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GP 43-52

Inspection and Integrity Assessment of Pipeline Systems

Group Practice

**BP GROUP
ENGINEERING TECHNICAL PRACTICES**

Foreword

This issue of Engineering Technical Practice (ETP) GP 43-52 includes the following significant changes:

1. Wording has been modified to reflect the revalidation requirements of GP 43-49.
2. Requirements for baseline and subsequent inspections inspection have been clarified.
3. Guidance on process for establishing a re-inspection interval has been added.
4. A new Normative Annex (Annex B) *Assessment of ILI Reports* has been added.

Because revisions were so extensive, revisions have not been identified in the margin as is normal practice.

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Introduction

Pipeline systems provide a safe and efficient means of transporting a wide range of fluids, from water, oil, gas, and petroleum products, to chemicals. They are used in all parts of the BP Group and include upstream production flowlines, export pipelines, chemicals, and refined products pipelines.

This GP provides requirements to BP entities for the inspection, testing, assessment, and revalidation of pipelines.



1. Scope

- a. This GP provides requirements for inspection, assessment and periodic revalidation of pipelines as an integral component of a pipeline integrity management system (PIMS).
- b. This GP was written for use by the engineering authority (EA) and pipeline technical authority (PTA).
- c. The PIMS process requires that components of a pipeline system be inspected and assessed on a regular basis. It also requires a process of periodic revalidation.
- d. The primary focus of this GP is inspection, assessment, and revalidation of pipelines from pig trap to pig trap. As such, there are many components of pipeline systems that are not directly covered by this GP. Inspection of other pipeline system components, such as tanks, process piping, pressure vessels, rotating machinery, and protective devices, can be found in the GP 32 series and associated guidance notes.
- e. Inspection and assessment may be required as part of a due diligence process if assets are either acquired or transferred.

2. Normative references

The following referenced documents may, to the extent specified in subsequent clauses and normative annexes, be required for full compliance with this GP:

- For dated references, only the edition cited applies.
- For undated references, the latest edition (including any amendments) applies.

BP

GP 32-30	Inspection and Testing of Equipment in Service - Management Principles.
GP 43-17	Pipeline Risk Management.
GP 43-49	Pipeline Integrity Management Systems (PIMS).

3. Terms and definitions

For the purposes of this GP, the following terms and definitions apply:

Assessment

A formal process or evaluation to establish the condition of a pipeline using available data to verify that the pipeline is fit for continued operation.

Feature

An indication identified by inspection that may affect the integrity of the pipeline system.

Pipeline

As defined in GP 43-49, a pipe on land or offshore (including associated risers), together with all facilities for the conveyance of the pipeline contents between points of use or different processing facilities. A pipeline system is a series of interconnected pipelines.

Risk

A measure of loss or harm to people, the environment, compliance status, Group reputation, assets, or business performance in terms of the product of the probability of an event occurring and the magnitude of its impact.



Revalidation

A formal process, including the use of ILI, hydrotesting or Direct Assessment techniques, to determine the condition of a pipeline and fitness for long term operation.

4. Symbols and abbreviations

For the purpose of this GP, the following symbols and abbreviations apply:

AUT	Automated ultrasonic technique.
AUV	Autonomous underwater vehicle.
BOEPD	Barrels of oil equivalent per day.
CIPS	Close interval potential survey.
CP	Cathodic protection.
DA	Direct assessment.
DCVG	Direct current voltage gradient.
EA	Engineering authority.
ECDA	External corrosion direct assessment.
ERF	Estimated repair factor.
FIMS	Facility integrity management system.
GIS	Geographical information system.
HCA	High consequence area.
HSSE	Health, safety, security, and environment.
ICDA	Internal corrosion direct assessment.
ILI	Inline inspection.
LRGWUT	Long range guided wave ultrasonic technology.
MAOP	Maximum allowable operating pressure.
MFL	Magnetic flux leakage.
NDT	Non-destructive testing.
PDAM	Pipeline defect assessment manual.
PLEM	Pipeline end manifolds.
PIMS	Pipeline integrity management system.
PTA	Pipeline technical authority.



ROV	Remote operated vehicle.
SRA	Structural reliability analysis.
TFOD	Time of flight diffraction.

5. Inspection overview

5.1. General

- a. This GP shall be read in conjunction with BP Group policies and standards and the full suite of category 43 Pipeline ETPs.
- b. The approach taken shall be consistent with the Group policy document for HSSE and the Group Integrity Management Standard.
- c. Organisational responsibilities referred to in this document shall comply with GP 43-49.
- d. Inspection, assessment and periodic revalidation of the condition of a pipeline are key elements of PIMS, as described in GP 43-49 and illustrated by Figure 1.
- e. If a pipeline is damaged or deteriorates in service over time, an integrity assessment shall be undertaken to determine the severity of the damage and required remedial actions to ensure safe continued operation.

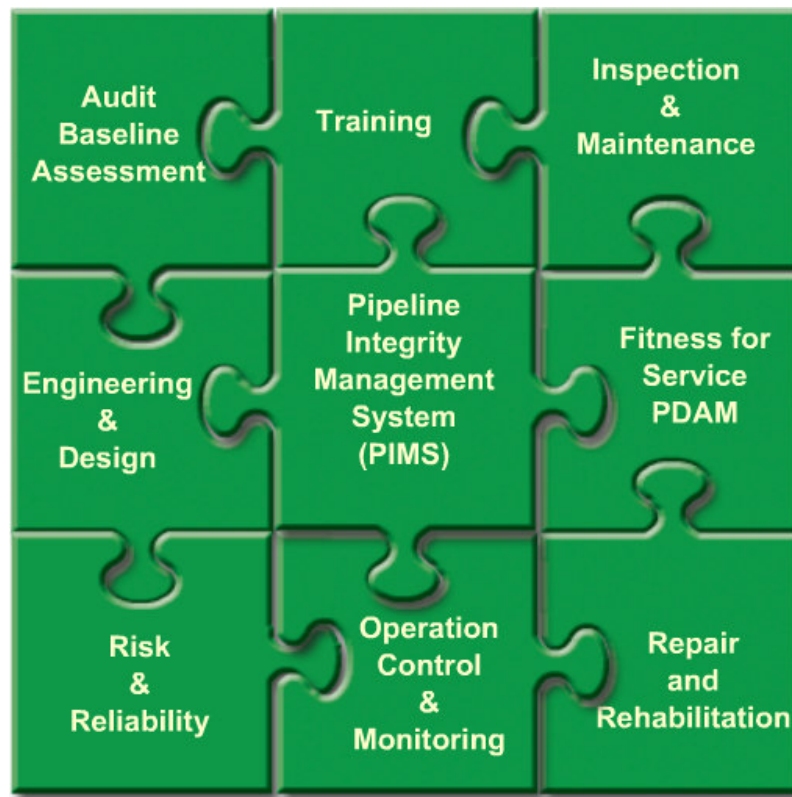
Whilst damage from third parties such as impact damage from an excavator or ship's anchor triggers the need for inspection and assessment, other mechanisms such as corrosion or fatigue failure may occur over a longer time frame.

- f. Planning and design consideration for periodic inspection and assessment of pipelines shall commence during the Select phase of a project (i.e., not left to the Operate phase) and shall continue through to handover to operations.
- g. During project development, the risk of failure (i.e., probability and consequence) for each potential event shall be identified to enable informed selection of appropriate inspection techniques.

These factors may directly influence the pipeline system design (e.g., the provision of pig traps, material selection, diameter changes, and the provision of additional protection features).

This cannot be achieved without competent discipline pipeline engineers and operations staff.



Figure 1 - Pipeline integrity management jigsaw

5.2. Inspection plan

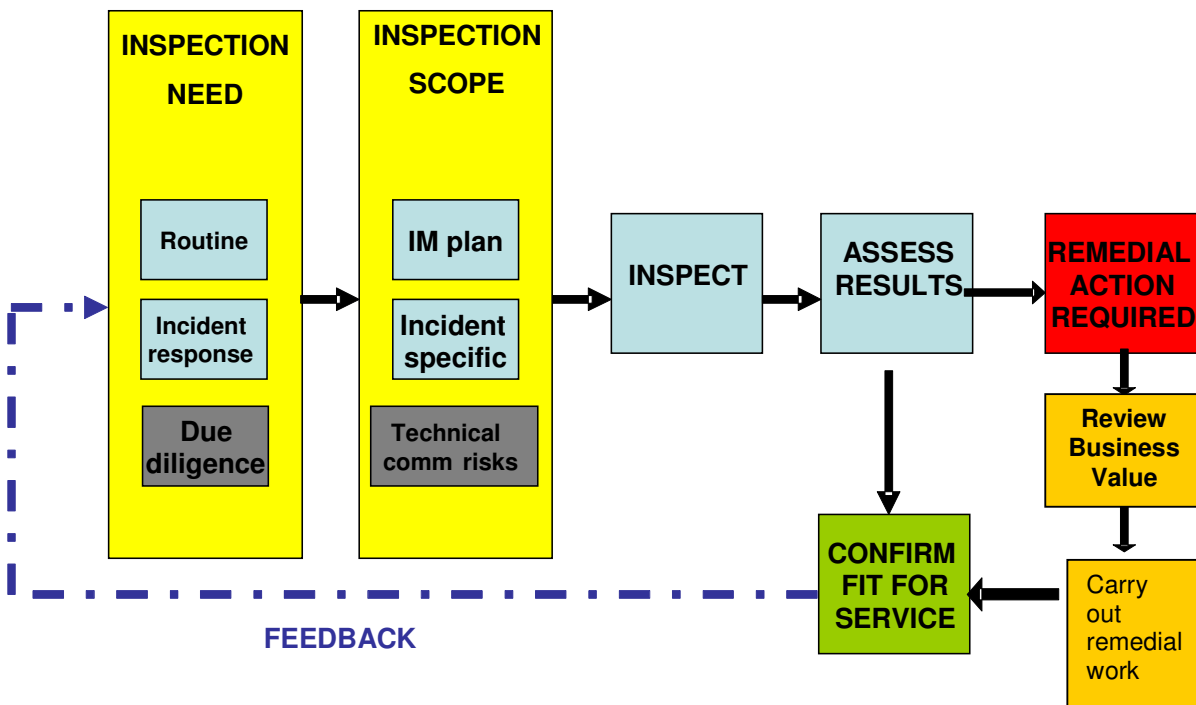
- a. An inspection plan shall be established for each pipeline as part of the requirements of PIMS, covering all component parts of the pipeline system.

Figure 2 illustrates a typical overall flowchart for inspection and assessment with four key steps:

- *Identification of the need for inspection. This could either be a routine inspection as part of the PIMS or a result of an incident (e.g., extreme weather, seismic activity, landslide, or third party damage). It is not possible to conduct a meaningful inspection unless clear requirements are provided on what needs to be inspected and why.*
- *Definition of the inspection scope. In the case of the routine inspection, this would comply with the risk based inspection plan drawn up under PIMS requirements. For incident responses, it is specific to the nature of the incident. For due diligence, the scope would be that required to understand the technical and commercial exposure in change of asset ownership.*
- *Execution of the inspection, using the range of tools and techniques appropriate to the system, its environment, and critical failure modes.*
- *Assessment of the results against acceptability criteria (critical feature sizes, allowable spans, etc.) based upon the original pipeline design basis and established within the inspection plan.*

Confirmation in the case of a routine inspection that either the system is fit for continued operation or remedial action is required. In some regulated locations, this may require certification by an independent authority.

Figure 2 - Inspection and assessment overview



Some components, such as tanks, pressure relief systems, or pig traps, may be included in FIMS. While all components are captured somewhere, it is important that, during a review, the pipeline is still reviewed as a complete system and that components are not lost between organisational groups.

- b. The inspection plan shall focus upon the following key steps:
 1. Inspection (measurement).
 2. Assessment of condition.
 3. Response (remedial action/future monitoring or inspection).
 4. Review of inspection plan.
- c. The inspection plan shall address each of the key risks identified in the risk management plan.
- d. Inspection scope and frequency shall be based upon the risk assessment, which shall consider and evaluate the risks associated with the loss of pipeline integrity in terms of the following consequences:
 1. Safety.
 2. Environment.
 3. Business interruption and reputation.
- e. The inspection plan shall adhere to local regulatory requirements. The requirements of this GP shall be followed if they are more stringent than the local regulatory requirements.

Requirements in this GP do not replace regulatory requirements affecting the pipeline.
- f. The inspection plan shall be based on structural design, loads, degradation mechanisms, and feature sizes defined in pipeline system design together with any additional information identified during construction or previous inspections.

If pipeline system design documents do not exist or are not adequate, the design basis and limitations need to be established and specialist advice needs to be sought.

New design concepts or the introduction of new materials often introduce a new or different element of risk. If this occurs, an increased level of monitoring is recommended until an operational track record has been established.

Changes of operation over time may also introduce new risks.

- g. The inspection plan shall comply with GP 32-30 and shall include:
 - 1. Objectives and scope of the inspection.
 - 2. Accuracy, reliability, and limits of the inspection techniques.
 - 3. Responsibilities and competencies.
 - 4. Reporting criteria.
 - 5. Frequency of inspection.
 - 6. Feature criteria.
- h. The inspection plan shall be reviewed as part of the annual PIMS review and in response to significant events or changes in risk exposure, noting changes to either the threats to or the condition of the pipeline.

Changes in either may indicate a need to change the type, scope, or frequency of inspection.

- i. The competency of individuals and organisations employed to perform inspection shall be verified to ensure that they are suitable for each inspection type.
- j. Procedures shall be maintained to promptly assess and respond to the condition of each pipeline, including reporting of incidents and features that could affect pipeline integrity, ensuring that reports are effectively communicated across the organisation.
- k. A response plan shall be established for each pipeline that sets clear time limits from discovery of features or reporting of incidents to taking remedial action.

Timing of response depends on the nature of the feature and the consequence of failure. In some instances, these may be driven by local regulations.

The response plan can significantly reduce time taken to restore the pipeline to normal operating service conditions.

Additional guidance is given in:

- *For inspection of subsea pipelines: DNV OS F101, Section 10.*
- *For onshore gas pipelines: ASME B31.8S.*
- *For liquid pipelines: API Std 1160.*

- l. The response plan shall address access to the pipeline which may be limited due to environmental considerations.

Ability to gain access to the pipeline and ability to intervene may be constrained by weather, metocean, seasonal throughput, wildlife migration, or land access at certain times of year.

- m. Records of each inspection and actions taken shall be maintained and available for review.

5.3. Identification of threats

- a. Typical threats to pipeline integrity are detailed in GP 43-17. Categories that shall be considered include:
 - 1. Time dependent



- a) External corrosion.
 - b) Internal corrosion.
 - c) Stress corrosion cracking (internal or external).
2. Stable
- a) Manufacturing related features.
 - b) Welding/fabrication related features.
 - c) Equipment.
3. Time independent
- a) Third party/mechanical damage.
 - b) Incorrect operational procedure.
 - c) Weather-related and outside force.
- b. The influence of fatigue shall also be taken into account.

The nature of the threat also depends on:

- *Materials of construction.*
- *Fabrication and installation procedures.*
- *Fluid to be transported, including assessment of potential changes over time (e.g., water cut, souring).*
- *External environment.*
- *Design.*

Materials of construction influence potential threats to be considered (e.g., corrosion resistant alloys, such as 13% Cr martensitic or 22% Cr duplex stainless steels, have internal corrosion resistant properties but can be vulnerable to external coating failures and hydrogen induced stress cracking).

UT inspection techniques may be preferable for clad and duplex pipelines.

For pipelines susceptible to cracking (e.g., high chrome pipelines: 13 Cr or duplex), provision of inspection access should be considered at design stage. Inspection access may require longer tools.

Fluid type influences pipeline susceptibility to internal corrosion and corrosion fatigue through pressure cycling. It also affects the type of inspection that is suitable. For example, ILI tools using ultrasonics are more readily applied to liquid filled pipelines than to gas systems.

The pipeline physical environment can influence both the nature of the potential threat, as well as affecting access for inspection and the feasibility and ease of deployment of inspection techniques.

The geometry of pipeline and availability of suitable launch/receive facilities determines whether pigging is possible.

5.4. Critical feature sizing

- a. Critical feature size for various components or segments of the pipeline system shall be established during the project phase and re-evaluated in advance of execution of any inspection program. The features shall be identified by consideration of a range of parameters, including:
- 1. Pipe dimensions.
 - 2. Pipe material.

