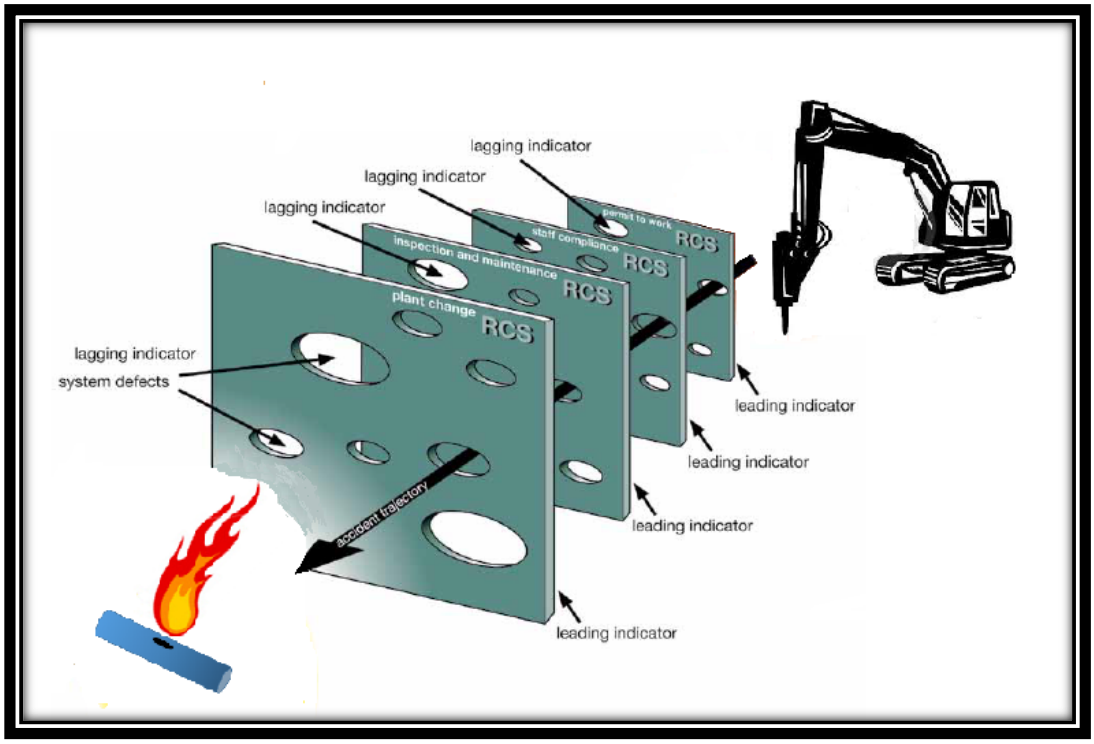
UKOPA

UK ONSHORE PIPELINE OPERATORS' ASSOCIATION - INDUSTRY GOOD PRACTICE GUIDE

PIPELINE PROCESS SAFETY PERFORMANCE MONITORING



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Document History	**Date**	**Review Date**
Edition 1 – prepared by the UKOPA Process Safety Working Group.	November 2014	November 2016

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1 INTRODUCTION

Performance monitoring forms a key part of process safety management. A number of pipeline incidents across the word highlighted the importance of monitoring the effectiveness of the control measures used to manage the integrity of a pipeline.

This good practice guide provides examples of "pipeline" process safety performance indicators which could be used to monitor performance. These indicators should form part of a risk based Safety Management System (SMS) which follows the Plan, Do, Check, Act approach described in HSG65 Managing for Health and Safety (Reference 1).

The process safety indicators have been developed using the approach recommended in the UK by the UK Health and Safety Executive (HSE) in their document HSG 254 (Reference 2). This requires that a number of process safety Key Performance Indicators should be defined and used by senior management to monitor the performance of their plant from a Process Safety viewpoint.

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:

- Natural gas transmission and distribution pipelines;
- Petrochemical liquids and gas pipelines;
- Oil and refined liquid pipelines.

For gas pipelines the guidance is generally applicable to pipelines with maximum operating pressures above 7 bar, however the principals of the document can be equally be applied to gas pipelines operating at lower pressures.

This document focuses on process safety indicators for buried pipelines and however a number of the concepts and approaches recommended in the document can be equally applied to other major hazard assets associated with the pipeline including: associated above ground installations; compressor stations and reception terminals.

3 PERFORMANCE INDICATORS AND MONITORING PERFORMANCE

HSG 254 defines key performance indicators as leading and lagging as follows:

Leading Indicators are a form of active monitoring focused on a few critical risk control systems to ensure their continued effectiveness. Leading indicators require a routine systematic check that key actions or activities are undertaken as intended. The can be considered as measures of process or inputs essential to deliver the desired safety outcome.

Lagging Indicators are a form of reactive monitoring requiring the reporting and investigation of specific incidents and events to discover weaknesses in that system. These incidents or events do not have to result in major damage or injury or even loss of containment, providing that they represent a failure of a significant control system which guards against or limits the consequence of a major incident. Lagging indicators show when a desired safety outcome has failed, or had not been achieved.

A leading or lagging measure should relate directly to a particular engineering control that is in place to prevent a hazardous event occurring or to mitigate the consequences of a hazardous event occurring. For example the level of maintenance that has been carried out compared with the scheduled level of maintenance (leading indicator) or the number of pipeline damages that that have occurred (lagging indicator).

Where possible, the chosen measures should be quantifiable, e.g. number of loss of product loss incidents.

UKOPA advises that Pipeline Operators (as defined in the Pipelines Safety Regulations 1996) should develop Process Safety Key Performance Indicators (KPI) to monitor the effectiveness of the management system used to control the risks associated with the pipeline operations. These KPIs should be collected and reviewed by Executive Directors, Non Executive Directors and Senior Managers on a regular basis. Relevant guidance Plans should be developed to address areas of poor performance and progress against these plans should be monitored.

When developing the KPIs to be monitored the significant risks to be controlled shall be considered. A structured process involving operational staff and experts with the competence to understand and analyse the hazard, its causes and consequences and identify the controls required to minimise risk should be undertaken. An example of this is the Bowtie Method is illustrated in Figure 1 where the hazard is Thermal Radiation following a pipeline failure caused by third party damage. The bowtie diagram identifying the causes and consequences of each identified risk can be constructed in facilitated

workshops involving relevant personnel. This directs attention to identifying the preventative, pro-active controls and the preparedness or reactive controls which can be put in place to control the risk. The preventative controls can then be used to identify leading indicators, and preparedness controls can be used to identify lagging indicators.

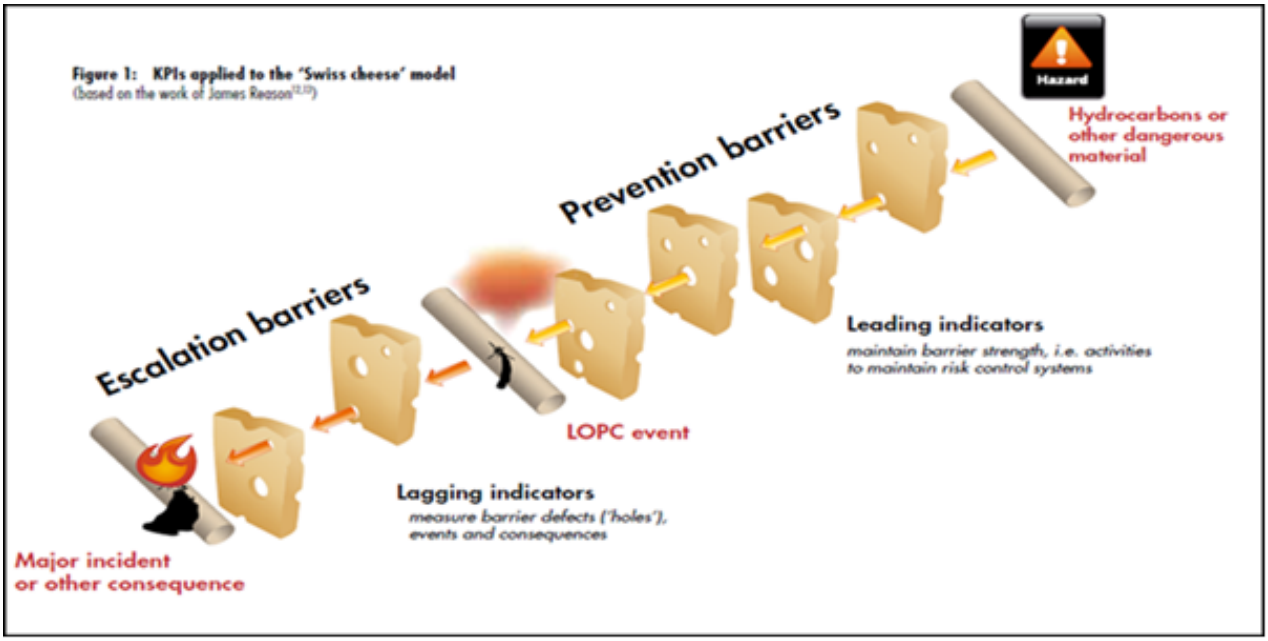

Figure 1 Example of a Bow Tie Model

The Table in Appendix 1 provides example performance indicators for the key risks, these measures are not an exhaustive list and should be used as guidance to assist in the development of and review of KPIs.

It is suggested that the following issues should be considered to ensure that appropriate KPI measures are in place:

- The hazardous events/accidents that could occur for the process safety assets that the KPI report is relevant to, and the scenarios that could lead up to these events.
- The KPI measures should be relevant to the engineering control measures that are in place to prevent these events from occurring.
- The challenges to the integrity of the plant, e.g. corrosion, third party damage, under/over pressure, review of the control mechanisms that are in place to mitigate these failure mechanisms.
- The KPI measures should be relevant to these control mechanisms.

- Use of accident and near miss data to identify the precursor events that would have given some prior warning that the incident could occur.
- The KPI measures should allow monitoring of such events.

The measures should be reviewed annually and where appropriate updated to ensure they continue to be appropriate and effective. The performance monitoring process should be audited on a regular basis to ensure the accuracy of data being used to collate the KPIs.

4 REFERENCES

1. HSE Guidance Document, HSG65 Managing for Health and Safety, 2013

2. HSE Guidance Document, HS254 Developing process safety indicators, A step-by-step guide for chemical and major hazard industries, 2006

Appendix 1 – Example Key Performance Indicators

Risk Control	PI Type	PI Description	Metric and purpose
Asset records	Leading	Number of key operational drawings checked within the past 5 year Examples of Key Operational Drawings Hazardous Area drawing, Pressure System Safety Regulations drawings, Process and instrumentation drawings	% of drawings checked to demonstrate records are being monitored
	Lagging	Number of Key drawings not available or require updating	Number of drawings - Use as a trend analysis to compare previous years to identify whether drawings are updated as part of change management process
	Leading	Number of projects where the Asset Register has not been updated within 3 months of assets being commissioned or modification / change being made	Number projects where records have not been updated used to confirm Asset Register is updated
Competence and training	Leading	Number of employees and /or contractors where their Competency has not reviewed within defined period.	Number of employees contractors - Used to confirm Competency review process is effective
	Leading	Training completed as per programme.	% of training complete as per plan – Used to confirm training programme is being delivered
	Leading	Number of workplace inspections carried out to ensure the employee / contractor is competent and working to procedure as per defined standard	% of workplace inspections completed – Used to confirm inspection process is being delivered

Risk Control	PI Type	PI Description	Metric and purpose
Competence and training (continued)	Lagging	Number of incidents where lack of competence was identified as a root cause	Number of incidents - Used as trend analysis to compare previous years identify whether the competency management process is effective
	Leading	Number of workplace inspections where issues of competency and training have been identified	Number of issues - Used as trend analysis to compare previous years identify whether the competency management process is effective
Emergency Response	Leading	Number of Emergency Procedures tested within 3 year period or as per operator policy	Number tested – used to determine whether the emergency testing programme is being followed
	Leading	Confirmation the emergency materials, equipment have been checked within the last five years or as per operator policy	Number of checks carried out - used to determine whether emergency equipment will be available
Integrity	Leading	Completion of integrity inspections as per plan e.g. Pressure System Safety Regulation inspections	% of inspections completed as per plan – Used to confirm of the inspections completed as per plan
	Leading	Completion of In Line Inspections or alternative pipeline integrity surveys as per plan	% of inspections completed as per plan – Used to confirm of the inspections completed as per plan
	Leading	Number of features identified by In Line Inspection or Coating survey/s	Number of features - Used as trend analysis to compare previous years identify whether the integrity management process is effective
	Leading	Completion of the maintenance of product (gas / liquid) quality monitoring systems as per plan	% of maintenance completed as per plan – Used to confirm product monitoring equipment is functioning correctly

Risk Control	PI Type	PI Description	Metric and purpose
Integrity (Continued)	Lagging	Number of events where product quality does meet required standard	Number of events – Used to ensure product quality is appropriate and will not cause unexpected internal corrosion of the pipeline
	Leading	Completion of Cathodic Protection monitoring as per plan	% of maintenance completed as per plan – Used to confirm Cathodic protection systems are functioning
	Leading	Completion of Cathodic Protection Surveys as per plan CIPS, DCVG etc	% of Surveys completed as per plan – Used to confirm Cathodic protection systems are effective
	Lagging	Number or Km of pipeline not protected by Cathodic Protection for more than 6 months	% or Km of pipeline network not protected by Cathodic Protection
	Leading	Completion of above ground pipework corrosion inspections as per plan	% of surveys completed as per plan to confirm pipe work is inspected as per plan
	Lagging	Number of integrity defects resulting in product loss or repair required to pipe wall caused by corrosion (internal or external)	Number of defects – Used to as trend analysis to compare previous years and identify whether the integrity management process is effective
	Leading	The number of Pressure Cycles monitored as permitted cycles over a given period.	The number of permitted pressure cycles defines the fatigue life of pipelines subject to pressure fluctuations.
	Lagging	The number of excursions from the permitted number of pressure cycles.	The number of excursions indicates any reduction in the fatigue life of the pipeline.

Risk Control	PI Type	PI Description	Metric and purpose
Leadership	Leading	Leadership (Executive or Directors) visit / audits to operational sites are carried as per programme	Number of Leadership visits / audits – used to confirm the Leadership are familiar with the issue and concerns of operational staff
	Leading	Audit of the management system and risk control measures carried as per plan	% of audits carried out per plan – used to confirm audits are being carried out
	Leading	Number of recommendations from audits or investigations not completed by target date	Number of outstanding recommendations - used to confirm action are carried out as per plan
3rd Party Interference Management	Leading	Landowners / Tenants / Local Authorities contacted within last 12 months	% of contacts made with key stakeholders to confirm awareness programme is effective
	Leading	Program of Pipeline marker post inspections complete	% of inspection programme carried out as per plan
	Leading	Number of days to respond to a 3rd party enquiry – average period and longest length of time.	Average number of days to respond to an enquiry – Used to confirm the process is efficient, measure should also consider the longest period to respond to an enquiry
	Leading	Aerial and Vantage surveys carried out as per plan	% of pipeline kms surveyed as per plan - Used to confirm surveys are carried out
	Lagging	Number A1, B1 and B2 infringements found in period	Number of infringements - Used as trend analysis to compare previous years identify whether the 3rd party enquiry process is effective
	Lagging	Number of incidents where pipeline or coating damaged	Number of incidents - Used as trend analysis to compare previous years to identify whether the 3rd party enquiry process is effective

Risk Control	PI Type	PI Description	Metric and purpose
Modification and repairs	Leading	Number of modifications completed in accordance with modification procedure within 12 months	Number of modifications- Used as trend analysis to compare previous years to identify if the process is capturing all modifications.
	Lagging	Number of incidents where the root cause is failure to follow modification process	Number of incidents - Used as trend analysis to compare previous years to identify if the process is capturing all modifications
Maintenance of equipment	Leading	Maintenance programme completed as per plan	% of maintenance carried out as per plan
	Leading	Protective devices and Safety Instrumented Systems tested as per plan	% of Protective device test carried out as per plan
	Lagging	Number of faults and defects found outside normal maintenance	Number of faults and defects – Used as trend analysis to compare previous years to determine the effectiveness of the maintenance policy
	Lagging	Number of protective devices and/or Safety Instrumented Systems fail when tested or required to operate	Number faults –Used as trend analysis to compare previous years to determine the effectiveness of the protective device maintenance policy
	Leading	Number of outstanding faults defects not completed as per required date	Number of outstanding faults and defects – Used to monitor the completion of defect rectification
Operating Procedures	Leading	Number of Operating Procedures not reviewed within last 5 years or updated following a process change	Number of procedures - Used to confirm operating procedures are current
Operating	Lagging	Number of incidents where poor or out of date operating procedure is identified as the root cause of the incident	Number of incidents - Used as trend analysis to compare previous years identify whether the review and update process is effective

Risk Control	PI Type	PI Description	Metric and purpose
Procedures (continued)	Leading	Alarm management, number of instance Operator alarm response time exceeds defined standard (or documented operator policy)	Number of occasions used to determine the effectiveness of the alarm management process
	Lagging	Number of incidents where alarm handling is consider to be root cause	Number of incidents - Used as trend analysis to compare previous years identify whether the alarm management process is effective
Route Management	Leading	Completion of route survey as per Programme Examples of surveys - IGEM/TD/1 Affirmation Survey, Line Walking Survey, River Crossing Surveys, Special Area Surveys	% of Surveys completed – Used to monitor progress.
	Lagging	Route exceptions found as part of survey. Examples of exceptions - building proximity infringements, loss of cover, washout erosion etc.	Number of exception per km - Used as a trend analysis to compare with previous years.
	Lagging	Infringements / exceptions where risk assessment or issues has not been closed out within 12 months of issue being identified	Number of outstanding actions from survey – Used to track progress.