# UKOPA

## United Kingdom Onshore Pipeline Operators' Association


# PD 8010 - Part 4: *Risk-Based Integrity management for steel pipelines on land and subsea pipelines* – DPC Overview

UKOPA/12/0016

# Contents

# Contents

Annexes:-

- Typical policy requirements
- The chemical injection system (CIS)
- Risk analysis
- Inspection, monitoring and maintenance plans
- In-service inspection
- Information management

# Key Principles of Integrity Management


- Policy & authorisation
- Organization & resources,
- Roles & responsibilities
- Process and performance indicators
- Review, audit, update
- Reporting (to senior management, regulator)
- Management of interfaces (technical groups, project/operations, 3rd parties)
- Clear definition of failure
- Incident investigations (& learning)
- Life cycle management

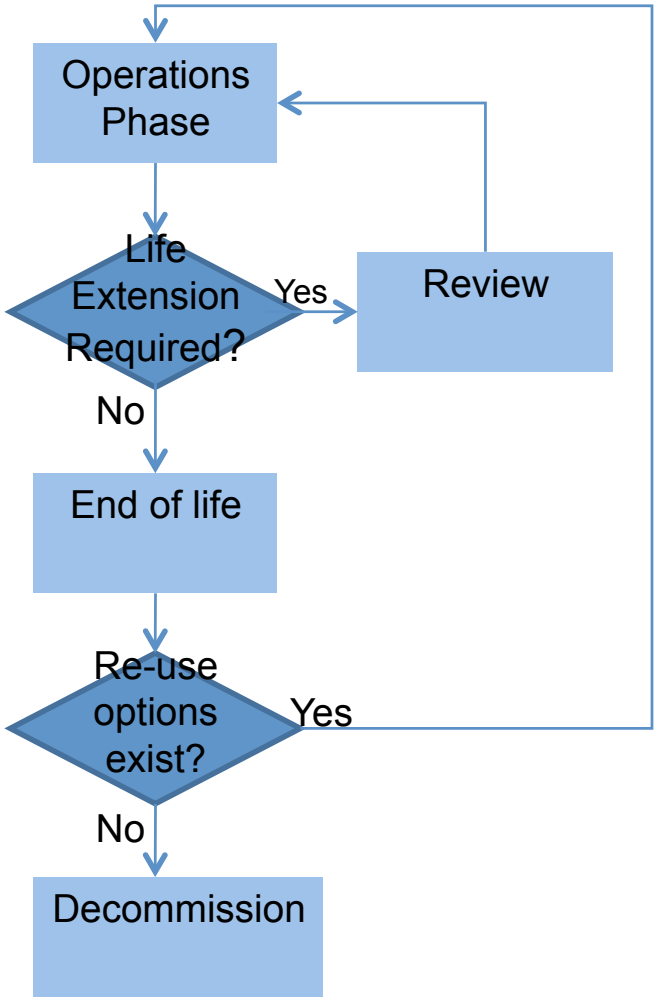
# Management Process

- Operational procedures
- Spares philosophy
- Preparedness
- Review and audit
- Management of change
- Emergency response
- Incident investigation and learning
- Competence Assurance

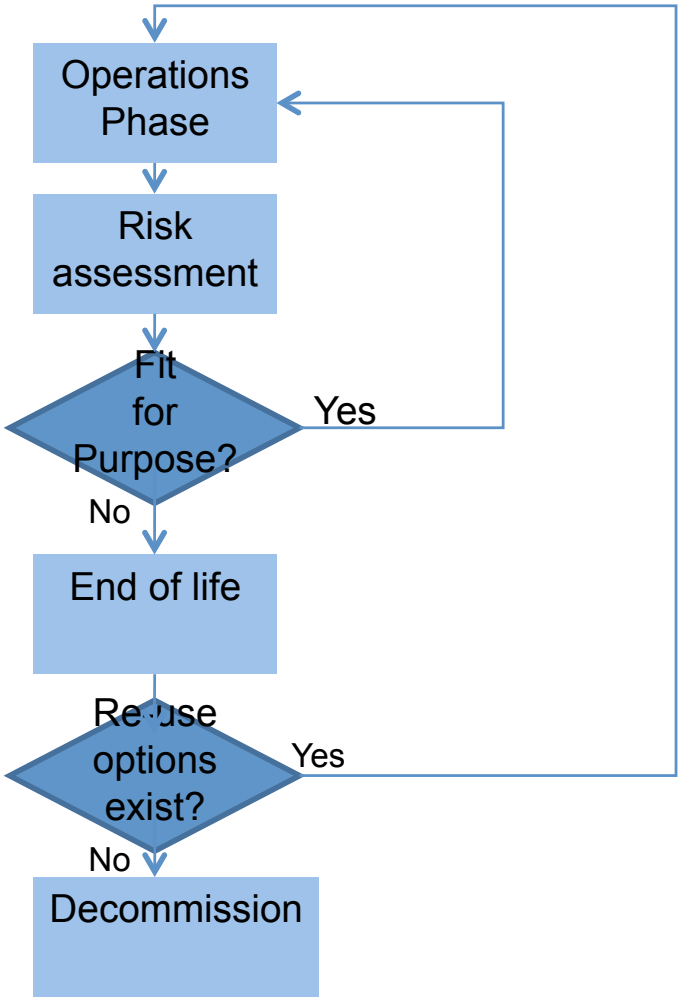
# Outline of the Integrity Management Process


- Contribute to the design of the pipeline system
- Define the pipeline system
- Subdivide the pipeline system into segments
- Define the threats to the pipeline system
- Gather likelihood data
- Carry out a risk assessment
- Plan for mitigation
- Carry out process and condition monitoring
- Carry out inspection
- Manage information

# End of Operating Life




Traditional design life extension




Risk based design life extension

# Check List Example – Incident Investigation

- *facilities – not inspected according to current plan;*
- *facilities – not addressed, or incorrectly addressed, in risk assessment;*
- *equipment, materials, tools – defective, inadequate or wrong type for function or task;*
- *facilities or equipment – lack of maintenance, inspection or housekeeping;*
- *correct safety protection or equipment not provided;*
- *failure to use safety protection or equipment provided;*
- *HAZOP – not carried out, or actions not completed ahead of task;*
- *inadequate procedure;*
- *lack of training;*
- *use of unqualified or non-competent personnel;*
- *lack of suitable supervision;*
- *poor communications;*
- *poor interface management.*

# Integrity Management Activities

- Contribute to the design of the pipeline system
- Define the pipeline system
- Subdivide the pipeline system into segments
- Define the threats to the pipeline system
- Gather likelihood data
- Carry out a risk assessment
- Plan for mitigation
- Carry out process and condition monitoring
- Carry out inspection
- Manage information

# Documentation

- Risk mitigation document
- Design, fabrication and installation document
- Operations documents
  - Pipeline operations and control philosophy.
  - Pipeline maintenance philosophy.
  - Pipeline integrity management systems.
- Integrity management manuals.
- Operations procedures.

# Roles & Responsibilities

- asset owner;
- responsible person;
- technical authorities;
- operator.

# Performance Indicators

A system should be put in place … including leading and lagging indicators:-

- Leading indicators are used to confirm that integrity tasks are undertaken - to show that the mitigations in place are active.
- Lagging indicators measure the degree to which the system has not worked as intended - identifying failures

The indicators should be selected by those involved in the process (i.e. not externally imposed), and should be SMART

**S**pecific, **M**easurable, **A**chievable, **R**eliable, **T**ime-based

# Example – leading indicators

- percentage of aerial surveys achieved against the annual plan;
- percentage of intelligent pig runs achieved against the annual plan;
- chemical injection system availability against design requirement;
- percentage of anomalies not closed out by the due date.

# Example – lagging indicators

- number of third party infringements;
- number of intelligent pig runs that reveal corrosion rates in excess of the design assumption (or that rate modified in the light of subsequent trending);
- number of valves failing to meet performance standard;
- number of leaks of hydrocarbons to the environment from the pipeline system.

# Design for Integrity

- Procurement quality assurance
- Installation, testing and commissioning
- Piggable systems
- Reliability, maintainability and data accessibility

# Risk Management

Risk Assessment:-

- Segmentation
- Identification of threats
- Estimation of likelihood
- Identification of failure mode
- Estimation of failure impact
- Evaluation of risk

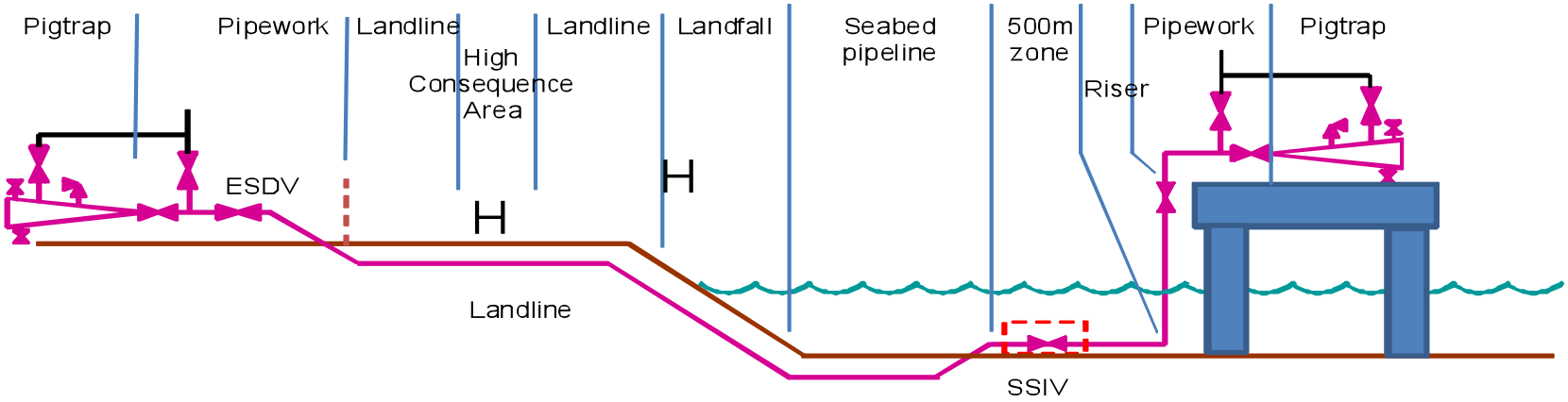
# Example Risk Matrix

| | | | Risk | | | | |
|---|---|---|---|---|---|---|---|
| Probability | E | Almost certain | M | H | H | X | X |
| | H | Likely | L | M | H | H | X |
| | M | Possible | L | M | M | H | H |
| | L | Unlikely | N | L | M | M | H |
| | N | Improbable | N | N | L | L | M |
| Consequence category | | Safety | First aid | Lost time injuries | Few major injuries | Few fatalities | Many fatalities |
| | | Environment | Low-level | Moderate | Large | Major | Disaster |
| | | Cost (millions) | <0.01 | 0.01 – 0.25 | 0.25 - 1 | 1 - 10 | >10 |
| Consequence | | | N | L | M | H | E |

# Risk Level vs Inspection Interval

| Risk Level | Inspection Interval |
|---|---|
| X | (unacceptable level of risk) |
| H | 1 year (i.e. annual) |
| M | 2 years (i.e. biennial) |
| L | 5 years |
| N | 10 years |

# Segmentation of Pipeline System




Plus

- CP Systems including anodes, transformer rectifiers, ground beds
- Corrosion and hydrate inhibitions systems
- SCADA system including sensors, telemetry, processors, displays
- Control systems including buttons, telemetry, cables, actuators
- Over-pressure protection systems
- Leak detection systems including inputs, processors and outputs
- ESD system including inputs, processors, outputs

# Threats & Mitigations

| Category | Threat | Mitigation – design | Mitigation - Operation |
|---|---|---|---|
| Internal Corrosion | $CO_2$ corrosion<br>$O_2$ corrosion<br>$H_2S$ corrosion<br>MIC<br>Erosion | Material selection e.g. CRA<br>Corrosion allowance | Corrosion inhibition<br>Inlet spec. control |
| External Corrosion | Galvanic corrosion<br>Crevice corrosion<br>Soil corrosion<br>AC corrosion<br>DC stray current corrosion<br>Atmospheric corrosion<br>CUI<br>MIC | Coating<br>CP | |

# Threats & Mitigations

| Category | Threat | Mitigation – design | Mitigation - Operation |
|---|---|---|---|
| Environmentally Assisted Cracking | HIC<br>SCC etc. | Material selection | |
| Mechanical Damage | Third party impact e.g. excavator, trawl gear, anchor, vehicle impact<br>Dropped objects<br>Sabotage<br>Illegal hot taps | Burial | Surveillance<br>ROW marking<br>Public awareness e.g. one-call<br>Impact protection e.g. concrete coating/ rockdump/concrete slabs |
| Natural Hazards | Earthquake<br>Landslide<br>River crossing scour | Routing<br>Backfill selection | River bank civil works |
| Operational Issues | Blockage/freezing<br>Incorrect operation | | Operator competence assessment/training |

# Threats & Mitigations

| Category | Threat | Mitigation – design | Mitigation - Operation |
|---|---|---|---|
| Operational Issues | Blockage/freezing<br>Incorrect operation | | Operator competence assessment/training |
| Design & Materials | Pipe body defects<br>Seam weld defects | Mill QA/QC | Pre-commissioning hydrotest |
| Construction | Girth weld defects | Construction QA/QC | Pre-commissioning hydrotest |
| Equipment Failure | Valve<br>Flange<br>Pig launcher/receiver | | |
| Fatigue | Pressure cycling<br>Thermal cycling | | |

# Final Sections

- Process & Condition Monitoring
- In Service Inspection
  - Pipeline Surveillance
  - Interpretation of Results
- Information Management
- Maintainability, spares & preparedness
  - Maintainability
  - Spares philosophy
  - Preparedness
- Audit & Review

# Features and Assessment Methodologies

| Feature | Applicable code or guideline |
|---|---|
| Anode loss or depletion | DNV-RP-F103<br>ISO 15589-1 &2<br>Norsok standard M-503 |
| Coating damage/loss | DNV-RP-F102 |
| Corrosion/metal loss | API 579-1/ASME FFS-1<br>ASME B31G<br>DNV-RP-F101<br>PDAM |
| Crack | API 579-1/ASME FFS-1<br>BS 7910<br>DNV-OS-F101 & RP-F113<br>PDAM |
| Dent | API 579-1/ASME FFS-1<br>BS 7608<br>DNV-OS-F101, RP-C203, F111, F113<br>PDAM |

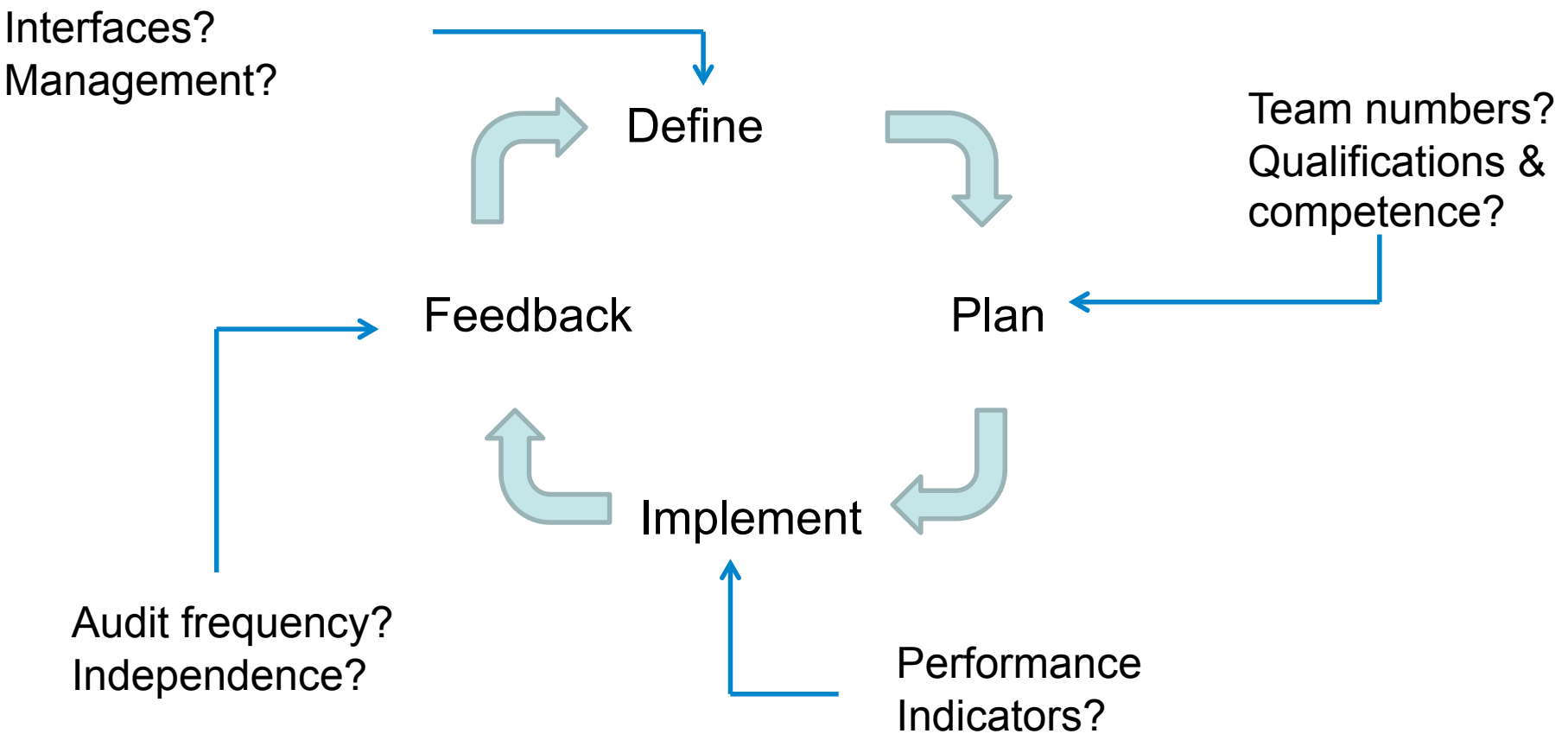
# Features and Assessment Methodologies

| Feature | Applicable code or guideline |
|---|---|
| Exposure | DNV-RP-F107, F109, F110 |
| Free span | DNV-RP-F105 |
| Global buckle | DNV-RP-F110<br>Germanischer Lloyd Rules for Classification and Construction – III Offshore Technology – Part 4 – Subsea Pipelines and Risers |
| Gouge | API 579-1/ASME FFS-1<br>PDAM |
| Local buckle | DNV-OS-F101<br>PD 8010-2 |

# Example – Data Stream Allocation

| Data Type | Operators | Integrity Engineers | Reliability Engineers | Subsea Engineers |
|---|---|---|---|---|
| Temp, Pressure, Flow rate, etc | Assessment of well performance<br>Confirm safe to continue operating | Input to calculations of corrosivity and chemical injection rate<br>Confirm operation within SOL | Sensor performance data (MTBF, etc) | Sensors OK<br>*/or/*<br>maintenance task to plan |
| Isolation valve operated | Task complete | Requirement to calculate new corrosivity in each leg | Valve condition monitoring data (footprint) | Valve status |
| Dewpoint, gas sampling ($CO_2$, $H_2S$, etc) | Confirm safe to continue operating | Assessment of corrosivity | Sensor performance data (MTBF, etc) | – |
| Chemical injection performance | Requirements achieved | Achieving protection (anticipate corrosivity) | Achieving availability (system condition monitoring) | Pumps, IRCDs, umbilical cores OK */or/* maintenance task to plan |
| Corrosion / erosion probe output | -- | Confirm corrosion under control, or calculate remaining life | Achieving availability (system condition monitoring) | Probes OK */or/* maintenance task to plan |
| Subsea Control Module performance | Confirm ability to control<br>/or/<br>shut-down required | -- | SCM component performance data (MTBF, etc) | SCM OK<br>*/or/*<br>intervention required |

# Audit & Review



# Comments & Feedback to BSI  Please