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Ageing Pipelines

BPA

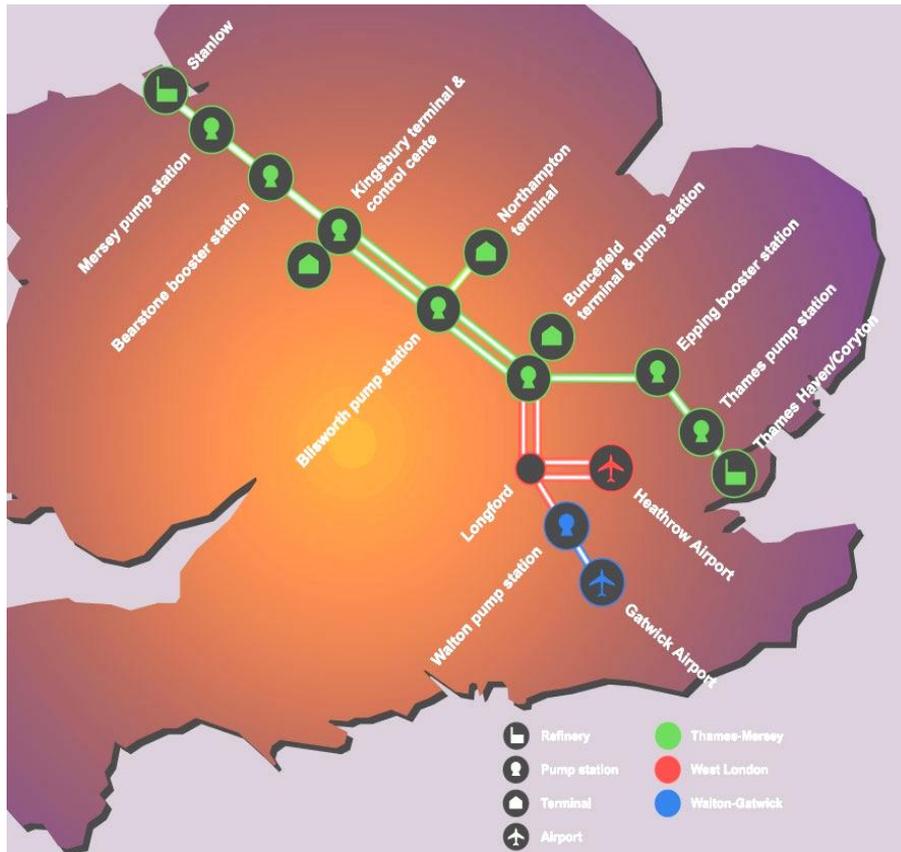
Richard Price

UKOPA/13/016

Ageing Pipelines - Contents

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- What is Ageing?
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- Examples of BPA works
 - Corrosion Management
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BPA Operated Network



- UKOP System (1968/82)
- WLPS System (1968)
- WGPC System (1982)
- BNW Pipeline (1968)
- Bacton-Great Yarmouth Pipeline (2002)
- LAP System (1953)
- BHP
- Shell OOS

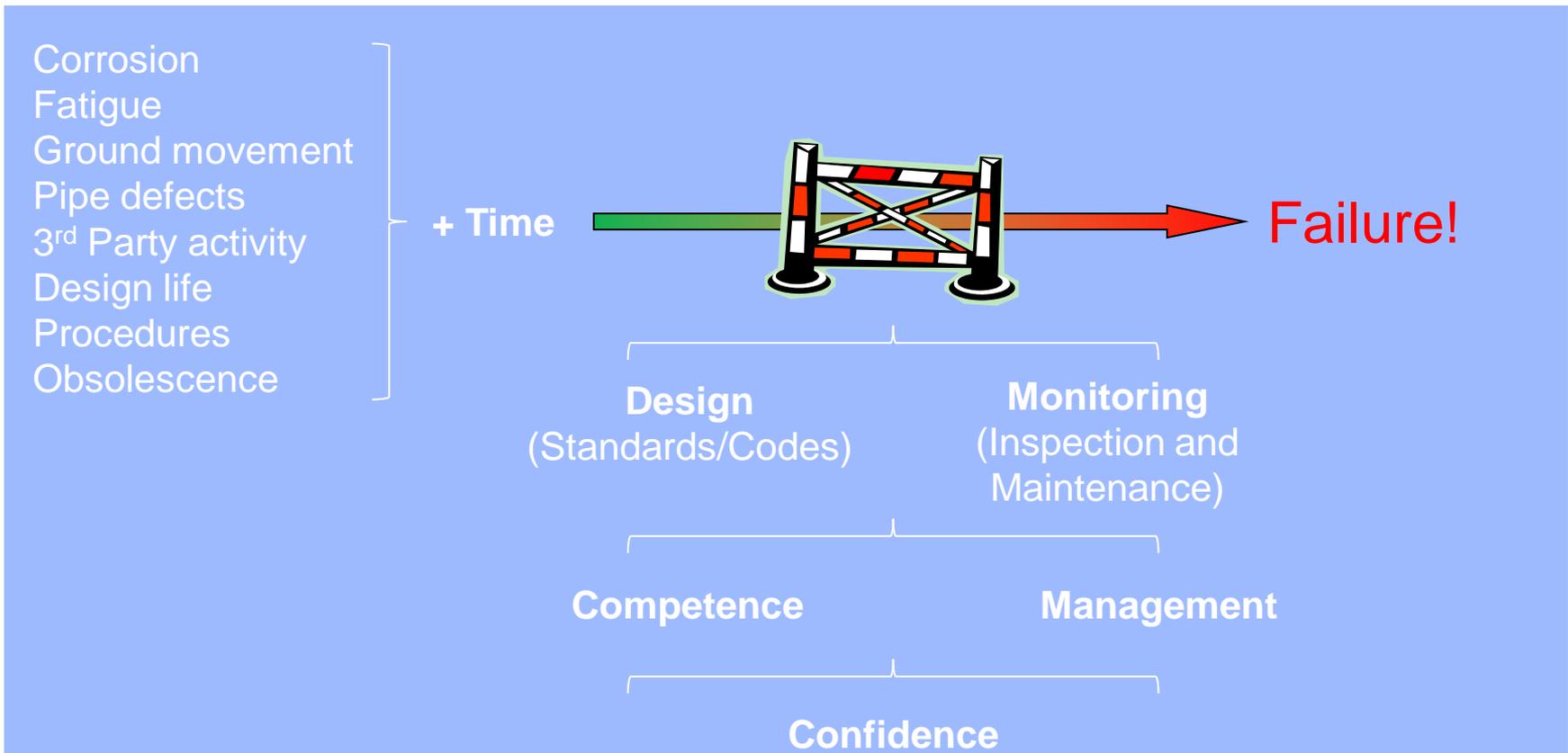
What is Ageing?

- Many of BPA's pipelines could be defined as old, the majority have been in service for almost 45 years.
- However ageing is not just time dependant, HSE RR509 – Ageing Plant, works around the theme:

“Ageing is not about how old your equipment is; it's about what you know about its condition and how that's changing over time”.

- Ageing is about the threats to the integrity of your pipeline or assets, managing asset ageing is about monitoring the condition of the asset against it design or operational requirements.

Ageing Pipelines - Factors



Pipeline Ageing – Assessment of Risks

- As with all risks there is a need to need to perform risk assessments
- Initial qualitative risk assessments using standard risk criteria
- Assessments map ageing mechanisms to failure effects and controls
- Recent qualitative risk assessments using UKOPA failure data
- Identified risks and details control measures against those risks

Plant Item Description	Function	Major Side Containment	Ageing Mechanisms	Failure Mode	Probabil	Safety Consequence	Safety Risk	Operations Consequence	Operations Risk Score	Risk Control/Mitigation Measures (Reference: IMAE 1 & 2)	Reference Measure (M)	
Motor Pump	Process Feedwater pump operation	Mechanical	Vibration	Crack or product leakage	M	LT, HRODOP, LT2	Permanently High	+	1+ 1 Step	CP, PM	Visual & audible detection, the motor pack, activation of the alarm, stop the pump and isolate the motor. Increase the number of pumps and testing the amount of liquid in the motor. Increase the amount of liquid in the motor. Increase the amount of liquid in the motor.	1001/300
			Misalignment	Cracking of seal and leakage	H	High Risk	+	1+ 2 Step	CP, PM	Visual & audible detection, the motor pack, activation of the alarm, stop the pump and isolate the motor. Increase the number of pumps and testing the amount of liquid in the motor. Increase the amount of liquid in the motor. Increase the amount of liquid in the motor.	1001/300	
Pump Comp			Fatigue	Vibration Fatigue	L	LT, HRODOP, LT2	Permanently High	+	1+ 2 Step	CP, PM	Visual & audible detection, the motor pack, activation of the alarm, stop the pump and isolate the motor. Increase the number of pumps and testing the amount of liquid in the motor. Increase the amount of liquid in the motor. Increase the amount of liquid in the motor.	1001/300
			Fatigue	Pressure Fatigue	L	LT, HRODOP, LT2	Permanently High	+	1+ 2 Step	CP, PM	Visual & audible detection, the motor pack, activation of the alarm, stop the pump and isolate the motor. Increase the number of pumps and testing the amount of liquid in the motor. Increase the amount of liquid in the motor. Increase the amount of liquid in the motor.	1001/300
			Corrosion	Corrosion of components and leakage of product	L	LT, HRODOP, LT2	Permanently High	+	1+ 2 Step	CP, PM	Visual & audible detection, the motor pack, activation of the alarm, stop the pump and isolate the motor. Increase the number of pumps and testing the amount of liquid in the motor. Increase the amount of liquid in the motor. Increase the amount of liquid in the motor.	1001/300

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Uttoxeter Leg 6"

PIE Predictive model for Pipe Failure Rates

Failure Mode	Small Pipe	Large Pipe	Subtotal
Mechanical	0.017	0.009	0.022
Corrosion	0.072	0.036	0.088

PIE 8016 Failure Rates for Mechanical, Corrosion, Natural

Failure Mode	Small Pipe	Large Pipe	Subtotal
Mechanical	0.009	0.004	0.002
Corrosion	0.000	0.000	0.000
Natural	0.000	0.000	0.000

Subtotal

Failure Mode	Small Pipe	Large Pipe	Subtotal
Mechanical	0.032	0.016	0.000
Corrosion	0.008	0.004	0.000
Natural	0.000	0.000	0.000
Pipe Fatigue	0.017	0.009	0.000
Total	0.057	0.029	0.100

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are shown below for the pipelines.

Pipeline Ageing – Corrosion Management

Design:

- Pipeline wrapped to help reduce risks from corrosion
- Coal-tar enamel on older pipelines, FBE on newer sections
- CP system installed

Monitoring:

- 7r programme for pipeline OLI
- CP routine monitoring and specialised survey programme (to meet requirements BS7631)
- Programmes provide data on condition

Pipeline Ageing – Corrosion Management

- Annual programme of CP monitoring at all pipelines TP's
- Improvements to monitoring by installation of Abriox remote monitors
- Increased data helps to build confidence in the condition of the pipeline
- 5yr programme of CIPS and follow-up DCVG
- Dependant on having competent people to interpret data and provide good conclusions



Pipeline Ageing – Corrosion Management

- Results of corrosion monitoring programmes have turned into several actions
- Re-wrap large sections of pipeline
- Re-alignment of a shorted metal sleeve at a road crossing
- Further investigation digs on abnormal results
- Installation of new ‘hot-spot’ TR units to help improve CP levels on certain sections of pipeline

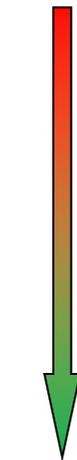


Ground movement + Corrosion

Ageing Pipelines – Modifications

- BPA are running several major pipeline programmes to remove equipment and ageing related risks.
- Improving the design increasing confidence in the condition of the equipment
- Major programmes:
 - Stopple removal
 - Pipebridges underground
 - CCV Replacement

Confidence



Risk

Ageing Pipelines – Stopple Removal

- Removing stopples to tackle several ageing mechanisms
 - Fatigue
 - Design life (elastomer seals)
 - Reduce inspection activities
- 2012 removed 12 stopples
- 2013 plan to remove 22 stopples
- Further removals planned for following years



Fatigue, Design life
& Reduction in inspection

Stopple Project – October 2012

Ageing Pipelines – Pipe bridges Underground

- Removing pipe bridges to tackle several ageing mechanisms
 - 3rd party activity (vandalism, boat or vehicle damage – the pipe is exposed!)
 - Corrosion
 - Reduce inspection activities
- 2 pipe bridges to be routed underground in 2013
- Further removals planned for following years



3rd Party Activity + Corrosion

Pipe-bridge – Planned 2013

Ageing Pipelines – CCV Replacement

- Replacing buried CCV's to tackle several ageing mechanisms
 - Design life (elastomer seals on seats and stems)
 - 3rd party activity (vandalism)
 - Improve ease inspection activities
- Automation to reduce consequence
- Relocation of certain valves to reduce consequence, based on risk assessments
- 9 CCV's planned for replacement in 2014 across pipelines
- Further replacements planned for following years



Design life + Fatigue (seals)

A38 CCV – Planned 2013

Ageing Assets on AGI's – BPA Activity

- Before 2010 BPA had identified both process safety and operations critical equipment
- HSE self-assessment questions on ageing plant completed, this highlighted...
- List did not relate equipment to ageing mechanisms – HSE intervention programme on Ageing Plant
- Process required to link credible ageing mechanisms and their affects to the assets that we operate on our AGI's
- Decided on a Failure Modes, Effects and Criticality Analysis (FMECA) as this enabled the relation of ageing mechanisms to effects and the level of criticality.



Ageing Assets on AGI's – BPA Activity

FMECA

- Generic level assessment
 - Major assemblies
 - Key components
 - Credible ageing mechanisms
 - Failure mode(s) for mechanism
 - Assessment of HSE risk
 - Assessment of operational risk
 - Risk control and mitigation measures
-
- Assessment of risks done using a BPA standard risk matrix, so level of risk can be related easily across the business

Plant Item Description	Function	Major Sub-Component	Ageing Mechanisms	Failure Mode	Probabih	Safety Consequence	Safety Risk Score	Operations Consequence	Operations Risk Score	Risk Control/Mitigation Measures	Referenced Maintenance Procedures (MAN-T-BI & O&M)				
Mainline Pump	Produce Pressure for boiler operation	Mechanical Seal	Vibration	Leakage of product between dynamic sealing faces	M	L1, R1000R, Not	Permanent Hazy	1	1	1	1	D, F, PM Seals will be replaced by the maintenance ops. on arrival of the alarm ring the pump out and remove the seal and change valves and fitting the amount of product creditable cap. Leak pot alarm undergo regular testing of alarm and shutdown.	MSY 302 E2M, permit of tasks		
			Misalignment	Cracking of seal faces and leakage	H	High Hazy	1	1	1	1	D, F, PM Seals will be replaced by the maintenance ops. on arrival of the alarm ring the pump out and remove the seal and change valves and fitting the amount of product creditable cap. Leak pot alarm undergo regular testing of alarm and shutdown.	MSY 302 E2M, permit of tasks			
		Pump Casing	Fatigue	Vibration fatigue caused by rotor casing	L	L1, R1000R, Not	Permanent Hazy	1	1	1	1	D Use NPS, testing of risk and subject to high frequency testing, manual intervention to demonstrate strength.			
			Fatigue	Pressure loading and/or rotor casing of casing	L	L1, R1000R, Not	Permanent Hazy	1	1	1	1	D Use NPS, testing of risk and subject to high frequency testing, manual intervention to demonstrate strength.			
		Corrosion	Corrosion of casing component and leakage of product	L	L1, R1000R, Not	Permanent Hazy	1	1	1	1	D, F, PM Use NPS, testing of risk and subject to process control specifications to prevent corrosion. If equipment are also subject to regular inspection.	MSY 402			
AGI area	Leak and AGI area	Manufacturing Defects	Fatigue	Thermal fatigue from weather exposure, cracks concrete	M	L1, R1000R, Not	Permanent Hazy	1	1	1	1	D, F, PM Design of new bonds by operators to industry standards. Bond Inspection Programme	MSY 406		
			Manufacturing Defects	Poor condition of concrete from exposure defects	L	L1, R1000R, Not	Permanent Hazy	1	1	1	1	1	D, F, PM Design of new bonds by operators to industry standards. Bond Inspection Programme	MSY 406	
			Escalation	Weather erosion due to mechanical damage to slab leading to cracking	M	L1, R1000R, Not	Permanent Hazy	1	1	1	1	1	1	D, F, PM Design of new bonds by operators to industry standards. Bond Inspection Programme	MSY 406
		Bond Foot Slabs	Ground movement	Ground movement around slabs causing them to move and crack	M	L1, R1000R, Not	Permanent Hazy	1	1	1	1	1	1	D, F, PM Design of new bonds by operators to industry standards. Bond Inspection Programme	MSY 406
			Fatigue	Thermal expansion weather exposure, cracks concrete	M	L1, R1000R, Not	Permanent Hazy	1	1	1	1	1	1	D, F, PM Design of new bonds by operators to industry standards. Bond Inspection Programme	MSY 406
		Manufacturing	Poor condition of	L	L1, R1000R, Not	Permanent Hazy	1	1	1	1	1	D, F, PM Design of new bonds by operators to industry standards. Bond Inspection Programme	MSY 406		

Ageing Pipelines - Summary

- Ageing is not just about the number of years on the clock – it's about how condition changes over time.
- Sleeve example - Ageing mechanisms can interact so you may need more than one condition monitoring programme to detect changes in condition e.g. OLI and CP
- Stopples, CCV's and Pipebridges – sometimes it is necessary to improve the design to help raise confidence in the condition of the pipeline
- FMECA used to provide assessment of ageing mechanisms for AGI equipment
- Confidence is very important – each barrier is not fool proof, you need to understand the limitation and bring in other barriers to bring confidence that the ageing mechanism is controlled
- You need to measure your performance in the key areas so you are confident the barriers are working!

Ageing Pipelines

- Questions?