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United Kingdom Onshore Pipeline Operators' Association

UKOPA Good Practice Guide

Line Walking Surveys

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The guidance in this document represents 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.

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EXECUTIVE SUMMARY

This UKOPA good practice guide has been developed by the UKOPA Pipeline Integrity Working Group and provides guidance on undertaking walking surveys (line walks) along the routes of buried pipelines. The guidance within the document is applicable to all buried pipelines operated by the UKOPA member companies.

It is generally recognised that some degradation mechanisms around the pipeline can best be identified and monitored by undertaking walking surveys along the route of the pipeline. This document provides a framework for developing and carrying out a line walking programme including how to determine the survey frequency if a risk-based approach is going to be applied. The document also summarises the requirements of current legislation and pipeline standards in this area.

The document provides advice on the preparations that should be made before undertaking a line walk including advice on health and safety related precautions.

The document summarises the issues that individuals undertaking line walks should be asked to report on. These include issues related to the pipeline infrastructure such as the condition of marker posts and CP test posts. They also include issues related to the local pipeline environment such as new developments in the immediate vicinity of the pipeline and issues such as signs of ground movement or shallow cover that could represent a threat to the pipeline's integrity.

Guidance is also provided within the document on what to do if an immediate threat to the pipeline is identified.

The document also outlines the steps that need to be taken on completion of the line walk to ensure that all of the identified issues are recorded and suitably actioned. Training and record requirements are also addressed in the document.

1 INTRODUCTION

1.1 Background

The pipelines operated by UKOPA member companies are subject to a number of overline survey techniques as part of their pipeline integrity management of systems. Some degradation mechanisms associated with the local pipeline environment can best be identified at close range and by comparison over time. These can only normally usefully be identified through line walking.

This document gives a framework for developing and carrying out a line walking programme, including the requirements of pipeline standards, preparations required, carrying out the line walk and managing follow-up / defect resolution. The document includes suggested frequencies for undertaking line walks and criteria for identifying higher risk locations, where a risk-based approach is to be applied.

Additionally, the document can also be used as guidance when undertaking other related pipeline condition monitoring activities such as monitoring for shallow depth of cover over the pipeline. The guidance within the document can be applied whether undertaking these other activities as part of the line walk or as a separate managed inspection.

1.2 Scope

The guidance in this document is applicable to all buried pipelines operated by the UKOPA member companies. These pipelines can be categorised as:

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

The guidance is generally applicable to the above pipelines; however, the principals of the document can be equally applied to other pipelines e.g. gas pipelines operating at lower pressures.

1.3 Application

This document covers routine pipeline line walking activities to assess the general environment around the pipeline including the condition of associated pipeline infrastructure such as pipeline marker posts or Cathodic Protection (CP) test posts. The document is not intended to cover overland or aerial surveys that might be undertaken to mitigate the likelihood of third party damage. Events that have the potential to cause third party damage are normally short duration activities and therefore the frequency of these surveillance activities need to be significantly more frequent (typically once every 2 weeks) than the line walking related activities covered by this document.

Within this document:

Shall: indicates a mandatory requirement.

Should: indicates good practice and is the preferred option.

2 STANDARDS AND LEGISLATIVE REQUIREMENTS

2.1 Pipeline code requirements

2.1.1 [Requirements for natural gas pipelines as detailed in IGEM/TD/1 and ASME B31.8](#)

Requirements for natural gas pipeline route inspections are included in IGEM/TD/1 (Reference 1). IGEM/TD/1 specifies that all parts (of the pipeline) should “*be walked at least once every 4 years, unless the frequency is set by a risk based approach*”. IGEM/TD/1 also states that “*if it can be demonstrated that sufficient surveillance takes place during aerial/vantage/overhead crossing/water course crossing/overline and on-line condition monitoring surveys and liaison activities, then separate walking surveys of all or part of a pipeline may not be required*”.

IGEM/TD/1 also details the requirements for notifying the owner/occupier/tenant, some of the precautions that should be taken when undertaking a line walk and the features that should be identified.

2.1.2 [ASME B31.8](#)

ASME B31.8 (Reference 2) advises that “*Distribution systems in a principal business district should be surveyed at least annually*” and that systems outside this area “*should be surveyed as frequently as experience indicates necessary, but not less than once every 5 years*”.

When determining the inspection frequency, ASME B31.8 advocates a risk-based method, stating “*The extent and frequency of leakage surveys shall be determined by the character of the general service area, building concentrations, piping age, system condition, operating pressure, and any other known condition (such as surface faulting, subsidence, flooding, or an increase in operating pressure) that has significant potential to either initiate a leak or to cause leaking gas to migrate to an area where it could result in a hazardous condition. Special one-time surveys should be considered following exposure of the gas distribution system to unusual stresses (such as those resulting from earthquakes or blasting).*”

2.1.3 [Requirements for non-natural gas pipelines as detailed in PD 8010 and ASME B31.4](#)

For non-natural gas pipelines, the principal standards that apply are:

- PD 8010 part 1 – Steel Pipelines on land – code of practice (Reference 3);
- PD 8010 part 4 – Steel pipelines on land and sub-sea pipelines – code of practice for integrity management (Reference 4);
- ASME B31.4 – Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids (Reference 5).

Section 13.3.2 of PD 8010 part 1 states that “*the pipeline route, including the right of way should be periodically patrolled/surveyed to detect factors that could affect the safety and operation of the pipeline system.*”

PD 8010 details the pipeline related issues that should be identified through a pipeline survey. The key requirements of PD 8010 parts 1 and 4 in summary are:

- Section 13.3 of PD 8010-1 details the requirements for pipeline route inspection;
- Section 9 of PD 8010 Part 4 deals with In-service Inspection and Section 9.2 of the document covers surveillance;
- Annex C of PD 8010 Part 4 addresses surveillance frequency.

Section 13.3 of PD 8010-1 states that *“the pipeline route, including the right of way should be periodically patrolled/surveyed to detect factors that could affect the safety and the operation of the pipeline system.”* Surveys should identify:

- a) encroachments;
- b) mechanical damage to above-ground and exposed pipeline sections;
- c) indications of leakage, e.g. discoloured vegetation;
- d) third party activities;
- e) change of land use;
- f) fire;
- g) mineral extraction/mining operations;
- h) ground movement;
- i) soil erosion;
- j) the condition of water crossings, such as sufficiency of cover, accumulation of debris, flood or storm damage;
- k) soft and waterlogged ground.

PD 8010-1 states *“the frequency of inspection can vary with local conditions, and urban areas and intensively farmed agricultural land are likely to require more frequent and closer inspection than heathland.”*

PD 8010-1 notes that PD 8010-2 (Reference 6) gives recommendations for the route inspection of sections of pipelines and land crossing large rivers and estuaries, IGEM/TD/1 Edition 5 gives guidance on the inspection of exposed crossings and water crossings.

PD 8010-4 states that with regard to the frequency of surveillance and inspection, the common approach is to use engineering judgement to decide the longest period that could possibly be acceptable (i.e. associated with the lowest possible risk), and then to determine inspection intervals on a linear scale of risk. PD 8010-4 provides a typical qualitative risk model based on a 5 x 5 matrix of frequency and consequences ranging from very low, low, medium, high and very high.

ASME B31.4 (Reference 7) does not specify a frequency but recommends that operators *“maintain a periodic pipeline patrol program to observe surface conditions on and adjacent to the pipeline right-of-way.”*

2.1.4 Other relevant standards

Requirements for managing rights of way are also specified in BS EN 14161 (Reference 8) and EN 1594 (Reference 9).

2.2 Key legislative requirements

The principal UK legislation in this area is the Pipelines Safety Regulations 1996 (SI 815 1996 as amended). Whilst the Pipelines Safety Regulations include no specific requirements with respect to line walking, there are a number of relevant regulations in this area, these include Regulation 13 which covers requirements for the maintenance of a pipeline.

Regulation 13 states that:

“The operator shall ensure that a pipeline is maintained in an efficient state, in efficient working order and in good repair.”

HSE document L82 – Guide to PSR 1996 (Reference 10) clarifies Regulation 13 as follows:

“The operator needs to consider maintenance and inspection requirements for the pipeline. Examination and monitoring of the pipeline are part of routine maintenance. The operator needs to consider both how and when the pipeline should be surveyed and examined to validate and maintain it in a safe condition.

The extent of the work done to maintain a pipeline will depend on its material of construction, its location, the fluid conveyed and the condition under which it is operated. For example, for low pressure gas distribution and service pipelines onshore, the operator should monitor the pipeline to secure its safe operation. For major accident hazard pipelines, the maintenance plan should form part of the pipeline’s safety management system.”

3 FREQUENCY OF LINE WALKING

As stated in Section 3, IGEM/TD/1 specifies that line walks should be undertaken on a “4 yearly basis unless the frequency is set based by a risk-based approach”. IGEM/TD/1 also states that “if it can be demonstrated that sufficient surveillance takes place during aerial/vantage/overhead crossing/water course crossing/over line and on-line condition monitoring surveys and liaison activities, then separate walking surveys of all or part of a pipeline may not be required.”

ASME B31.8 suggests a risk-based approach, with a maximum interval of 1 year for gas distribution systems within a “principal business district” and a maximum of 5 years for systems outside such areas.

This UKOPA document recommends that ideally the frequency of line walking should be determined using a risk-based approach. If this is not practical, then it is suggested that individual pipelines should be line walked at four yearly intervals. Consideration should be given to having more frequent surveys in more heavily industrialised areas, or in areas with a high population density.

If a risk-based approach is to be applied, then the frequency of line walking should take account of the potential degradation mechanisms that might impact upon the pipeline, and also the potential for other existing planned regular pipeline inspection and maintenance activities, such as CIPS, to identify potential pipeline integrity related issues.

It may also be appropriate to target the line walks at specific sections of the pipeline that are known to be at higher levels of risk, or to increase the frequency of inspections in such areas.

If a risk-based approach is to be applied, then the factors that should be taken into consideration when deciding upon the frequency of line walking and the locations that need to be line walked (if the whole pipeline is not being line walked) are detailed in Section 6 of this document.

4 RISK BASED APPROACH

If a risk-based approach is to be applied, then the risk assessment should consider both the locations along the pipeline route that need to be surveyed and also the frequency with which they need to be surveyed. In this manner, the risk-based approach can be used either to determine the survey frequency of the entire pipeline length or just the identified high-risk sections of the pipeline.

It is the responsibility of the pipeline operator to determine and justify the selected frequencies based on the environment of the pipeline and the known risks associated with the pipeline. Some of the factors that should be taken into account when assessing these risks are detailed in the sections below.

4.1 Pipeline route locations

As identified above, it may be considered that the most cost-effective means of monitoring the pipeline is to survey the higher risk locations rather than undertaking a line walk of the whole of the pipeline route. If this is the case, then the following factors should be considered when identifying the locations that need to be surveyed:

- Known issues associated with shallower cover or locations that are laid in ground conditions that might be associated with shallow cover, for example peaty soils or soils with a high organic content that are known to shrink over a period of time;
- Farm land that is arable (rather than grazing land) and is therefore more susceptible to changes in depth as a result of farming activities;
- Known ground movement related issues **or** that are considered to be at risk from ground movement;
- Associated with land erosion or subsidence in the vicinity of the pipeline;
- In the vicinity of meandering rivers or rivers that are known to be prone to flooding;
- Coastal or tidal areas that may be prone to scour;
- Potential for higher failure frequency or higher consequence of failure. The higher consequence of failure could be as a result of a higher population of occupied buildings in the vicinity of the pipeline. IGEM/TD/2 (Reference 11), ASME B31.8S (Reference 12 and PD 8010-3 (Reference 13) provide guidance on a range of factors that could result in a pipeline having an increased failure probability or higher consequences of failure;
- Vulnerability to illegal hot taps;
- Known recent local construction, development or industrial activity or where there have been historically higher levels of activity, e.g. construction work, street works, tree felling or quarrying;
- Railway crossings where there is the potential for CP interference;
- Obstruction of or planting over the easement.

4.2 Frequency of line walks

The frequency at which line walks should be undertaken should take account of the following factors:

- Locations on the pipeline where there is known ground shrinkage. Whenever possible the rate of ground shrinkage should be estimated;
- On completion of known recent local activity, e.g. construction work, tree felling, quarrying;
- Where other pipeline surveillance, e.g. aerial surveillance or vantage point surveys have identified a high level of activity in the vicinity of the pipeline;
- Areas of land in the vicinity of the pipeline where there are known high levels of development or high levels of potentially intrusive farming activity;
- Pipeline locations that have been identified from previous pipeline surveys as having potential local issues that need to be surveyed more frequently.

It may also be prudent to undertake a walking survey when there has been significant flooding over the pipeline route once the flood water has subsided, or in the event of high river flows for pipelines that cross under or over rivers or run alongside rivers.

A documented risk assessment may identify that some pipeline sections will require line walking if triggered by a specific event (such as ground movement) or a high number of recorded aerial surveillance sightings. The requirement for line walking of specific pipeline sections should be based on a regularly updated risk assessment rather than at a set frequency based on a single risk assessment.

A qualitative risk assessment model based on the guidance in PD 8010-4 is given in Appendix 1.

5 PREPARING FOR LINE WALKS

5.1 General

Prior to undertaking a line walk, it should be ensured that the individuals undertaking the line walk:

- Have the necessary training and competencies to undertake the required work activities, see Section 12;
- Have been fully briefed on the issues that need to be recorded;
- Have the required PPE (Personal Protective Equipment);
- Have pipeline route maps which identify the sections of pipeline that need to be surveyed;
- Have the relevant equipment to record issues or sightings, this could be pen and paper recording systems or suitable electronic devices;
- Have the necessary equipment to take and record pipeline depth of cover if it is proposed to also take depth of cover measurements during the line walk, and be trained in its use;
- Are fully briefed on any known works that are currently being undertaken in the vicinity of the pipeline, and on the steps they should take if they observe any other activities in the vicinity of the pipeline that represent an immediate threat to the integrity of the pipeline, e.g. mechanical excavation work on top of or close to the route of the pipeline.

An assessment should be undertaken to ensure that the individuals undertaking the line walks can access the whole of the pipeline route to be surveyed. This should include assessments to identify routes for the safe crossing of fences, hedges, ditches, streams and rivers as applicable. When determining when to perform line walks, factors that could affect access (such as seasonal flooding, crop growth, animals rearing young and bio-security) should be considered.

The landowners or tenants should have been provided with prior warning that access is required to the land in order to carry out the proposed surveys. Such notice should ideally be in the form of written notice with acknowledgement where required (where the pipeline is operated under a deed of grant there may not be a need for a formal acknowledgement).

The pipeline will normally be broken down into sections that can be walked in a reasonable timeframe. Factors to be taken into account when planning the route sections include:

- Identifying areas with restricted access, e.g. MOD areas, airports, railways;
- Giving suitable prior notice to landowners;
- Industrial areas or construction areas that might be fenced off;
- The arrangements for crossing ditches, rivers etc;
- Access to locked/private areas e.g. parks, golf courses or sections of pipeline that run through private gardens;

- The numbers of people required to undertake the specified activities;
- Type and thickness of vegetation underfoot;
- Time of year, e.g. avoiding crop damage, animals rearing young or local flooding;
- Farm related access restrictions, e.g. disease, bio-security, crop spraying, harvesting.

The overall logistics in terms of accessing the start of day and end of day locations with vehicles should also be considered, i.e. minimising the requirement for the individuals undertaking the line walks needing to return back along the route a significant distance on foot.

5.2 Health and safety

The operator should carry out a location specific risk assessment to determine the safety precautions that need to be put in place. These should typically include:

- Suitable clothing including: high vis clothing, boots, gloves (the required clothing may be dependent on the nature of the location e.g. urban/rural);
- Dangerous animals, including dogs, livestock and wildlife;
- Lone working arrangements;
- Ground conditions;
- Weather including the provision of sunscreen or waterproof clothing;
- Communications including the location of mobile phone dead spots;
- Known aggressive landowners/occupiers/tenants;
- Provision of food and water;
- First aid provision;
- Insect repellent;
- Size and weight of equipment that may need to be carried;
- Communication arrangements;
- Pre-identified locations to take shelter or rendezvous in the event of bad weather or an emergency.

6 WHAT TO LOOK FOR

Individuals undertaking a line walk should carry out a desk study prior to the line walk to identify specific issues which may affect the relevant pipeline. The desk study should include the following:

- The condition of marker posts including aerial marker posts, CP and/or boundary marker posts;
- The condition of sleeves and the position of the pipeline within the sleeve, where visible;
- The condition of above ground pipework, valves etc.;
- The condition of surface boxes and CP test posts;
- The general condition of exposed crossings including security and access prevention devices;
- Ongoing work around the pipeline including drainage, ditches, fencing or other farming activity which may affect the integrity of the pipeline;
- Ongoing civil or engineering work of any kind including demolition;
- Evidence of ground movement or changes in water courses;
- Removal of surface soil or the tipping or stacking of materials on top of the pipeline;
- Evidence of temporary sites of public gathering such as Sunday markets, camp sites, festivals or agricultural shows;
- Evidence of tree felling and timber transportation;
- Discoloration of vegetation or any other evidence of leakage;
- Blasting or mineral extraction in the vicinity of the pipeline;
- Details of any large electrical substations or overhead pylons running parallel with the pipeline;
- Unknown solar parks or wind turbines including installations that could impact upon the CP system and impede access;
- Farm activity, with the exception of normal topsoil cultivation;
- Evidence of fires of any description, including straw burning;
- The general condition of the easement and whether it may not be passable as a consequence of excessive undergrowth;
- Change of land use;
- Trees or large shrubs over or close to the pipeline;

- The condition of water crossings including the accumulation of debris and any flood or storm damage;
- Any other unusual features that might affect the condition or integrity of the pipeline;
- Evidence of suspicious or illegal activities related to the pipeline;
- New buildings or developments within the land use planning consultation zone.

If it has been decided that pipeline depth of cover is going to be recorded as a part of the line walk survey, then readings of depth of the pipeline below the surface of the ground should be taken at regular intervals using the approved, calibrated pipeline detection device. Further guidance on taking depth of cover measurements including recording of the pipeline depth of cover readings is provided in Reference 13.

When conducting the line walk it is advisable to take photographs at regular intervals/distances and at specific locations to allow changes in the condition of the easement over time to be monitored. Any specific areas of concern should be photographed, to enable personnel not present at the site to determine the appropriate actions to take.

7 IN THE EVENT OF AN IMMEDIATE THREAT TO THE PIPELINE

Where a serious infringement is observed that represents a direct threat to the pipeline then immediate action must be taken. This should include informing the individual(s) undertaking the work to stop work until the location of the pipeline has been identified and their method of work reviewed.

The individual(s) undertaking the line walk should also report the work immediately to his/her line manager or pipeline control room as appropriate. The surveyor must make any individual(s) undertaking the work aware of the presence of the pipeline, their legal obligations when working within the pipeline easement and the safe working requirements.

If necessary, they should inform the relevant individual(s) responsible for managing the site works that they must contact the pipeline operator's head office or plant protection department to obtain formal consent for their works.

8 ON COMPLETION OF THE LINE WALK

The pipeline sections surveyed should be checked against the pipeline records to confirm that all required sections of the pipeline have been correctly surveyed. Any pipeline sections not surveyed (for example due to not being accessible) should be recorded along with the reasons as to why those sections could not be surveyed.

Recorded features and issues should be reviewed and prioritised including any dates set for close and/or remedial action. This includes any identified pipeline issues or activities that require follow up visits.

Any data that has been recorded on electronic devices should be downloaded to a centrally networked computer or the data backed up on suitable computer or data storage device.

All relevant documentation should be completed and recorded as soon as possible.

There should be appropriate monitoring of the identified issues through the operator's safety management systems and internal governance processes to ensure that all identified issues are dealt with in a timely manner and that the relevant records are also updated and retained for a suitable period of time.

9 RECORDS REQUIREMENTS

All records of the recorded features must be retained in line with the relevant pipeline operator's records policy.

All electronic records such as pipeline depth measurements must be suitably backed up and stored in a location where they would be available to any individuals needing to access them in the future.

12. TRAINING

Suitable training should be provided to ensure that the individuals undertaking the line walks are suitably competent to undertake all of the activities they are required to do. This could also include relevant on-the-job training with an experienced line walker.

Training records should be maintained and updated to ensure that individuals undertaking the line walks have the appropriate knowledge and competencies. Routine revalidation of competence should be undertaken at pre-defined intervals.

10 REFERENCES

1. IGEM/TD/1 Edition 5 with amendments July 2016 Communication 1789, Steel pipelines and associated installations for high pressure gas transmission. Institution of Gas Engineers and Managers.
2. ASME B31.8 Gas Transmission and Distribution Piping Systems.
3. PD 8010-1:2015 + A1:2016 Pipeline systems – Part 1: Steel pipelines on land Code of Practice. BSI Published Document.
4. PD 8010-4:2012 Pipeline Systems part 4: Steel pipelines on land and subsea pipelines – Code of Practice for Integrity Management. BSI Published Document.
5. PD 8010-2:2015+A1:2016 Pipeline Systems – Part 2: Subsea pipelines – Code of Practice.
6. ASME B31.4 Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids.
7. BS EN 14161:2003 Petroleum and natural gas industries. Pipeline transportation systems.
8. EN 1594:2013 Gas infrastructure. Pipelines for maximum operating pressure over 16 bar. Functional requirements.
9. HSE Document L82 A Guide to the Pipelines Safety Regulations 1996.
10. IGEM/TD/2 Edition 2 Communication 1764 Assessing the risks from high pressure Natural Gas pipelines.
11. ASME B31.8S 2012 Managing System Integrity of Gas Pipelines.
12. PD 8010-3:2009+A1:2013 Pipeline systems – Part 3: Steel pipelines on land - Guide to the application of pipeline risk assessment to proposed developments in the vicinity of major accident hazard pipelines containing flammables.
13. UKOPA Good Practice Guide GP 001, Managing Pipelines with Reduced Depth of Cover.

APPENDIX 1

The recommended risk assessment model based on that given in PD 8010-4 is as follows:

Assessment of probability of failure:

Factor	Score		
	1	2	3
Shallow depth of cover	No evidence/ mitigated	Suspected due to soil type	Confirmed
Farming Land use	Grazing	Arable	Stables
Ground movement	None	Susceptible	Active
Erosion/flooding/ scour	None	Susceptible	Active
Development or active land management	None	Planned	Recent
Tree felling, quarrying	None	Planned	Recent/ recorded
Activity or materials on easement	None	Potential	Recorded

Assessment of consequences:

Factor	Score		
	1	2	3
Safety	Low	Moderate	High
Environment			
Security of supply			

Application:

Divide the pipeline into sections taking account of developments in the vicinity, land type, environmental factors etc. as appropriate.

Assess risk factors for different sections of the pipeline route assuming it is unlikely that more than two factors will occur on the same pipeline section.

Take account of the number of aerial and or vantage point survey sightings recorded for each section of pipeline since the previous risk assessment.

Assign the frequency for line walking for the different pipeline sections.

Carry out risk assessment at regular intervals.

Note 1: it is recommended that the risk assessment is undertaken annually.

Note 2: it is recommended that a line walk frequency of 10 years is applied for the assessment of pipeline marker and CP posts.

Recommended line walking frequencies:

		Frequency		
		Low	Moderate	High
Possibility of failure	High	4 years	2 years	Annual or less
	Moderate	Not required	4 years	2 years
	Low	Not required	Not required	4 years
		Low	Moderate	High
		Consequences of failure		