UKOPA

United Kingdom Onshore Pipeline Operators' Association

Good Practice Guide

Verification of Features Identified by In Line Inspection

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The guidance in this document identifies what is considered by UKOPA to represent current UK pipeline industry good practice within the defined scope of the document. All requirements should be considered guidance and should not be considered obligatory against the judgement of the Pipeline Owner/Operator. Where new and better techniques are developed and proved, they should be adopted without waiting for modifications to the guidance in this document.

Comments, questions and enquiries about this publication should be directed to:

UK Onshore Pipeline Operators' Association
Pipeline Maintenance Centre
Ripley Road
Ambergate
Derbyshire
DE56 2FZ

E-mail: enquiries@ukopa.co.uk

Website: www.UKOPA.co.uk

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CONTENTS

1. EXECUTIVE SUMMARY

This UKOPA good practice guide (GPG) has been developed by the UKOPA Pipeline Integrity Working Group to provide guidance on the verification of features identified by in line inspection (ILI). The guidance within the document is applicable to all buried pipelines operated by the UKOPA member companies.

In line inspection represents good practice in inspection of pipelines. The UKOPA GPG on In Line Inspection provides guidance for pipeline operators. GPG 21 states that it is important that reported features are verified in the field, in order to confirm the accuracy and reliability of the inspection data, which determines future actions for the management of pipeline integrity. Feedback of the field inspection results to the ILI service provider also helps the ILI service provider to continuously improve the validity and accuracy of the data analysis. Verification of ILI feature identification is essential in confirming the accuracy and reliability of inspection data, and therefore in establishing future actions for the management of pipeline integrity.

This document provides guidance on the selection and prioritisation of features identified by ILI for verification through field investigation. The document also provides guidance on the requirements for the field investigation procedure.

2. OBJECTIVES

The objectives of this good practice guide (GPG) are to provide guidance to pipeline operators on a consistent approach for the minimum requirements for the confirmation and prioritisation of features identified by ILI for field investigation, in order to provide verification of the accuracy of the ILI tools used for pipeline inspection.

This document supports the UKOPA GPG 21 on the in line inspection of pipelines.

3. INTRODUCTION

3.1 Background

Pipelines are long life assets, and their safe operation is controlled by legislation, which requires integrity assessments to confirm fitness for operation. An important aspect of pipeline integrity management is in line inspection. UKOPA good practice for ILI is given in GPG 21. GPG 21 states that it is important that reported features are verified through field investigation in order to confirm the accuracy and reliability of the inspection data, which determines future actions for the management of pipeline integrity. Feedback of the field inspection results to the ILI service provider also helps the ILI service provider to continuously improve the validity and accuracy of the data analysis. Verification of ILI feature identification is essential in confirming the accuracy of inspection data in relation to feature sizing and feature location, and therefore in establishing future actions for the management of pipeline integrity.

3.2 Application

The guidance in this document is applicable to all buried pipelines operated by the UKOPA member companies, which are able to be inspected using conventional flow-driven ILI tools. These pipelines can be categorised as:

- Above 7 barg natural gas pipelines.
- Petrochemical liquids and gas pipelines.
- Oil and refined liquid pipelines.

The guidance is generally applicable to the above pipelines, however, where appropriate, the principles of the document can be equally applied to other pipelines.

Within this document:

Shall: indicates a mandatory requirement.

Should: indicates good practice and is the preferred option.

4. SELECTION OF FEATURES IDENTIFIED BY ILI FOR VERIFICATION

The accuracy of ILI is influenced by various factors. ILI vendors calibrate the accuracy of inspection tools through pull through tests to validate the tool specifications provided to operators. Most ILI vendors will provide support for field verification activities, in order to ensure the ILI tool has performed to specification, and to obtain good quality field data to help verify the tool performance specifications for a range of feature types. In this respect., ILI vendors use field verification data to supplement pull through tests to validate tool accuracy.

Operator verification of the ILI accuracy through field investigation and inspection of a sample of detected features for comparison with the ILI results enables the accuracy of the feature sizing (depth, length and width) and location (external/internal, distance from referenced girth weld and reference points, GPS coordinates) to be established. It is of value in:

- Confirming the reported features can be used to assess the condition of the pipeline, so allowing any required actions to be identified and justified;
- Provides information on tool performance for use at locations where field verification is not possible.

The approach applied to identifying and selecting the features for field investigation depends upon the inspection history of the pipeline, the findings of any previous field investigations, the operator's requirements and the features detected by the ILI and can vary from the simple selection of the feature of maximum size to selection of features screened using fitness for purpose assessment. This GPG provides guidance for consideration by pipeline operators in selecting features for investigation and provides recommendations for the procedure for feature investigation.

4.1 ILI throughout the pipeline life

The typical approach to the ILI of pipelines throughout the pipeline life is:

1. Fingerprint inspection carried out soon after commissioning in order to record the as build feature signature of the pipeline. This is of particular importance in identifying the mill/material features present in the pipeline at the start of operation and construction damage, which have been subject to the pipeline hydrotest. The results of this inspection facilitate the identification of changes detected in subsequent inspections during the pipeline operating life.
2. First operating inspection carried out after a number of years defined by the pipeline operator. This inspection is of particular importance in establishing any time dependent failure mechanisms e.g. corrosion growth and enables the operator to establish the future inspection frequency, using either a deterministic (fixed interval) or risk based approach.
3. Subsequent operating inspections carried out at frequencies defined using a deterministic or risk based approach. The frequency of subsequent inspections should be informed by a comparison of sequential inspection results to determine the extent of active corrosion growth.
4. Inspection carried out to establish condition at a change in operating conditions (e.g. uprating or change of use), life extension or when bringing a decommissioned pipeline back into service.

4.2 Actions following ILI

The ILI report should be reviewed to identify the size, location and severity of identified features, which should be evaluated against acceptable limits.

Features may be selected for field investigation by the operator where:

I. The first ILI run identifies features which if investigated, would verify the accuracy of the inspection tool and assist in future integrity management actions, or

II. Comparison of the location and size of identified features with those identified in a previous ILI run using a verified tool indicates an increase in the number and size of identified features.

Where features identified in a first ILI run are deemed as not significant, or where those identified in repeat ILI runs are consistent with features identified in previous inspection runs, field investigation is unnecessary.

Features selected according to i) or ii) above may be prioritised for field investigation using the following approach:

1. Any feature that represents an immediate or short-term integrity threat at the ILI reported dimension; this involves consideration of the Estimated Repair Factor (ERF) which is discussed in section 4.3.

2. Features that cannot be accurately identified and accounted for from pipeline design or operational records.

3. Dents meeting the criteria in UKOPA GPG/06.

4. Any feature that represents an integrity threat within two ILI inspection intervals, based on the assessed degradation progress rate.

5. Consideration of and comparison with previous ILI results or investigations carried out by the operator.

6. Any other criteria identified by the operator.

Operator pipeline specific specifications for flaw size limits based on fitness for service should be applied where possible.

Typical limiting feature sizes for pipelines operating a maximum design factor of 0.72 that may be used to identify features for field verification are:

- General corrosion (including cluster features) of maximum depth > 20% nominal wall thickness (NWT).

- Pitting corrosion of maximum depth greater than 50% NWT.

- Dents of maximum depth > 7% pipeline outside diameter (OD).

- Dents associated with welds > 2% OD.

Note: UKOPA GPG/06 states that constrained dents must not be excavated except for repair.

Further guidance is given in Table 1.

The following actions should be considered:

- Check CIPS levels at any possible corrosion features to confirm the location is adequately protected by the CP system.
- Carry out a DCVG survey at any dents located on the top of pipeline (TOL) to confirm possible coating damage. If coating damage is confirmed:
  - Check the CIPS readings at the location to confirm the location is protected.
  - Carry out a site investigation and inspect and assess areas of damage.
  - Where associated gouging and/or cracking is identified carry out a permanent pipeline repair.
- Review historical ILI records to identify any changes in the reported feature description or dimensions.
- Review historical field investigation records, repair records and 1st, 2nd and 3rd party activity reports for any relevant information relating to the location of the feature.
- Pipeline dent features should be prioritised for investigation, inspection and repair in accordance with UKOPA GPG 06.
- If the pipeline is subject to cyclic pressure, a fatigue analysis should be carried out in accordance with UKOPA GPG 06.
- Carry out an active corrosion analysis involving the comparison of results with those from the previous inspection to estimate the corrosion growth rate.

4.3 Selection of features for investigation

The selection of features for field investigation following an ILI run for verification of the ILI results depends upon the Estimated Repair Factor (ERF) calculated by the inspection vendor and results of any previous investigations carried out by the pipeline operator.

The ERF is defined as:

$$ERF = MOP/P_{safe}$$

Where P_{safe} is the safe operating pressure calculated using an assessment method agreed between the ILI provider and the pipeline operator as part of the ILI contract.

Where ERF is the ratio of the pipeline design pressure to the 'safe maximum pressure' as determined by an analysis criterion. (e.g. ASME B31G, modified ASME B31G, RSTRENG, DNV-RP-F101, PDAM)

Features with calculated ERF values equal to or greater than 1.0 must be prioritised for investigation, and features with calculated ERF values less than 1.0 are then prioritised in decreasing importance with reducing ERF values.

Requirements that should be taken into account in selecting features detected by ILI to be investigated for verification of the ILI accuracy are summarised in Table 1.

Guidance note	Type of damage	Guidance	Action	
1	General corrosion	Includes clusters, See guidance note 3	D ≤ 20% NWT, monitor	D >20% NWT, Inspect, assess & repair as required
2	Pitting corrosion	See guidance note 3	D ≤ 50% NWT monitor	D >50% NWT, Inspect, assess & repair
3	Corrosion associated with weld	Corrosion associated with a seam or girth weld is coincident with welding defects, repair	As for general or pitting corrosion	
4	Crack	**Not acceptable**	Inspect & repair ASAP	
5	Kinked dent	**Not acceptable**	Inspect & repair ASAP	
6	Dent, TOL	If new feature, may be due to external interference, carry out DCVG	Assess and rank using UKOPA/GPG/06 Inspect, assess and plan to repair if required	
7	Dent, BOL	Do not excavate, monitor, carry out static and fatigue assessment assess as unconstrained	Assess and rank using UKOPA/GPG/06 **Excavate to repair only** (failure may occur when constraint is released)	
8	Dent associated with weld	Apply guidance notes 6 & 7 above. If pipeline is pressure cycled, carry out fatigue assessment. Assess weld quality in accordance with UKOPA/GPG/06	If weld is poor quality, repair. Otherwise, if D ≤ 2% monitor	D > 2% OD Inspect and repair if subject to fatigue
9	Dent associated with metal loss	Apply guidance notes 6 & 7 above. If feature is due to external interference, metal	Dent depth ≤6% OD and metal loss due to corrosion ≤ 20% NWT, monitor	Dent depth > 6% OD or metal loss due to corrosion > 20% NWT, inspect and repair

Table 1 Selection of ILI features for investigation (inspection and repair)

Note: The guidance on the size of features to be considered for field verification given in Table 1 applies to pipelines operating at a design factor of 0.72.

In the absence of any defects that are equal to or greater than limiting dimensions for fitness for service as applied by the operator, it may be advisable to excavate and inspect a sample of these smaller defects.

4.4 Recommendations for the procedure for field investigation of ILI features

The primary objective of ILI is to obtain data which enables the pipeline condition and integrity to be confirmed and/or revalidated. A key part of this process is verification of the ILI tool

performance and analysis of the recorded data through field investigation. It is essential that field investigations are carried out to a reliable level of quality and consistency.

Guidance on field verification procedures for in line inspection is published by the Pipeline Operators Forum (POF). This guidance states that field investigation is important in confirming the size of feature detected by the ILI tool, and confirming tool performance for use on other pipelines where field investigation is not possible. It is recommended that the POF guidance is considered when developing the procedure for field investigation, and as a minimum the following are included:

1. Arrange land access and agree work site and reinstatement criteria with the landowner or tenant.
2. Establish the exclusion zone for the feature investigation site[1].
3. Before commencing excavation, prevent pressure from exceeding the level at date of inspection, or apply pressure reduction if feature size exceeds limiting criteria.
4. Design trench stability and egress
5. Excavate damage location in accordance with relevant operator safe working procedure.
6. Monitor trench stability as required.
7. Restrict access within exclusion zone and into trench to appropriate personnel only.
8. Inspect and categorise feature. Note, where the feature is categorised as external interference damage, the time at which the damage occurred should be established.
9. If feature size exceeds limiting criteria, reduce pressure to a level which will reduce operating stress to a maximum of 30% SMYS and carry out repair.
10. Record all data in accordance with the UKOPA FR1 form and logged in the appropriate operator and UKOPA databases.
11. Ensure appropriate pressure restrictions are in place throughout work.
12. Assess need for permanent support of the pipeline on completion of work.
13. Reinstatement and full records of inspection activities and repair.

[1] The safe distance should be specified by the operator.

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