

PIPELINE LEAK DETECTION

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DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the application of Leak Detection Systems and gives an overview of available pipeline leak detection techniques and their effectiveness for pipeline applications. This DEP is primarily aimed at continuous on-line leak detection systems. Discrete off-line systems are only briefly discussed.

This DEP provides guidance on the following:

- when to specify a leak detection system;
- how to specify performance parameters;
- what system to select;
- how to implement a system.

This DEP is a revision of the previous publication of the same number and title, dated September 1994. A summary of changes from the previous edition is given in (1.6).

Although applicable to onsite lines, this DEP is intended for use with long, cross-country or subsea transportation pipelines that are outside facility battery limits.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI and SIEP, the distribution of this DEP is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company, and to Contractors nominated by them (i.e. the distribution code is "C", as described in DEP 00.00.05.05-Gen.).

This DEP is intended for use by all Functions in the Group that are involved in the design and operation of pipelines, but in particular for use during the conceptual design phase when the requirement for a leak detection system is being decided.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Fluid - substances that are transported through a pipeline in liquid and/or gaseous phase.

Hard liquid - a liquid with a vapour pressure below the prevailing atmospheric pressure, e.g., gas oil.

Leak - an uncontrolled fluid release from a pipeline.

Pipeline - a system of pipes and other components used for the transportation of fluids, between (but excluding) plants. A pipeline extends from pig trap to pig trap (including the pig traps and associated pipework and valves), or, if no pig trap is fitted, to the first isolation valve within the plant boundaries or a more inward valve if so nominated.

Pipeline section - the user-selected subdivision of a pipeline.

Soft liquid - a liquid with a vapour pressure above the prevailing atmospheric pressure, e.g., ethylene, NGL, LPG, etc.

1.4 ABBREVIATIONS

ALARP	-	As Low as Reasonably Practicable
DCS	-	Distributed Control System
FAT	-	Factory Acceptance Testing
ISDN	-	Integrated Service Digital Network
LBV	-	Line Block Valve
LDS	-	Leak Detection System
MAOP	-	Maximum Allowable Operating Pressure
OPC	-	OLE (Object Linked Editing) for Process Control
PC	-	Personal Computer
PSTN	-	Public Subscriber Telephone Network
SCADA	-	Supervisory Control and Data Acquisition
SPLD	-	Statistical Pipeline Leak Detection

1.5 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced in this DEP are listed in (7). Bibliography references are listed in (8).

1.6 SUMMARY OF CHANGES FROM PREVIOUS EDITION

The previous edition of this DEP was dated September 1994. This edition is a major revision, with changes in all sections.

The previous DEP described the use of a risk approach, which proved to be difficult to apply for specifying a Leak Detection System (LDS). In addition, guidance was needed in the selection and implementation of the leak detection method, making use of lessons learned. A number of LDSs have been unsuccessful in the past because of the wrong methodology, e.g., dynamic model based systems which are notoriously unreliable and expensive, and/or because insufficient attention was paid to system reliability and operator interface. Suppliers with reliable and relatively cheap systems have entered the market and application of these systems is seen as good practice.

2. REQUIREMENT FOR LEAK DETECTION

Group and public awareness of safety and environmental issues puts increasing emphasis on the potential consequences of a pipeline leak for human safety and pollution of the environment. Proper pipeline management should ensure technical integrity of a pipeline in order to prevent failures and fluid releases and to limit the consequences if a leak occurs.

An LDS reduces the consequences of failure by enabling fast emergency response. These consequences comprise economic consequences, safety consequences, environmental consequences and the more intangible socio-political consequences. Pipeline leaks can result in bad publicity and penalties, both of which can be reduced by having a proper pipeline integrity management and emergency response system in place including an LDS.

Other measures should be in place to prevent and monitor degradation of the pipeline that in the end may lead to failure, and to consequently reduce the probability of a leak to as low as is reasonably practicable (the ALARP principle).

Most authorities do not specify an LDS for pipelines as part of the pipeline management system. However, most countries have some form of legislation and regulations regarding pipeline safety, and installing an LDS may help to obtain appropriate authorisations. In recent years, governments have tended to move from specific rules to performance-based regulations. The risk management concept has now been introduced in both Europe and the USA. Because an LDS may help pipeline operators reduce the loss of containment and hence risks, it should be considered as part of the risk management programme.

As a consequence of the above, an LDS for a new pipeline should be specified in the following cases:

- If leak detection is required by applicable mandatory legalisation. All mandatory legislation and local codes shall be complied with in full, concessions notwithstanding. If the requirements of said legislation and codes are less than those that could be provided by use of SCADA based leak detection, then the latter should be provided as long as the former are still satisfied. (SCADA based leak detection means leak detection methods using pipeline data provided by SCADA or DCS systems).
- If a single phase pipeline is provided with remote monitoring and control using telemetry/SCADA facilities. Most pipelines, especially those with high potential consequences resulting from a pipeline failure (leak event), should be provided with telemetry/SCADA to provide operational monitoring and control. If telemetry/SCADA facilities are available, a SCADA based LDS should also be provided. The LDS may be fully integrated with the SCADA or stand-alone with appropriate real time communications with the SCADA system.

Amended per Circular 41/08

- If leak detection is required as an outcome of a Quantitative Risk Assessment, hence if it would significantly reduce the failure risk. The safety consequence of a pipeline leak is directly related to population density, product toxicity, volatility and explosiveness. In general, the safety consequences for pipelines containing volatile or very toxic products (see DEP 01.00.01.30-Gen.) are more severe than for other products. Important features enabling an LDS to limit the safety consequences are fast response time, high reliability (low false alarm rate) and robustness. The environmental consequence of a pipeline leak is directly related to the environment itself, the persistence and density of the product, and the potential leak volume. Generally important features enabling an LDS to limit the environmental consequences are high localisation accuracy and high sensitivity.

In all other cases, an LDS should only be specified on an exception basis.