SLOVENSKI STANDARD
SIST EN 1918-3:1999

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Sistemi oskrbe s plinom - Podzemna plinska skladišča - 3. del: Funkcionalna priporočila za skladiščenje v solnih kavernah

Gas supply systems - Underground gas storage - Part 3: Functional recommendations for storage in solution-mined salt cavities

Gasversorgungssysteme - Untertagespeicherung von Gas - Teil 3: Funktionale Empfehlungen für die Speicherung in gesolten Salzkavernen

Systeme d'alimentation en gaz - Stockage souterrain de gaz - Partie 3: Recommandations fonctionnelles pour le stockage en cavités salines creusées par dissolution

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

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English version

Gas supply systems - Underground gas storage - Part 3: Functional recommendations for storage in solution-mined salt cavities

Système d'alimentation en gaz - Stockage souterrain de gaz - Partie 3: Recommandations fonctionnelles pour le stockage en cavités salines creusées par dissolution

Gasversorgungssysteme - Untertagespeicherung von Gas - Teil 3: Funktionale Empfehlungen für die Speicherung in gesolten Salzkavernen

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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
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Central Secretariat: rue de Stassart, 36 B-1050 Brussels

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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of an identical text or by endorsement, at the latest by August 1998, and conflicting national standards shall be withdrawn at the latest by August 1998.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 3 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

The underground storage of compressed natural gas (CNG) and liquified petroleum gas (LPG) in solution-mined salt cavities is a proven technology for adjusting gas supply systems to short-term and seasonal changes in gas demand.

It is known that suitable salt layers and salt domes are impermeable to gas at normal pressures. In addition cracks and faultsin the salt are healed by the viscoplastic behaviour of the salt under the geostatic pressure.

A cavity is constructed by drilling a well into the salt dome or salt layer deposit with adequate protection for the underlaying and overlaying stratas. Figure 1 illustrates a gas cavity in a salt dome or salt strata.

Cavities are leached by the controlled circulation of water with known solution characteristics down the wellbore into the salt zone and back as brine to the surface (see figure 2).

Cavities for compressed natural gas (CNG)

Once the design volume has been reached, the brine is displaced from the cavity by the controlled injection of CNG.

The pressure in a CNG cavity can be cycled between the minimum and the maximum operating pressure of the cavity.

Cavities for liquid petroleum gas (LPG)

Once the design volume of the cavity has been reached, the brine is displaced from the cavity by controlled injection of LPG.

The brine is generally collected in a pond, which has the minimum volume for the volume of the cavity. When it is necessary to recover the LPG from the cavity, the brine stored in the pond will be injected into the cavity, while the LPG comes out. An LPG cavity , in this case, does not require any downhole pumping equipment.

This is the most common method for constructing and operating an LPG cavity in salt. With shallow salt cavities, however, the operation may be similar to the operation of a rock cavern for LPG (see EN 1918-4).

Figure 3 gives a schematic view of an LPG cavity in operation.

There are more than 30 years of experience of storage of CNG and LPG in solution-mined salt cavities, and the technique is well known and highly developed.

To guarantee a high level of safety sophisticated techniques are available for :

- the evaluation of the suitability of the geological salt formation for storage;

- the description of the salt behavior under stress conditions;

-the description of the local stresses around the salt cavities and the demonstration of its mechanical stability;

-drilling, cementing and completion of wells to prevent external gas migration from the cavity towards the surface or upper geological formations;

-controlled leaching of the cavity to its design form and size;

-first gas filling under controlled conditions;

- monitoring critical parameters of the cavities in operation.

1 Scope

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

It covers the functional recommendations for design, construction, testing, commissionning, operation and maintenance of underground gas storage facilities in solution-mined salt cavities 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.

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 purpose of this standard, the following definitions apply :

2.1 annulus

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

2.2 blanket

Liquid or gaseous medium in the annulus between the last cemented casing string and the outer leaching string used in order to ensure that the planned shape is achieved by controlled leaching of the cavity during the whole leaching period.

2.3 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 bore(hole) and to act as a barrier preventing subsurface migration of fluids when the annulus between it and the borehole has been cemented.

2.4 casing shoe

Bottom end of a casing string :

EXAMPLE: Casing shoe is a reinforced collar of steel screwed or welded onto the bottom joint of casing to prevent abrasion or distorsion of the casing as it forces its way past obstruction on the wall of the borehole.

2.5 cavity

Leached volume in the salt below the shoe of the last cemented casing.

2.6 cavity convergence

Reduction in the cavity volume by salt creeping.

2.7 cavity free volume

Volume of the cavity that is available for the injection of gas.

2.8 cavity height

Distance between the bottom of the shaft and the lowest point of the cavity.

2.9 cavity pillar

Mass of salt that remains between two adjacent cavities after the leaching phase.

NOTE : This is normally defined in terms of thickness.

2.10 cavity roof

Upper part of the cavity located between the bottom of the shaft and the vertical wall of the cavity.

2.11 cavity shaft

Well segment below the shoe of the last cemented casing string and above the cavity roof.

2.12 cavity sump

Bottom part of the cavity filled with sedimented insoluble materials and residual brine.

2.13 cavity stock

Total quantity of gas in the cavity at any given moment.

2.14 cavity working gas volume

Difference between the stock and the minimum cavity stock (cushion gas) at any given moment.

2.15 cavity flowrate

Volume per time that can be withdrawn from or injected into a cavity.

NOTE: It can be given as maximum-stock flowrate, minimum-stock flowrate, design flowrate.

2.16 cementing

Operation whereby a cement slurry is pumped and circulated down a well through the casing and then upwards into the annular space between the casing and the open or cased hole.

2.17 completion

Technical equipment inside the last cemented casing for leaching, first gas filling or production/injection.

2.18 drilling

All technical activities connected with the construction of a well.

2.19 eductor

String of tubing or casing placed within the production completion to displace the brine out of the cavity by injection of gas.

2.20 exploration

All technical activities connected with the investigation of a geological site.

2.21 gastightness

Adherence to a minimum leakage rate in an approved test procedure.

2.22 hanger

Hanging device for supporting the weight of pipes, which where necessary should assure the pressure tightness of the annulus.

2.23 leaching; solution mining

The controlled supply of water into the salt strata and the production of brine in order to construct a salt cavity.

2.24 leaching phase

Period between two rearrangements of the leaching completion.

2.25 logging

Measurement of any physical parameter versus depth in a well.

2.26 master valve

Valve at the wellhead, vertically above the well, designed to close off the well in case of emergency or maintenance.

2.27 maximum cavity stock

Maximum quantity of gas that the cavity can contain in the accepted operating conditions.

2.28 maximum cavity operating pressure

Maximum pressure that the cavity may be subjected to under normal operating and maintenance conditions.

NOTE: It is usually given as the maximum pressure at the shoe of the last cemented casing.

2.29 maximum cavity working gas volume

Difference between the maximum and the minimum stock.

2.30 minimum cavity operating pressure

Minimum pressure that the cavity may be subjected to under normal operating and maintenance conditions.

NOTE: It is usually given as the minimum pressure at the shoe of the last cemented casing.

2.31 minimum cavity stock; cushion gas

Minimum quantity of gas that the cavity can contain in the accepted operating conditions.

2.32 seismic technology

Generation of acoustic waves underground, by mechanical shocks or vibrations. The depth of the underground layers may be estimated by measuring the time taken for the signal to be reflected from the various layers to the surface. Seismic surveys also help to determine the thickness of layers and fault pattern.

2.33 overburden

All sediments or rock that overlie a geological formation.

2.34 string

Set of casing or tubing pipes plus additional equipment, screwed or welded together for a defined purpose.

EXAMPLES : cemented casing string , eductor string, production or leaching string.

2.35 subsurface safety valve

Valve installed in tubing or casing beneath the wellhead for the purpose of stopping the flow of gas in emergency.

2.36 tubing

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

2.37 well

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

2.38 wellhead

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

2.39 workover

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