INTERNATIONAL STANDARD

ISO 20074

First edition
2019-07

Petroleum and natural gas industry — Pipeline transportation systems — Geological hazard risk management for onshore pipeline

Industrie du pétrole et du gaz naturel — Systèmes de transport par conduites — Gestion des risques géologiques pour les conduites terrestres

Reference number
ISO 20074:2019(E)

© ISO 2019



COPYRIGHT PROTECTED DOCUMENT

© ISO 2019

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword ..... **v**

Introduction ..... **vi**

1 Scope **1**

2 Normative references **2**

3 Terms, definitions and abbreviated terms **2**
3.1 Terms and definitions 2
3.2 Abbreviated terms 5

4 Pipeline geohazard risk management program **5**
4.1 Key principles 5
4.2 Requirements for a PGMP 5
4.3 Elements of a PGMP 6
4.3.1 General 6
4.3.2 Preliminary engineering and route selection phase 7
4.3.3 Detailed design phase 9
4.3.4 Construction phase 10
4.3.5 Operation and maintenance phase 12

5 Risk identification **13**
5.1 General 13
5.2 Geohazard inventory 17
5.3 Desktop data analysis 17
5.4 LiDAR and remote sensing imagery analysis 18
5.5 Field investigation 18
5.5.1 Field investigation techniques 18
5.5.2 Field investigation scope 18
5.5.3 Field investigation recommendations 18
5.6 Geotechnical investigation 19

6 Risk assessment **19**
6.1 General 19
6.2 Assessment systems and methods 19
6.2.1 Assessment systems 19
6.2.2 Assessment methods 20
6.3 Assessment for regional pipeline geohazard susceptibility 22
6.4 Assessment for individual pipeline geohazard 22

7 Risk mitigation **23**
7.1 General 23
7.2 Mitigations 23
7.2.1 Physical and procedural mitigations 23
7.2.2 Short-term and long-term mitigation measures 24

8 Techniques and methods for geohazard risk management **25**

9 Data management **28**

Annex A (informative) **Guidelines for pipeline route selection** **29**

Annex B (informative) **Field investigation recommendations** **31**

Annex C (informative) **Example of classification of geological environmental conditions by complexity level** **33**

Annex D (informative) **Example qualitative assessment method** **35**

Annex E (informative) **Example semi-quantitative assessment method** **45**

Annex F (informative) **Potential methods to mitigate risk** **54**

© ISO 2019 – All rights reserved

Annex G (informative) **Some key influencing factors of selected geohazards** **61**
Bibliography **66**

 © ISO 2019 – All rights reserved

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 2, *Pipeline transportation systems*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

© ISO 2019 – All rights reserved

Introduction

This document is used by pipeline operators and designers for the implementation and improvement of geohazard risk management of onshore pipelines.

It is used for the orderly and effective identification, assessment and mitigation of geohazards threatening the integrity or safety of the pipeline, and to reduce the potential for risks and accident loss. This document is intended to address geohazards along the pipeline and right-of-way (RoW).

© ISO 2019 – All rights reserved

Petroleum and natural gas industry — Pipeline transportation systems — Geological hazard risk management for onshore pipeline

1 Scope

This document specifies requirements and gives recommendations on the management of geohazard risks during the pipeline design, construction and operational periods.

This document is applicable to all operators and pipelines (existing and proposed/under construction).

This document applies to onshore gathering and transmission pipelines used in the petroleum and natural gas industries.

NOTE This document is not applicable to piping and pipelines within well-defined plants and facilities, such as pump or compressor stations, processing facilities or refineries. It is assumed that the facility site as a whole will be subject to a separate geohazard assessment to evaluate applicable natural and man-made hazards. Nevertheless, this document can provide useful guidance for assessing the geohazard threat to facilities, including the pipelines within the facility.

This document is applicable to all reasonable and credible natural hazards induced by natural forces and hazards induced by human activity that manifest similarly to natural hazards collectively referred to as "geological hazards" or "geohazards", or through industry as attributed to "natural forces". Geohazards covered by this document include, but are not limited to (not given in order of significance):

— mass wasting processes, including landslides, lateral spreads, rockfalls, debris flows, avalanches, and similar processes whether naturally occurring or anthropogenic;

— land subsidence and/or sinkhole formation, whether naturally occurring such as from dissolution of salt or carbonate rock formations (karst formation) or human caused, such as from underground mining or withdrawal of subsurface fluids such as groundwater and oil and gas;

— seismic hazards, such as ground shaking, fault rupture, liquefaction, flow failures and lateral spreading or associated secondary effects, such as seismically triggered landslides;

— volcanic hazards, such as lahars, pyroclastic flows, lava flows, dam break, and volcanically induced seismicity (excluding ashfall), where such hazards can be reasonably predicted;

— hydrologic processes, such as flooding, vertical scour of river bottoms, channel migration and bank erosion, channel avulsion, rapid lake drainage;

— permafrost/periglacial processes and geothermal effects, such as thermal degradation, frost heave or thaw settlement, thermal erosion, thermokarst;

— surface (overland), trench backfill, or earthwork fill erosion;

— expansion or collapsing processes caused by expansive and collapsible soils, such as glaciomarine clays, collapsible loess, etc.

This document is not applicable to atmospheric/environmental effects, such as the following:

— high winds induced from hurricanes and tornadoes and similar storms, except where such events are reasonably predictable and will induce geohazards such as landslides, erosion, etc.;

— lightning;

— forest or brush fires;

© ISO 2019 – All rights reserved

— ashfall from volcanic eruptions.

Furthermore, this document is not applicable to cascading events, where one remote event leads to a chain of events that eventually induces a geohazard near the pipeline. It is only applicable to geohazards that directly affect the pipeline or RoW.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1.1
construction phase
period where the pipeline is physically constructed encompassing all activities from RoW clearing, to commissioning and RoW clean-up/reinstatement

3.1.2
detailed design phase
period consisting of detailed design, which can include but is not limited to detailed hydraulic studies, mechanical design of the pipeline, stress analysis, design of RoW, full characterization of all identified geohazards, construction and logistics planning, and supply management

3.1.3
dynamic management
process that covers the pipeline's full life cycle, which can be implemented when a new hazard is identified or an existing hazard changed

3.1.4
geohazard inventory
list of all identified geohazards which can be maintained, enhanced or decreased throughout the life of the pipeline project

Note 1 to entry: Ideally, the inventory would be computer based and linked to a Geographic Information System (GIS).

3.1.5
geohazard susceptibility
geological or environmental conditions that might allow a geohazard event to occur

Note 1 to entry: A geohazard event can be natural or man-made occurrence that induces an integrity or safety threat to the pipeline or RoW.

3.1.6
geologically sensitive area
area potentially prone to geohazards

EXAMPLE Such areas include seismic fault zones or active faults, medium and large rivers, high and steep slopes, debris flows corridors, landslide prone topography, areas prone to karst collapse, mined-out areas.

© ISO 2019 – All rights reserved

3.1.7
hydrologic process
process associated with flowing water, i.e. river and stream processes

3.1.8
individual pipeline geohazard
specific geohazard that can impact the pipeline

3.1.9
land subsidence
sinking or gradual downward settling of the earth's surface with relatively little horizontal movement

Note 1 to entry: It can be caused by karst processes, collapsible or dispersive soils, piping erosion, upward migration of underground mining works, or other processes.

3.1.10
long-term management
management activities for *pipeline geohazards* (3.1.15) through monitoring and periodic re-evaluation of threat levels from geohazards

3.1.11
mass wasting process
general term for the dislodgement and gravity-driven downslope movement or transport of soil and rock material

3.1.12
operation and maintenance phase
period in pipeline lifecycle during which hydrocarbon product fills the pipeline and is transported through the pipeline, and the pipeline operator addresses issues related to pipeline and RoW maintenance and integrity

3.1.13
operator
person or organization which owns or operates a pipeline system or facilities and which is responsible for the operation and integrity of the pipeline system

3.1.14
pipeline failure consequence
impact or loss caused directly or indirectly by leakage, damage or reduced performance of a pipeline subject to geohazards

EXAMPLE Social and environmental impact, loss of life and property, negative impact on corporate reputation, and economic loss.

Note 1 to entry: This includes individual pipeline geohazard and regional pipeline geohazard.

3.1.15
pipeline geohazard
geological process or phenomenon that have the potential to cause damage to a pipeline or RoW

3.1.16
pipeline geohazard risk
combination of *geohazard susceptibility* (3.1.5), *pipeline vulnerability* (3.1.22) and *pipeline failure consequence* (3.1.14)

3.1.17
pipeline geohazard risk assessment
process of determining whether *pipeline geohazard risks* (3.1.16) are acceptable or require mitigation or an intervention

© ISO 2019 – All rights reserved

3.1.18
pipeline geohazard risk identification
process of discovery, characterization and description of credible and probable geohazards that can impact the pipeline or RoW

3.1.19
pipeline geohazard risk management
coordinated activity for guiding and coping with issues related to *pipeline geohazard risk* (3.1.16)

3.1.20
pipeline geohazard risk management program
set of processes and procedures for guiding operating companies or *operators* (3.1.13) to carry out *pipeline geohazard risk management* (3.1.19)

3.1.21
pipeline geohazard risk mitigation
process of selecting and implementing a geohazard risk countermeasure or intervention to reduce the probability of a negative event or reduce the consequences of a negative event that can impact the pipeline or RoW

3.1.22
pipeline vulnerability
conditional likelihood of a pipeline being subject to damage due to a geohazard, given a geohazard occurs and impacts the pipeline, which is an estimate of how resistant it is to damage caused by geohazards

3.1.23
preliminary engineering and route selection phase
initial period in the pipeline lifecycle during which basic design work is completed, including but not limited to route study and selection, preliminary design of the pipeline, early planning for logistics, supply management and regulatory planning and submissions

3.1.24
regional pipeline geohazard
group or cluster of existing and potential geohazards located within a defined geographic area

3.1.25
right-of-way
corridor of land within which the pipeline operator has the right to conduct activities in accordance with the agreement of the land owner

[SOURCE: ISO 13623:2017, 3.1.19]

3.1.26
seismic hazard
hazard occurring as a result of an earthquake

3.1.27
subject matter expert
SME
practitioner experienced with evaluating and managing geohazards

Note 1 to entry: The qualifications for a subject matter expert vary by location but they generally include a degree in geology, geomorphology, hydrogeology, geotechnical engineering, geological engineering, civil engineering, or related degree and at least five years of practical experience working with geohazards.

© ISO 2019 – All rights reserved