Pipeline Integrity Reviews - A Holistic Approach

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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

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** - Uprating 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 your 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....

There are far worse things.

Every morning I look in the mirror, and I think I look better. Sadly, I'm fooling myself....

consider how your humour is changing... for a simple in a bomb squad....
Change in pipeline construction... little change.

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
Pipeline safety… not confined to USA
Pipeline failures... why?

<table>
<thead>
<tr>
<th>CAUSES</th>
<th>US GAS</th>
<th>EUROPEAN GAS</th>
<th>CANADA GAS</th>
<th>US OIL</th>
<th>EUROPEAN OIL</th>
<th>HUNGARIAN OIL &amp; GAS</th>
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</thead>
<tbody>
<tr>
<td>THIRD PARTY</td>
<td>40.4</td>
<td>28.2</td>
<td>12.6</td>
<td>21.5</td>
<td>47.5</td>
<td>56.5</td>
</tr>
<tr>
<td>CORROSION</td>
<td>20.4</td>
<td>15.7</td>
<td>11.6</td>
<td>21.7</td>
<td>27.7</td>
<td>17.6</td>
</tr>
<tr>
<td>MATERIAL AND CONSTRUCTION DEFECT</td>
<td>12.7</td>
<td>9.5</td>
<td>34.3</td>
<td>11.5</td>
<td>23.4</td>
<td>12.9</td>
</tr>
<tr>
<td>RATIONAL ERROR</td>
<td>26.4</td>
<td>46.5</td>
<td>41.5</td>
<td>45.4</td>
<td>4.3</td>
<td>12.9</td>
</tr>
<tr>
<td>DENTS/ 1000 M YR</td>
<td>0.26</td>
<td>1.85</td>
<td>2.93</td>
<td>1.33</td>
<td>0.83</td>
<td>4.03</td>
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</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Corrosion Spills/year/1000km</th>
<th>1-5</th>
<th>6-10</th>
<th>11-15</th>
<th>16-20</th>
<th>21-25</th>
<th>26-30</th>
<th>31-35</th>
<th>36-40</th>
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<td></td>
<td>0</td>
<td>0.02</td>
<td>0.04</td>
<td>0.06</td>
<td>0.08</td>
<td>0.1</td>
<td>0.12</td>
<td>0.14</td>
<td>0.16</td>
</tr>
</tbody>
</table>
Change in approach to pipeline safety….

- Old Style… Reactive… from failure to failure….
  - Legislation and/or Pipeline Integrity Review
  - Act and/or Plan
  - No Failure
  - Don’t update Plan
  - Failure

- New Style… Proactive… no failure philosophy
  - Pipeline Management System
  - Pipeline Integrity Review
  - Plan
  - No Failure
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 that the current regulatory regime.

- **UK Pipelines Safety Regulations:**
  - Goal-setting, not prescriptive
  - 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

- 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, pigging systems).
# Pipeline Integrity Review - Execution plan

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
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</thead>
</table>
| 1. PIR Objective, Scope and Overview of Programme. | i. Descriptions, and  
ii. Timetable  
i. Office Set Up (if needed),  
ii. Mobilisation of Review Teams,  
iii. Kick-Off Meetings/Documentation Review,  
iv. Data Gathering and Analysis by Discipline (Item 4),  
v. Integrity and Risk Review (Item 5),  
vi. Reporting, with Corrective Actions. |
| 2. Overview of Activities | i. Office Set Up (if needed),  
ii. Mobilisation of Review Teams,  
iii. Kick-Off Meetings/Documentation Review,  
iv. Data Gathering and Analysis by Discipline (Item 4),  
v. Integrity and Risk Review (Item 5),  
vi. Reporting, with Corrective Actions. |
| 3. Activity Schedule | i. Pre-Data Gathering Reviews,  
ii. Data Analysis & Report Preparation,  
iii. Review Report Submission,  
iv. Clarification Meetings on Draft Review Report,  
| 4. Scope of Data Gathering Activities by Discipline (many disciplines may be needed during the review) | i. Process,  
ii. Mechanical,  
iii. Electrical,  
iv. Instrumentation/Control,  
v. Risk and Integrity (Item 5),  
vii. Cathodic Protection,  
viii. Safety and Environment. |
| 5. Pipeline Fitness for Purpose and Risk Review | i. See Section 4.3.4. |
| 6. Additional Information Required from Integrity | i. CVs of Key Personnel,  
ii. Organigram,  
iii. HSE Plan,  
iv. HSE Plan,  
v. HSE Plan,  
vi. HSE Plan. |
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.

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.

If you need my advice if you need to find more!
Risk Assessments

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

- Internal Corrosion
- External Corrosion
- Fatigue
- Stress Corrosion Cracking
- Mechanical Damage
- Loss of Ground Support
- Third Party Intervention

- Probability of Failure

- Relative Risk

- Consequences of Failure

- Risk to Life
- Damage to Property
- Loss of Service
- Cost of Failure
- Environmental Effects

PRIORITY RATING
Results of a risk assessment

Results from part of a Qualitative Risk Assessment

Main Pipe Sections - Current Operating Pressure

- Section 1
- Section 2
- Section 3
- Section 4
- Section 5
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
- Pipeline management system

= Integrity management
Management System - Generic

- Policy
- Organising
- Planning and Implementing
- Measuring Performance

Policy development
Organisational development
Developing techniques of planning, measuring and reviewing
Pipeline Integrity/Risk Management System

- Integrity or Risk Management
  - Organising
  - Planning and Implementing
  - Measuring Performance
  - Auditing

Policy development
Organisational development
Developing techniques of planning, measuring and reviewing
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

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

Einstein 1879-1955
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 luke warm defenders in those who should be its zealous and active enemies.’

Machiavelli 1469-1527
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 cut 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 you Contract/Finance Department select pipeline contracts or services. Why not?

- A trained monkey can select the smallest of three objects
- An engineer can select the safest and best
- I have advice against selecting the lowest bid from Ruskin, 1819-90:

  ‘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 (not.)

‘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’ selected or required

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 diligence; 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.’
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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.

QUANTIZED 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!

We are in a litigious society today… we are outnumbered… Don’t get it wrong!!!!!

This is USA data… there are more engineers in USA now than scientists and engineers combined....
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

The lecture, and associated paper, was presented at:


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.

He 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 from Executives to Administration.

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

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