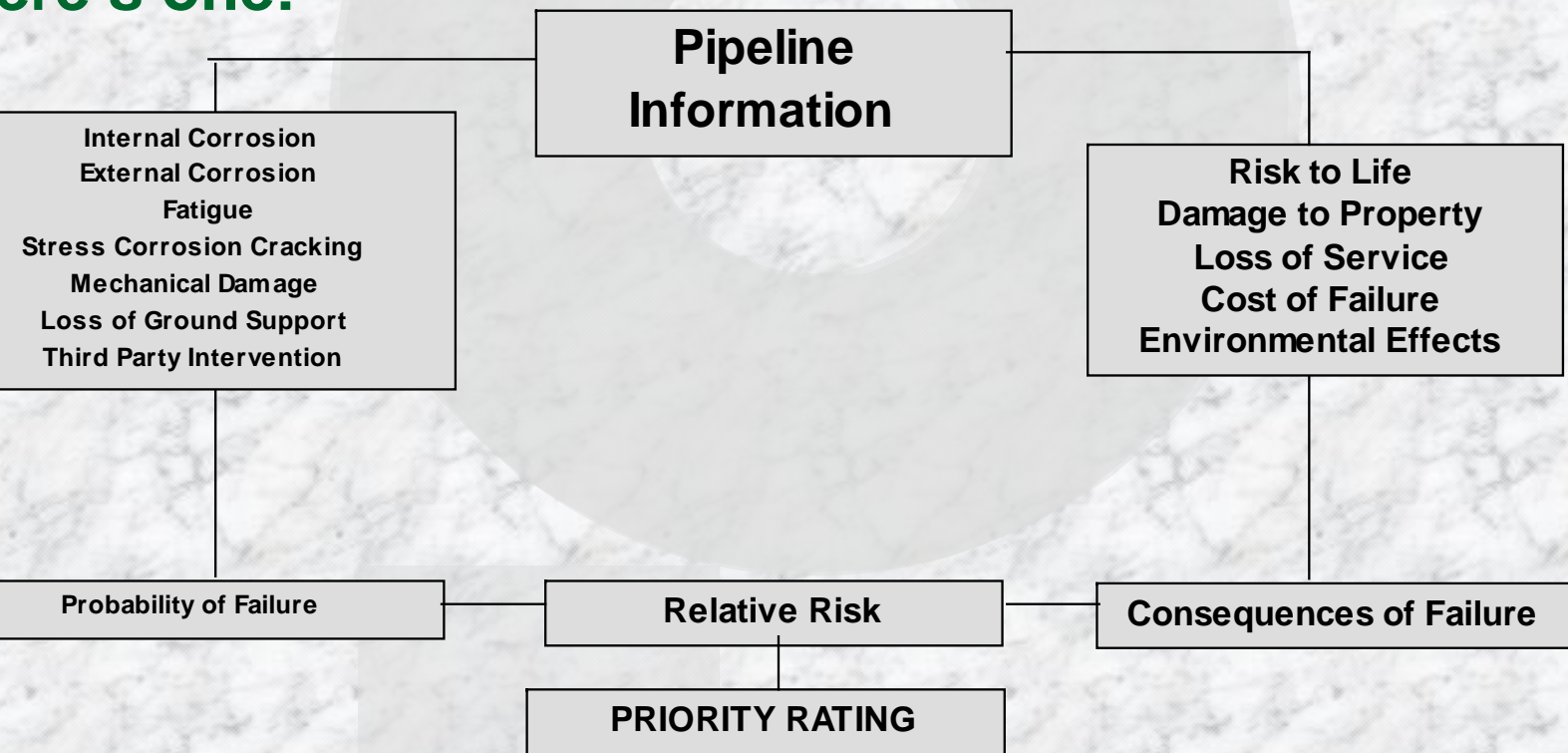
You can also determine when to repair defects, which pig to use, how often, and whether you need to hydrotest or not.

Send me my course if you want to find out more!



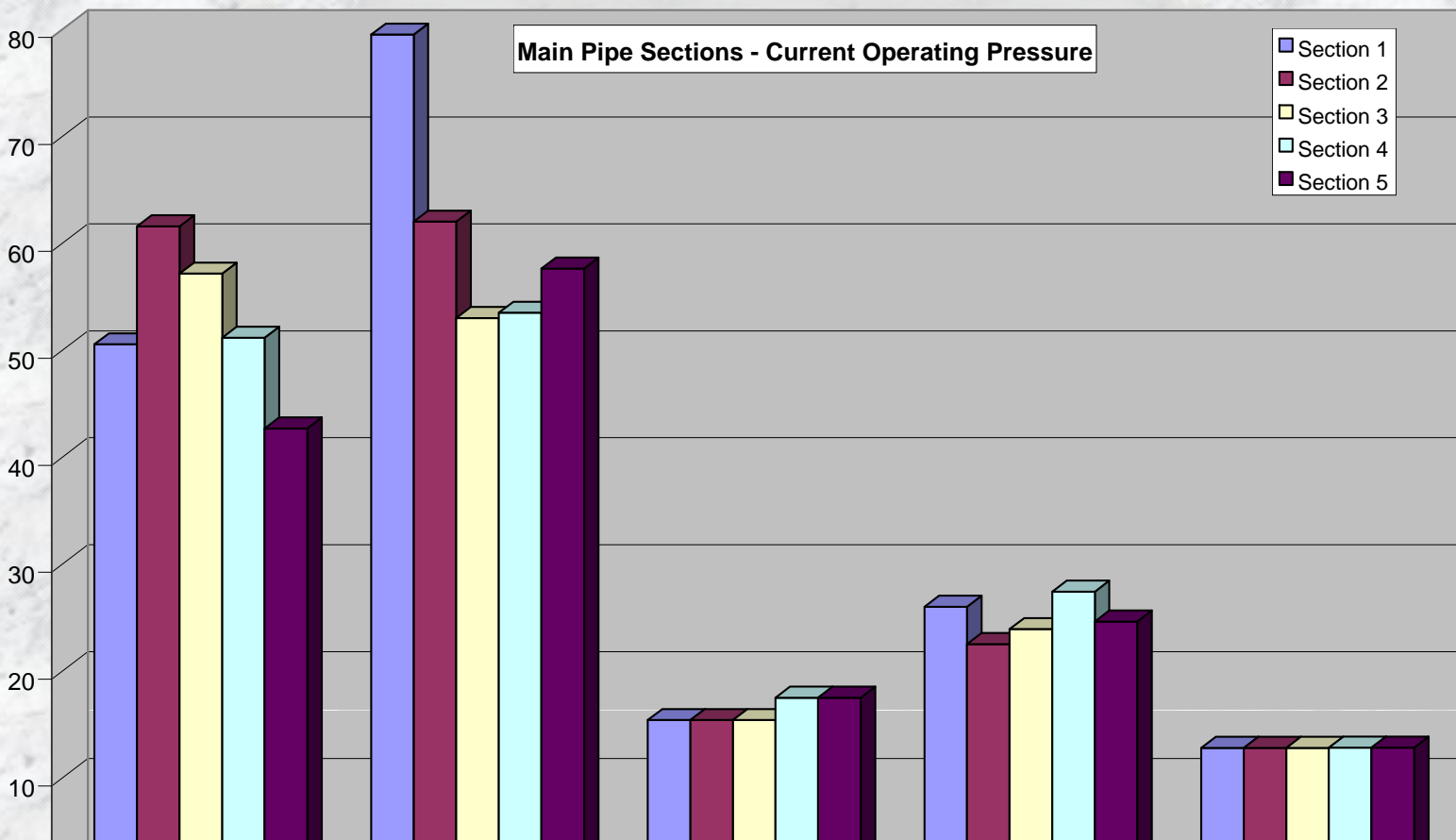
# Risk Assessments

Risk Assessment is essential, and you have many risk assessments methods and packages to choose from. Here's one:



# Results of a risk assessment

## Results from part of a Qualitative Risk Assessment



## Some Decisions made in a PIR

**Outcome of FFP and Risk Assessment may include recommendations for:**

- **Smart pigging,**
- **Hydrotesting,**
- **Critical point inspection,**
- **Cathodic protection testing,**
- **Repair methods,**
- **Other rehabilitation methods.**

Note that the results of the risk review are important, but the most important feature of the risk review is the PROCESS we go through in identifying risks and understanding our pipeline



## Who should conducting a PIR?

The review should be conducted by an organisation that can offer the following skills:

- Independence
- Design, construction and commissioning of above and below ground plant (or offshore and subsea plant if appropriate),
- Operation, inspection and maintenance of pipeline systems,
- Communications and instrumentation,
- Defect assessment, repair and rehabilitation,
- Risk and safety assessments,
- Management consultancy,

# A Pipeline Integrity Review Report

The integrity review report should include:

- **An overall view of pipeline system condition:**
  - Wellheads / above ground installations
  - Pipeline
  - Cathodic protection
  - Controls
  - Associated facilities
  - Operation and Maintenance
- **Recommendations on:**
  - Modification and Repair
  - Inspection
  - Future operation
- **An appraisal of management system and procedures**

# Pipeline Management System\*



# Pipeline Management System

- Pipeline integrity review

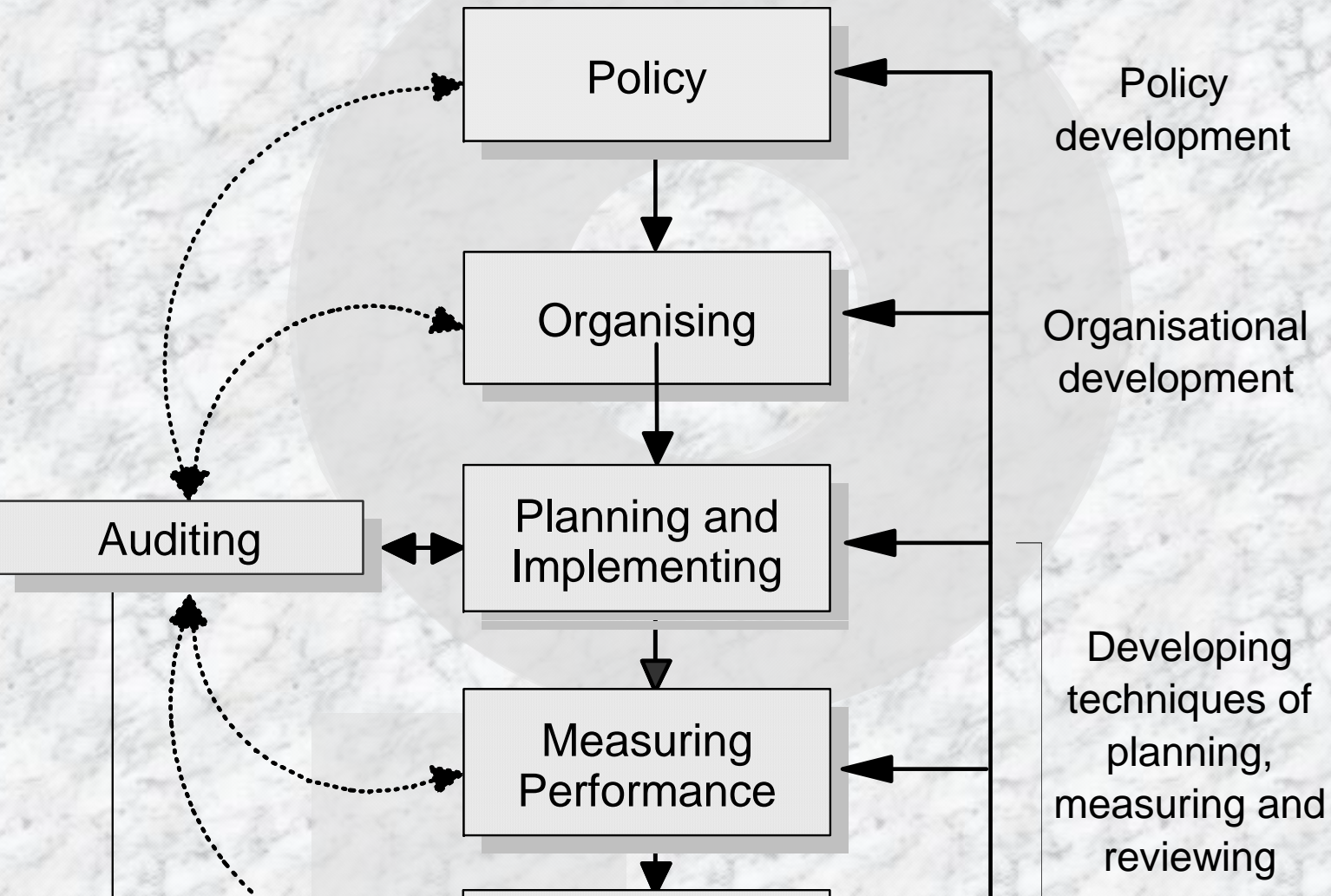
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- Pipeline management system

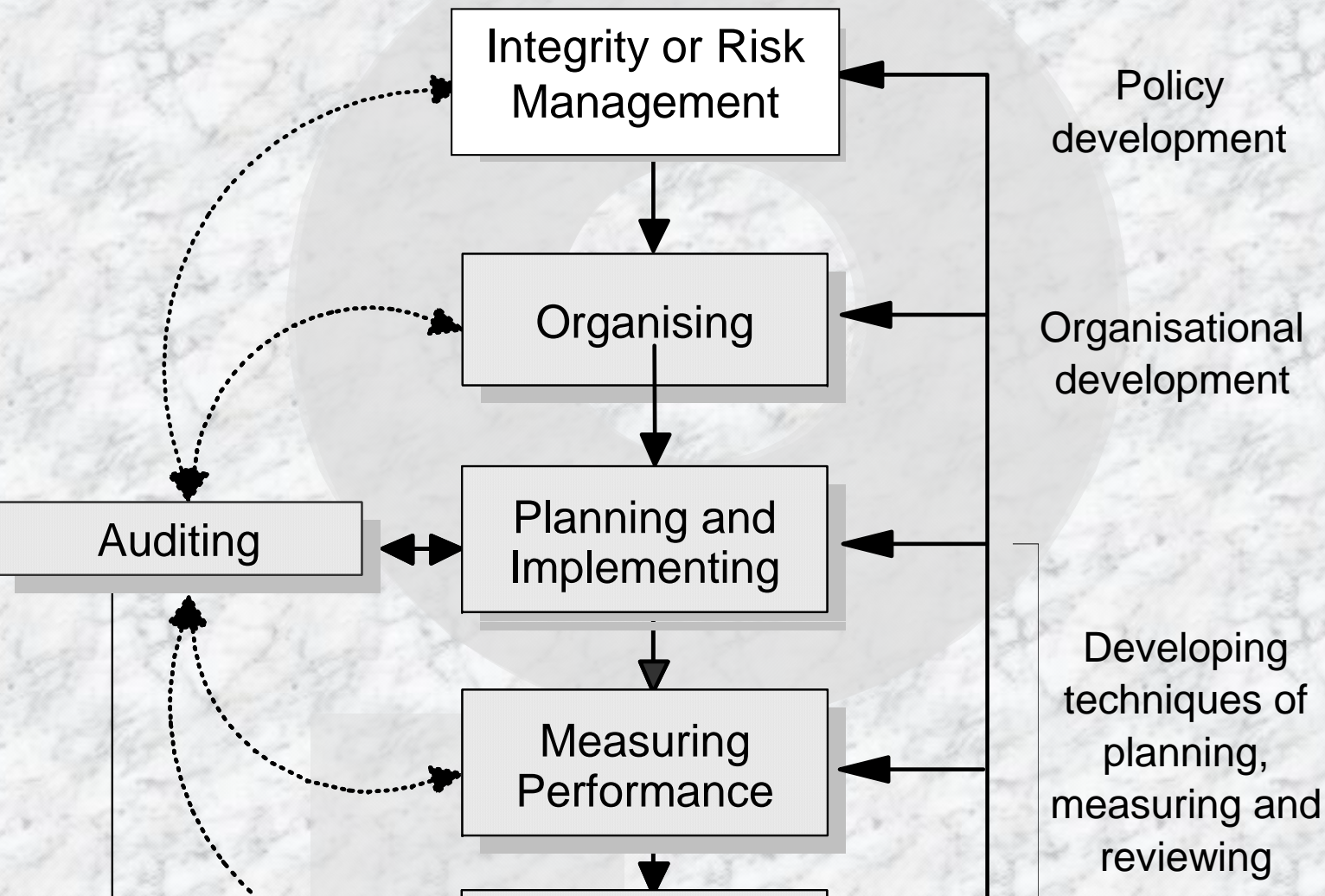
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- Integrity management

# Management System - Generic



# Pipeline Integrity/Risk Management System

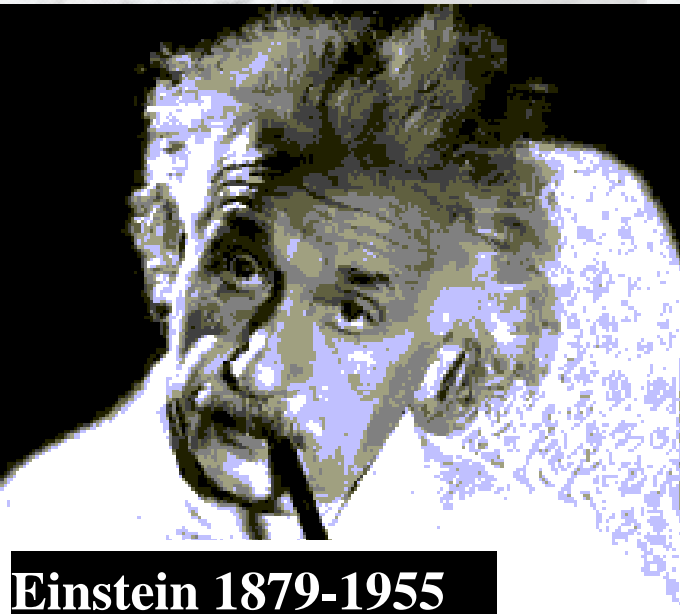


# Ten Key Considerations for Engineers when Considering your Pipeline's Integrity & Safety

- **Changing to a safer pipeline....**

# Ten Key Considerations for Engineers when Considering your Pipeline's Integrity & Safety

## Key Consideration 1. Change Requires New Thinking



**Einstein 1879-1955**

*'The significant problems  
we face, cannot be  
solved at the same level  
of thinking we were when  
we created them'.*



# Ten Key Considerations for Engineers when Considering your Pipeline's Integrity & Safety

## Key Consideration 2. Change Will be Resisted



*'There is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new system.*

*For the initiator has the enmity of all who would profit by preservation of the old institutions, and merely lukewarm defenders in those who have a slight interest in the new system.'*

# Ten Key Considerations for Engineers when Considering your Pipeline's Integrity & Safety

## Key Consideration 3. Corporate Culture

*In pipeline operation, our maintenance costs are minor compared to our corporate overhead.*

*It is a fact that large organisations operating pipelines will put costs on maintaining their pipelines, but let junior executives travel over the world in business class, or waste time on meetings that all participants know are a waste of time.*

*These companies are both out of date, not serving their business goals, and creating imbalances between the*

# Ten Key Considerations for Engineers when Considering your Pipeline's Integrity & Safety

## **Key Consideration 4. Selecting the lowest bid**

*Don't let your Contract/Finance Department select pipeline contracts or prices. Why not?*

- *a trained monkey can select the smallest of three objects*
- *an engineer can select the safest and best*
- *we have advice against selecting the lowest bid from Ruskin, 1819-*

*0):*

■ ***'It is unwise to pay too much but it is worse to pay too little. When you pay too much you lose a little money... that is all. When you pay too little you sometimes lose everything because the thing you bought was incapable of doing the things it was bought to do.***

■ ***The common law of business balance prohibits paying a little and getting a lot... it cannot be done. If you deal with the lowest bidder it is well to add something for the risk you run.***

■ ***And if you do that, you will have enough to pay for something***

# Ten Key Considerations for Engineers when Considering your Pipeline's Integrity & Safety

**Key Consideration 4. Selecting the lowest bid  
(Int.)**

**'Low bidders and "can-do" type of guys  
kill people'**

# Ten Key Considerations for Engineers when Considering your Pipeline's Integrity & Safety

## ***Key Consideration 5. Do not do the 'minimum' expected or required***

***Codes, Regulations, etc., are minimum requirements  
to do more than your peers - it makes sense...***

- ***If you do only one thing more than your peers, his/her pipeline will probably fail first***
- ***You'll learn from their experience, and act accordingly, so it doesn't happen to you***
- ***They will then copy your practices, but***
- ***You will then move one step ahead again...***
- ***And then their pipeline will fail before yours again!***

# Ten Key Considerations for Engineers when Considering your Pipeline's Integrity & Safety

## ***Key Consideration 6. Think Holistic Solutions***

***Pipeline Integrity Management must consider  
aspects of our pipeline system as it is an  
integrated process, where all elements affect  
safety.'***

***We must apply holistic solutions***

# Ten Key Considerations for Engineers when Considering your Pipeline's Integrity & Safety

## **Key Consideration 7. 'Calculations are not Engineering'**

***They do convey the thought process and design intent.  
The quality, etc. of calculations indicates the level of care and  
competence; calculations substantiate,  
but do not substitute for judgement.***

***The use of canned calculations and design approaches without  
understanding their application & limitations, is beneath an  
engineer's standard of care.'***

# Ten Key Considerations for Engineers when Considering your Pipeline's Integrity & Safety

## ***Key Consideration 8. Management***

***Smart pigging, risk management programmes,  
correct routeing etc., will help you achieve high  
integrity...***

***but only good management will GUARANTEE  
integrity***



# Ten Key Considerations for Engineers when Considering your Pipeline's Integrity & Safety

## Key Consideration 9. Murphy's Law

### **MURPHY'S UNIVERSAL LAW:**

- *If anything can go wrong, it will.*

### **MURPHY'S COROLLARIES:**

- *No. 1 - Left to themselves, things tend to go from bad to worse.*
- *No. 2 - It is impossible to make anything foolproof because fools are so ingenious.*

### **MURPHY'S CONSTANT:**

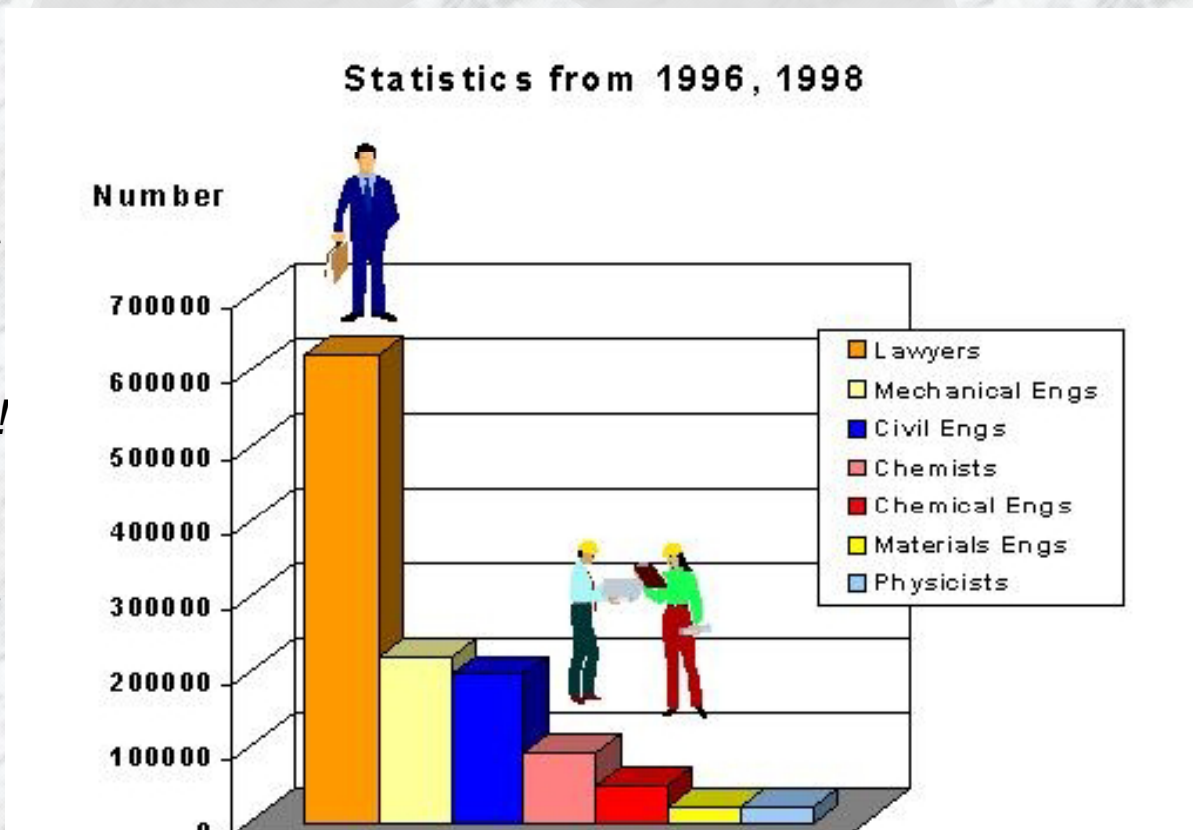
- *Matter will be damaged in direct proportion to its value.*

### **QUANTIFIED REVISION OF MURPHY'S LAW**

# Ten Key Considerations for Engineers when Considering your Pipeline's Integrity & Safety

## Key Consideration 10. Don't Get it Wrong!

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is USA data...  
ers in USA now  
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cientists  
ned....



# CONCLUSIONS

Integrity Reviews can be conducted on pipelines in a systematic manner. They provide:

- Pipeline 'health' check,
- Independent review of design and operation,
- Confirmation of existing safety and safe operating limits,
- Confirmation of compliance, and ability to be uprated/reused/sold, etc.,
- Opportunity to undertake remedial action before operational or design discrepancies develop,
- Confirmation of future safety and security of supply to all stakeholders.

You must adopt a 'holistic' approach, taking account of all the engineering associated with the pipeline system

The resulting integrity plan must be adopted within a

## ABOUT THE LECTURE & LECTURER



lecture, and associated paper, was presented at:

• *The Pipeline Pigging, Integrity Assessment and Repair Conference. February 2001, Houston. Conference Proceedings from Clarion Press, Houston, Tx.*

Phil Hopkins is a Director of Penspen Ltd., UK, the international pipeline engineering company, and was previously Managing Director of Andrew Palmer and Associates, UK, a company of specialist pipeline engineers.

has over 20 years experience in all aspects of pipeline engineering, integrity and management consultancy and has presented many keynote papers and lectures at national conferences.

Technical and management training courses and lectures are presented all over the world; additionally he presents lectures and courses on 'Change', for all levels of staff from Executives to Administration.

If you require this lecture (in 1,2 or 3 hour format) or any of his training courses, please contact either:

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