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PIPELINE LEAK DETECTION SYSTEMS

(PROJECT STANDARDS AND SPECIFICATIONS)

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SCOPE

This Project Standard and Specification provides guidance on the selection, operation and maintenance of automatic systems intended to automatically detect the loss of containment, for any reason, from a pipeline or network of pipelines.
This document applies to new or existing pipelines of any size, length and carrying any type of liquid or gas.
This document is not intended to cover those checks for pipeline leaks such as visual inspection by line walking and overflying. Hand held and aircraft mounted equipment for detecting the presence of hydrocarbons or other substances are also excluded from this document.

REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

1. IEC 85 Thermal Evaluation and Classification of Electrical
2. ISO 5208 Industrial Valves - Pressure Testing for Valves
3. ISO 9000 Series Quality Management Systems
4. ANSI/ISA-S18.1 Annunciator Sequences and Specifications

DEFINITIONS AND TERMINOLOGY

Addressable system - a system in which analogue or digital signals from each head (detector or manual callpoint) are individually identified at the control panel.

Addressable head module - the control panel mounted unit in an addressable detection system interfacing with the field equipment via a data highway, handling alarm and fault detection functions. Also know as an Addressable Loop Interface Module (ALIM).

Circuit - the most precise identification in a hard-wired detection system of the location of an alarm within the fire area.

Contract - the agreement or order between the purchaser and the vendor (however made) for the execution of the works including the conditions, specification and drawings (if any) annexed thereto and such schedules as are referred to therein.

Control action - an output from the control panel that can initiate extinguishant discharge, request ESD action, stop fans and close fire dampers etc. Control actions are divided into two groups per fire area for inhibit functions:
- Extinguishant outputs
- Remaining executive actions.

Control panel - the panel which integrates all the control and indicating equipment necessary for the Fire and Gas System.

Cost of ownership - the life cost of a system including initial supply contract value, installation cost, ongoing support costs (e.g. spares, maintenance and service charges).

Detector interface module - the control panel mounted unit in a hard-wired detection system interfacing with detector circuits handling alarm and fault monitoring functions.

Ex - electrical apparatus protected to meet hazard classification.

Fire area - an area normally bounded by fire walls, physical boundaries such as platform edges, site limits, building walls or partitions and notional boundaries, subject to their fire protection limitations.

Lower Explosive Limit (LEL) - the lowest concentration by volume, of a flammable gas in air that will sustain combustion of the flammable gas. Also known as Lower Flammable Limit (LFL).

Occupational Exposure Limits (OEL) - the concentration, in air, of a toxic gas as defined in HSE Guidance Note EH40. These are normally long term (8 hour time weighted average) and short term (10 minute time weighted average).

Status - the relative condition of a control panel input or output.

Voting system - confirmed fire or gas detection is normally required to initiate a Control Action. Voting generally occurs between 2 - out-of-3 (or more) independently wired circuits of the same type, e.g. smoke, heat, flame or gas.

Works - all equipment to be provided and work to be carried out by the vendor under the contract.
Zone - a part or whole of a fire area monitored by 1 or more detectors, a zone may cover more than 1 room within a fire area.

SYMBOLS AND ABBREVIATIONS

SYMBOL/ABBREVIATION	DESCRIPTION
ALIM	Addressable Loop Interface Module
ANSI	American National Standards Institute
API	American Petroleum Institute
ARE	Admiralty Research Establishment
BS	British Standard
CAD	Computer Aided Design
CCR	Central Control Room
d.c.	Direct Current
DN	Nominal Diameter
EDP	Electronic Data Processing
EC	European Community
EN	European Standards issued by CEN (European Committee for Standardisation) and CENELEC (European Committee for Electrotechnical Standardisation)
ESD	Emergency Shutdown
FGCP	Fire and Gas Control Panel
HSE	Health and Safety Executive (UK Government)
HVAC	Heating, Ventilation and Air Conditioning
IP	Institute of Petroleum
IR	Infra-Red
ISA	Instrument Society of America
ISO	International Organisation for Standardisation
LED	Light Emitting Diode
LEL	Lower Explosive Limit
LFL	Lower Flammable Limit
LPG	Liquefied Petroleum Gas
MAC	Manual Alarm Call Points
NFPA	National Fire Protection Association
NPS	Nominal Pipe Size
OEL	Occupational Exposure Limit
OTDR	Optical Time Domain Reflectometry
OTIM	Optical Transform Image Modulation
PA	Public Address

PAU	Pre-Assembled Units
PC	Personal computer
PLC	Programmable Logic Controller
PPA	Pressure Point Analysis
QA	Quality Assurance
SI	Systeme International d'Unites
UK	United Kingdom
VESDA	Very Early Smoke Detection Apparatus
UV	Ultra Violet
VDU	Visual Display Unit

UNITS

This Standard is based on International System of Units (SI) except where otherwise specified.

PIPELINE LEAK DETECTION SYSTEMS

Requirement for Pipeline Leak Detection

1. Regulatory and Legislative Framework

   There is little in the way of national or international legislation concerning the provision of pipeline leak detection systems, or the capabilities of such systems. It is likely that more specific guidance will be given in the next few years but this is unlikely to be of a prescriptive or legislative nature. The USA is the exception to this where it is expected that prescriptive legislation will be introduced.
   Whereas, in general, the provision of leak detection is unlikely to be the subject of prescriptive legislation, there is likely to be an increasing demand on operators to demonstrate that all reasonable precautions are being taken to avoid and mitigate the effects of any possible environmental hazards.

2. Risk Assessment

   If not prescribed by legislation, the requirement for pipeline leak detection will be determined by risk management considerations.
   An environmental risk assessment should be carried out for each pipeline system. The depth and complexity of the assessment will be very much dependant on the particular pipeline. The factors which will influence the environmental risk assessment will include:

a. the environmental sensitivity of the areas affected by the pipeline routing (e.g. areas of special scientific interest, proximity of shorelines, rivers and water courses, density of human population)
b. the fluid carried by the pipeline
c. the likely causes of pipeline leakage. Causes of pipeline leakage can be divided into five main categories:
    - internal and external corrosion
    - third party damage
    - operational error
    - natural hazards
    - mechanical failure

An examination of the likely causes of failure will provide an indication of the most likely leak (hole) sizes and hence leakage rates.
The potential risk to the environment and the potential for financial loss are closely linked. The financial risk associated with pipeline leakage arises from:

- value of lost line contents
- clean-up costs associated with loss of line contents
- the possibility of a large scale clean-up operation hindering the repair and re-instatement of the pipeline system.
- temporary or permanent loss of pipeline operating licence
- damages or fines imposed by criminal or civil courts
- loss of Company image as an environmentally concerned operator, thereby impeding future applications for operating licences.

In the case of liquid carrying pipelines the most environmentally sensitive routings would include subsea and those close to shorelines, rivers and water courses. In a marine or river environment, a relatively small quantity of liquid hydrocarbon will be spread over a great area and can potentially cause a disproportionately large amount of damage. Clean up costs for this type of spill can therefore be considerable, making preventative and loss limiting measures cost effective. Toxic effects from the release of unstabilised sour crudes also requires consideration if the pipeline is routed in proximity to populated areas. This hazard is discussed under gas transportation below.

Leakage of chemicals, particularly those soluble or miscible with water, once released into marine or river environments are virtually impossible to recover. In this case the clean up costs arise from the necessity to neutralise as far as possible the harmful effects of the released chemicals. Additionally the claims for damages arising out of pollution to water supplies are potentially very large. Against this potential liability, preventative and loss limiting measures