ISE Document

TECHNICAL POLICY

In-Line Inspection

Transmission Pressure Pipelines

Owner		M Fothergill		Next Review Date **Feb 2020**	
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APA Group

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1 INTRODUCTION

This document is applicable to all transmission pressure steel pipelines operated by Transmission and Network personnel.

All work performed in accordance with this document shall comply with the all relevant Acts, Regulations, Standards, and Codes of Practice of all authorities having jurisdiction over the work.

When conflict exists between the various applicable documents, the following order shall apply, in decreasing order of precedence. Where APA requirements are more stringent, they shall take precedence.

- Acts of law or other legislation
- Government licenses and permits
- APA Standards
- Local standards

Any identified discrepancies shall be reported to the document owner for remedy.

If you are reading a hard copy of this document, please consider it uncontrolled.

1.1 Purpose and Scope

This policy is to provide standard criteria for determining the selection of appropriate inspection tools and inspection intervals using intelligent pigging inspection technology for every piggable pipeline with a nominal diameter greater than 100mm. either owned or operated by APA.

1.2 Definitions

The definitions used in this document are listed in Table 1;

Table 1 Definitions

Item	Definition
Transmission Pressure	Pipelines operating under AS2885.3 at >20% SMYS

1.3 Abbreviations

The abbreviations used in this document are listed in Table 2; when the table is more than one page it should be included as an Appendix.

Table 2 Abbreviations

Item	Definition
ILI	Inline Inspection also known as Intelligent Pigging

1.4 References

All work performed in accordance with this Document Type shall be in conformance with the current issue, including amendments, of those national and international standards, codes of practice, guidelines and APA documents listed in Table 3; When the table is more than one page it should be included as an Appendix.

Table 3 Referenced Documents

Referenced Document	
AS2885.3	Pipelines – Gas and Liquid Petroleum Part 3: Operation and Maintenance

1.5 Superseded Documents

This Document Type replaces the previously used document listed in Table 4

Table 4 Superseded Documents

Superseded Document	
Nil	

2 COVERAGE / SCOPE

This policy applies to all piggable hydrocarbon pipelines that fall within the scope of Australian Standard AS 2885.3 – 2012 Pipelines-Gas and liquid petroleum Part 3: Operations and maintenance.

This policy covers intelligent in line inspection (ILI) technologies including:

- Magnetic Flux Leakage (MFL)
- Geometry (Calliper Logging)
- XYZ
- EMAT
- Ultrasonic Crack Detection

This policy addresses criteria that can determine the frequency of initial and subsequent inspection runs including:

- Defect growth rate
- Regulated maximum interval
- Special integrity concerns
- Initial survey requirements
- Special considerations for High Consequence Areas (HCA)

Scope does not cover pipelines with third party ownership or licensee for these pipelines APA Group must comply with contractual arrangements. All recommendations to a third party licensee to perform an intelligent pig run shall be in accordance with this policy.

NOTES:
For non-piggable lines and lines where flow rates or operating pressures prevent effective ILI inspections approved alternate methods of determining structural integrity must be implemented. Alternate methods may include application of direct assessment methodology.

3 VALUES & COMMITMENTS

The policy promotes the safe and reliable delivery of energy in a safe environment.

This policy directs the determination of appropriate tools and inspection intervals for intelligent pigging, which is an important identifier of pipeline condition and a leading consideration in the review of pipeline structural integrity.

Dialogue should be maintained with all technical regulators to promote the deregulation of pigging frequencies in favour of a risk based approach.

Where APA Group begin operation of an existing pipeline due consideration of the pipeline's operational history must be applied.

4 POLICY

An engineering assessment addressing all of the criteria in this policy must be carried out in planning for all pipeline in line inspection (ILI) survey programs. The assessment shall determine:

- The appropriate ILI tools to be utilised.
- The appropriate initial inspection timing.
- The appropriate re-inspection interval.

The engineering assessment shall adopt a risk based methodology to determine if the normal initial inspection and re-inspection frequencies given in Section 4.1 are appropriate. If the calculated interval from the engineering assessment is less than that nominated in Section 4.1 the calculated interval must be adopted. Intervals longer than those nominated in Section 4.1 of this policy may be approved by the relevant Infrastructure Strategy & Engineering Manager.

Initial inspection requirements and timing for new assets shall be determined within 12 months of commissioning or of when the asset is acquired by APA and reviewed within 5 years or when new integrity threats are identified. All pipelines 6" and greater will be designed to be inspected by ILI where reasonably practical. Due to the inherent risks associated with ILI in smaller diameter pipelines these will generally not be inspected by ILI, however 'shorter length' sections with no internal weld beads or other similar obstructions may be considered on a case by case basis. Pigs will not be inserted into small diameter lines without risk assessment and approval by the relevant General Manager.

Re-inspection intervals shall be determined as soon as practicable after validation of initial or previous inspection runs and reviewed within 5 years or when changes that affect assumptions used in determining intervals are identified.

Every engineering assessment shall be approved by the relevant Integrity Manager/Engineer.

The Pipeline Integrity Management Plan will be maintained with the determined date and if necessary resigned by the Approver, detailed in the AS2885.3 Approvals Matrix 320-MX-AM-0001.

4.1 Selection and Timing of In Line Inspection Tools

4.1.1 Magnetic Flux Leakage – Axial Field

Regular inspection with traditional MFL tools with axial field direction is a minimum requirement under this policy for all pipelines. The normal time interval between commissioning and the first MFL and between subsequent MFL surveys is 10 years unless the engineering assessment determines otherwise.

4.1.2 Magnetic Flux Leakage – Circumferential Field

These MFL tools are specifically designed to detect long, narrow axially orientated metal loss defects. They may under some circumstances detect open axially aligned crack like defects and lack of fusion in seam welds. As resolution and detection capabilities of available tools currently do not meet those of high resolution traditional tools use of circumferential field tools in lieu of traditional (Axial field) MFL tools is not recommended under this policy however they may be utilised in addition to axial field tools to address specific integrity concerns or assist in discrimination of EMAT ILI crack indications.

4.1.3 Axial Field: Tri-Axial Sensors - Magnetic Flux Leakage

Tri-Axial MFL tools have been developed to provide higher resolution than traditional MFL tools and also enhance detection of long, narrow axially orientated metal loss defects.

Tri-Axial MFL tools are recommended in lieu of traditional MFL tools in high consequence areas and where extensive areas of corrosion are anticipated.

Where Tri-Axial MFL tools are utilised the normal time interval between commissioning and the first MFL and between subsequent MFL surveys is 10 years unless the engineering assessment determines otherwise.

4.1.4 Geometry (Calliper Logging) Tools

Regular inspection with intelligent geometry tools is a minimum requirement under this policy for all pipelines unless the engineering assessment determines dents are not a threat to integrity. Initial geometry surveys shall be conducted during commissioning or within 10 years of commissioning. The nominal interval between subsequent surveys is 20 years unless the engineering assessment determines otherwise.

Note: Engineering assessments determining geometry inspection intervals are to be reviewed where:

- Ground movement is reported or suspected.
- MFL inspections report excessive numbers of or previously unreported dents.
- Gauge plates detect increased levels of deformation over previous geometry or gauge pigs.

4.1.5 XYZ Surveys

An initial inspection with a XYZ tool is a minimum requirement under this policy for all pipelines unless the resolution of the 'as built' construction survey is sufficient for effective integrity management and location of defects detected by ILI. Initial XYZ surveys shall be conducted during commissioning or in conjunction with the next scheduled MFL inspection. Subsequent surveys are not required unless the engineering assessment determines otherwise.

Note: Engineering assessments determining XYZ inspection intervals are to be reviewed where ground movement is reported or suspected

4.1.6 EMAT Surveys

EMAT tools are specifically designed to detect axial cracking and are recommended for use in gas and liquid hydrocarbon pipelines where significant axial environmental cracking (Category II, III or IV determined using a safety factor of 1.39)[1] or longitudinal seam weld cracking has been detected by direct assessment methods. Initial inspections are to be completed as soon as practicable after detection of the significant cracking with subsequent re-inspection intervals to be determined by engineering assessment.

[1] Table 4.1: CEPA Stress Corrosion Cracking Recommended Practices, 2nd Edition, December 2007

4.1.7 Ultrasonic Crack Detection

Ultrasonic crack detection tools are specifically designed to detect axial cracking and are recommended for use in liquid hydrocarbon pipelines where significant axial environmental cracking or longitudinal seam weld cracking has been detected by direct assessment methods. Initial inspections are to be completed as soon as practicable after detection of the cracking with subsequent re-inspection intervals to be determined by engineering assessment.

Ultrasonic crack detection tools are not to be utilised in gas pipelines unless viable EMAT tools are unavailable and approval is obtained from the General Manager Infrastructure Strategy and Engineering.

4.1.8 Other Technologies

Other types of ILI tools currently on the market or under development are not recommended for integrity management of APA pipelines. APA will continue to encourage and monitor developments in ILI technology and review their applicability as a nationally co-ordinated activity. APA will endeavour wherever practicable to assist ILI vendors in development of new and existing technologies by providing access to pipelines for trial runs.

4.1.9 Vendor Selection

APA Group will maintain an agreement nationally with one or more ILI providers for the supply of tools and equipment. Use of any other vendors tools shall be approved by General Manager Infrastructure Strategy and Engineering.

Vendor ILI tool specifications shall be provided in accordance with the latest version of the Pipeline Operators Forum 'Specifications and requirements for intelligent pig inspection of pipelines' for the purposes of evaluating the suitability of tools for managing the integrity of APA pipelines.

In selecting vendors the specified probability of detection (POD) and probability of identification (POI) of features of concern shall be key criteria.

For pipelines with large numbers of detectable features higher resolution tools are recommended over lower resolution tools to minimise life cycle costs by reducing unnecessary repairs and potentially allowing longer re-inspection intervals.

4.2 Engineering Assessment Criteria

4.2.1 Defect Growth Rate

For time dependant corrosion growth (environmental cracking, internal and external corrosion) the pipeline is to be re-inspected no later than when:

1. The largest remaining unrepaired feature at the calculated average growth rate reaches the maximum size permitted for the "Safe" curve. or;
2. The largest remaining unrepaired feature at the calculated maximum growth rate has a failure pressure reaching the MAOP/MOP curve.

Supporting data to be utilised in determining growth rates may include:

- Internal or external growth rate determined from initial or multiple previous ILI inspections of the pipeline after validation of results.
- External growth rates determined from validated ILI inspections of pipelines with equivalent coating and cathodic protection levels operating in similar soil types and temperatures.
- Internal growth rates determined from validated ILI inspections of pipelines with equivalent gas or product composition.

Where specific corrosion information is known it will be utilised for corrosion growth assessment. Where information initial ILI inspection shall identify external corrosion development and the rate shall be deemed to be double the rate determined by calculating between construction and the ILI run date. This reflects an assumption that corrosion didn't actually commence at commissioning. For internal corrosion growth rates the period will be assumed to commence at commissioning and the rate will calculated directly from the ILI run data.

In the **absence of supporting growth data** minimum depth growth rates to be used in assessments are:

- Internal Corrosion – to be determined by engineering assessment based on gas composition.
- External Corrosion – 0.4 mm per year[2]
- Stress Corrosion Cracking – 0.6 mm per year

For features subject to fatigue failure, including dents and manufacturing/weld defects inspection intervals shall be 50% of calculated pressure cycles to failure.

Methodologies used for calculation of corrosion growth rate and fatigue failure must be approved by the National Integrity Management Engineer.

4.2.2 Regulated Maximum Pigging Interval

In some states there is a maximum interval between inspections dictated by Pipeline Regulation for particular pipelines. Where applicable, the timing between pigging shall be complied with, unless dispensation is granted by the regulator.

4.2.3 Special Integrity Concerns

Events that shall trigger a review of ILI tool use and frequency are:

- MAOP upgrades
- Remaining life review or design life extension.
- Class location changes.
- Natural events including earthquakes, major floods and landslips.
- Land subsidence, identification of acid sulphate soils or any other significant environmental change.
- Pipeline failure or failure of a similar pipeline, due to an undetected or unexpected defect.
- Detection of corrosion or cracking where growth rate exceeds rate used for calculation of inspection interval in accordance with 4.2.1.

[2] NACE SP 0502-2008

- Coupon corrosion rates exceeding the rate used for calculation of inspection interval in accordance with 4.2.1.
- Detection of significant SCC or other environmental cracking.
- Detection of seam weld cracking or lack of fusion/penetration of seam welds.
- Detection of narrow axial corrosion or selective corrosion at seam welds.
- Deterioration of cathodic protection levels or unexpected levels of coating deterioration
- Detection of steady state AC in excess of current acceptable levels.
- Changes in gas quality specification.
- Hydrostatic test failure during commissioning.

4.2.4 Initial Survey Requirements

The structural integrity of new pipelines is confirmed by hydrostatic testing, gauge pigging and a post construction coating defect survey. There is no specific requirement to perform initial benchmark ILI surveys, unless required by regulation.

Shortly after construction XYZ and geometry ILI surveys should be consider to establish a pipeline data benchmark and to provide 'as built' construction surveys.

Where hydrostatic test failure of a defect type that is known to have a low fatigue life occurs benchmark ILI surveys capable of detecting similar sub critical defects shall where practicable be carried out within 12 months or prior to expiry of the defect liability period.

4.3 High Consequence Areas

For any pipeline that passes through a high consequence area[3] and with physical and operating parameters that allow a critical defect to result in rupture as determined by AS2885.1, the approved engineering assessment must apply a 1.25 factor to any calculated time dependant growth rates used when establishing re-inspection intervals and 1.39 when calculating repair requirements.

Unless specifically determined otherwise the normal ILI requirements for pipelines passing through high consequence areas are:

- Tri-Axial MFL or combined axial and circumferential MFL inspections and;
- Geometry (Calliper logging) inspections (in conjunction with each MFL inspection).

Where practicable EMAT or dedicated circumferential field MFL inspections shall be carried out in pipelines in high consequence areas with:

- Unknown seam weld quality, or
- Very low seam weld toughness, or
- Historical seam weld or lamination hydro test failure, or
- Lack of fusion identified in seam welds during direct assessment programs.

EMAT inspections shall be carried out where practicable for pipelines in high consequence areas with:

- Known susceptibility to SCC.
- Hook cracks identified in seam welds.

[3] As defined in AS2885.1

New pipelines in high consequence areas shall be designed to be piggable. Existing un-piggable pipelines in high consequence areas shall wherever practicable be modified to accommodate in line inspections.

Note: Rupture of pipelines has occurred below 30% SMYS in pipelines with seam weld defects and combined dent/gouges. [4]

5 DOCUMENTATION AND REPORTING

The ILI inspection types and frequencies determined in accordance with this policy shall be documented in the Pipeline Integrity Management Plan (PIMP).

Approved defect growth rate and fatigue failure assessments carried out in accordance with this policy shall be documented and referenced in the PIMP.

Vendor ILI inspection reports shall be provided in a format that is compatible with the APA integrity data management tool (IDMT) and complies with the APA ILI data specification.

6 LINKS / INTERACTION WITH OTHER POLICIES

Key external standard documents that this policy has links to are:

- AS2885.3 – 2012 Pipelines-Gas and liquid petroleum Part 3: Operations and Maintenance.
- Pipeline Acts and Regulations.
- Pipeline Licences.

Related APA policies include:

- APA Asset Management Policy
- APA Pipeline Integrity Management Policy

Other related national APA documents include:

- APA Pipeline Management System
- National ILI pigging contract
- APA ILI Data Specification (Under development – to include data format standards, interaction rules, failure pressure calculation methodologies)
- APA Pigging Expert Guide (Under Development – to include risk management of pigging activities)
- APA Defect Assessment Guide (Under Development – to include assessment of ILI data sets, growth models, field assessment, defect acceptance criteria, and ILI validation guidelines)
- APA SCC Expert Guide (Under Development – SCC management practices for pipelines)
- APA Integrity Management of Un-piggable Pipelines Expert Guide (Under Development – to include direct and indirect assessment methodologies).

[4] Michael Rosenfield and Robert Fasset, 'Study of pipelines that ruptured while operating at a hoop stress below 30% SMYS', Pipeline Pigging and Integrity Management Conference, Houston, USA. February 2013.

7 PROCEDURES

Procedures, including those required by legislation will be developed for each application in accordance with the Pipeline Management System.