SLOVENSKI STANDARD
SIST EN 1918-2:1999

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Sistemi oskrbe s plinom - Podzemna plinska skladišča - 2. del: Funkcionalna priporočila za skladiščenje na naftnih in plinskih poljih

Gas supply systems - Underground gas storage - Part 2: Functional recommendations for storage in oil and gas fields

Gasversorgungssysteme - Untertagespeicherung von Gas - Teil 2: Funktionale Empfehlungen für die Speicherung in Öl- und Gasfeldern

Systeme d'alimentation en gaz - Stockage souterrain de gaz - Partie 2: Recommandations fonctionnelles pour le stockage en gisements de pétrole et de gaz

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ICS:

75.200	Oprema za skladiščenje nafte, naftnih proizvodov in zemeljskega plina	Petroleum products and natural gas handling equipment

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Descriptors: storage, natural gas, definitions, specifications, environmental protection, design, safety, layout, tests, operating requirements, wells, maintenance, inspection

English version

Gas supply systems - Underground gas storage - Part 2: Functional recommendations for storage in oil and gas fields

Système d'alimentation en gaz - Stockage souterrain de gaz - Partie 2: Recommandations fonctionnelles pour le stockage en gisements de pétrole et de gaz

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 234 "Gas supply", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 1998, and conflicting national standards shall be withdrawn at the latest by August 1998.

It is Part 2 of a standard on underground gas storage which includes the five following Parts:

Part 1 - Functional recommendations for storage in aquifers

Part 2 - Functional recommendations for storage in oil and gas fields

Part 3 - Functional recommendations for storage in solution mined salt cavities

Part 4 - Functional recommendations for storage in rock caverns

Part 5 - Functional recommendations for surface facilities

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

Natural gas produced from oil and gas fields is increasingly being used to supply energy requirements. The inflexible gas production from these fields does not match the variable market demand. Underground storage of compressed natural gas in oil and gas fields is an efficient common technology and has been used since 1915 for adjusting supply to meet demand.

For underground storage, natural gas is injected into subsurface oil and gas reservoirs when market demand falls below the delivery from the supply sources. It is withdrawn from storage to supplement the steady supply when demand exceeds that supply.

The primary function of underground gas storage is to ensure that supply is adjusted for peak and seasonal demand. Apart from this, the storage facilities can provide standby reserves in case of interruption to the normal supply and can help to conserve energy by storing associated gas which, otherwise, would have to be flared.

Oil and gas fields are preferred as underground storage for large gas volumes, as the containment up to the initial pressure of these reservoirs is proven by the existence of the hydrocarbon accumulation. Furthermore the knowledge about the reservoir behaviour and properties is available from the exploration phase and from the production period of the oil and gas field.

Nevertheless the suitability of each oil and gas reservoir for gas storage has to be investigated individually, to operate the storage facilities in an efficient, safe and environmentally compatible manner.

In order to construct a storage facility, wells are used to establish a controlled connection between the reservoir and the surface. The wells used for cycling the storage gas are called operating wells. In addition to the operating wells, specially assigned observation wells may be used.

Figure 1 illustrates a storage facility in an oil and gas field. Two typical completions of storage wells are shown in figures 2 and 3.

Natural gas is injected via the operating wells into the pores of a subsurface reservoir, which was originally hydrocarbon bearing, thus building up a containment of compressed natural gas. Gas is withdrawn using the operating wells. Compression may be needed for injection and withdrawal.

The storage can be cycled between the maximum and minimum operating pressures equivalent to the working gas capacity. Below the minimum operating pressure it is inevitable that a large quantity of gas, known as cushion gas, remains in the reservoir. This cushion gas volume usually represents roughly half the maximum volume of gas in place.

Recommendations for the design, construction and operation of underground storage facilities in oil and gas fields are described in clauses 4 to 7.

For specific elements of an underground gas storage facility, e.g. wells and surface installations, existing standards should be applied.

1 Scope

This standard specifies procedures and practices which are safe and environmentally acceptable.

It covers the functional recommendations for design, construction, testing, commissioning, operation and maintenance of underground gas storage facilities in oil and gas fields up to and including the wing valve of the wellhead.

The necessary surface facilities for underground gas storage are described in EN 1918-5.
In this context "gas" is any gaseous fuel which is in a gaseous state at a temperature of 15 °C and under a pressure of 1 bar and which remains in a gaseous state under storage conditions.

This European Standard specifies common basic principles for gas supply systems. Users of this European Standard should be aware that more detailed national standards and/or codes of practice may exist in the CEN member countries.

This European Standard is intended to be applied in association with these national standards and/or codes of practice and does not replace them.

This standard is not intended to be applied retrospectively to existing facilities.

2 Definitions

For the purposes of this standard, the following definitions apply:

2.1 abandoned well

Well whose use has been discontinued and which has been permanently plugged.

2.2 annulus

Space between two strings of pipes or between the casing and the borehole.

2.3 aquifer

Reservoir, group of reservoirs, or a part thereof that is fully water-bearing.

2.4 boundary fault

Fault which forms the physical border of a field.

2.5 capillary pressure

Pressure difference between the non-wetting phase and the wetting phase in porous rock.

2.6 caprock

Oiltight and gastight layer covering a porous and permeable formation.

2.7 casing

Pipe or set of pipes that can be screwed or welded together to form a string which is placed in the borehole for the purpose of supporting the sides of the borehole and to act as a barrier preventing subsurface migration of fluids when the annulus between it and the borehole has been cemented.

2.8 closure

Vertical distance between the top of the structure and the spill-point.

2.9 fault sealing capacity

Capacity of a fault to prevent the movement of fluids.

2.10 field

Hydrocarbon-bearing reservoir or a sequence thereof within defined horizontal and vertical boundaries.

2.11 formation

Body of rock characterized by a degree of homogeneous lithology which forms an identifiable geologic unit.

2.12 gas in place

Total amount of gas present in a reservoir, expressed as volumes at standard or normal conditions.

2.13 gas–oil contact

Interface between the gas and the oil phases in a reservoir.

2.14 gas–water contact

Interface between the gas and the water in a reservoir.

2.15 hydrocarbons in place

Total amount of hydrocarbons present in a reservoir, expressed as volumes at standard or normal conditions.

2.16 landing nipple

Device in a production string with an internal profile to provide for latching and sealing various types of plugs or valves.

2.17 liner

Casing installed within production casing in the lowermost section of the well without a surface string.

2.18 lithology

Study and description of rocks on the basis of colour, mineral composition, grain characteristics and crystallization.

2.19 material balance

Calculation method used to make an inventory of the fluids produced from or injected into a reservoir and the fluids remaining in the reservoir.

2.20 overburden

All sediments or rock that overlie a geological formation.

2.21 reservoir simulation

Numerical modelling of a reservoir system to predict or to monitor the behaviour and movement of the fluids in the storage formation and in general the reservoir behaviour.

2.22 observation well

Newly drilled well or existing well converted and completed for the purposes of observing subsurface phenomena such as pressure fluctuation, fluid flow, temperature, etc.

2.23 operating well

Newly drilled well or existing well converted for injection, production or both.

2.24 original reservoir pressure

Pressure existing in a reservoir before any change due to operation of the reservoir or in the surrounding area.

2.25 reservoir

Porous and permeable rock in the subsurface having area- and depth-related boundaries based on physical and geological factors. It contains fluids which are internally in pressure communication.

2.26 spill-point

Highest structural position within a reservoir, above which hydrocarbons could leak and migrate out.

2.27 tubing

Pipe or set of pipes that can be screwed, welded or flanged together to form a string through which fluids are injected or withdrawn.

2.28 well

Technical equipment of a wellbore from the wellhead to the bottom of the hole.

2.29 wellhead

Equipment supported by the top of the well casings including tubing head, shut off and flow valves, flanges and auxiliary equipment.

2.30 workover

Operation to restore or increase production or to repair the downhole completion of the well.

3 General

This clause gives requirements for general for underground gas storage. More specific requirements for underground gas storage in oil and gas fields are given in clauses 4, 5, 6, and 7.

3.1 Long-term containment of stored products

The storage facility shall be designed to ensure the continuing long-term containment of the stored products.

This presupposes:

- adequate prior knowledge of the geological formation in which the storage is to be developed and of its geological environment;

- acquisition of all relevant information needed for specifying parameter limits for construction and operation;

- demonstration that the storage is capable of ensuringlong-term containment of the stored products through its hydraulic and mechanical integrity.

The construction facility shall be constructed and operated so as to maintain the integrity of the containment.

No other installation or activity shall affect the integrity of containment.

3.2 Environmental conservation

3.2.1 Underground

The storage facility shall be designed, constructed and operated so as to prevent any inadmissible impact on the environment.

This presupposes that the surrounding formations have been identified and their relevant characteristics determined, and that they are adequately protected.

3.2.2 Surface environment

The storage facility shall be designed, constructed and operated so that it cannot cause any inadmissible ground movement at the surface and that it will prevent any inadmissible impact on the environment.

3.3 Safety

The storage facility shall be designed, constructed, operated and maintained so as to present no inadmissible risk to the safety of the staff and the public.

In addition to the usual safety rules and recommendations applicable to all comparable industrial installations, measures shall be taken to reduce the risk and consequences of blow-out and leakages.

3.4 Monitoring

In order to verify that the recommendations above are met, monitoring systems and procedures shall be implemented.

4 Design

4.1 Design principles

Surface and subsurface installations shall be designed to control the process and utility fluids at any combination of pressure and temperature to which they may be subjected within a determined range of operating conditions. They shall conform to existing standards for the individual part of a storage system.

Proven technology shall be used for analysis and calculations. All relevant data should be documented.

Technology proven in the oil and gas industry should be used where possible.

The design shall be based on written procedures and shall be carried out by competent personnel and companies.

All relevant data concerning the design (such as equipment specification, operating procedures, quality assurance plan) shall be documented and made available to the owner and the operator of the storage facility.

Emergency procedures should be developed.

Adherence to the safety and environmental requirements shall be monitored.

4.2 Field description

A review of all available information shall be conducted in order to:

- identify the trapping mechanism;
- evaluate the structure of the reservoir and its closure;
- delineate the boundaries of the proposed storage formation;
- identify the fault pattern;
- determine the sealing capacity of the boundary faults;
- determine sealing properties of the surrounding formations;
- determine the sedimentology of the reservoir;