SLOVENSKI STANDARD
SIST EN 1918-5:2016

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Infrastruktura za plin - Podzemna plinska skladišča - 5. del: Funkcionalna priporočila za nadzemno opremo

Gas infrastructure - Underground gas storage - Part 5: Functional recommendations for surface facilities

Gasinfrastruktur - Untertagespeicherung von Gas - Teil 5: Funktionale Empfehlungen für Übertageanlagen

Infrastructures gazières - Stockage souterrain de gaz - Partie 5: Recommandations fonctionnelles pour les installations de surface

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ICS:

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

SIST EN 1918-5:2016 **en,fr,de**

EUROPEAN STANDARD

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EN 1918-5

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English Version

Gas infrastructure - Underground gas storage - Part 5: Functional recommendations for surface facilities

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Gasinfrastruktur - Untertagespeicherung von Gas - Teil 5: Funktionale Empfehlungen für Übertageanlagen

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

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European foreword

This document (EN 1918-5:2016) has been prepared by Technical Committee CEN/TC 234 “Gas infrastructure”, 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of an identical text or by endorsement, at the latest by September 2016 and conflicting national standards shall be withdrawn at the latest by September 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1918-5:1998.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

For a list of significant technical changes between this European Standard and EN 1918-5:1998, see Annex B.

This document is Part 5 of a European Standard on “Gas infrastructure - Underground gas storage” which includes the following five 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.*

Directive 2009/73/EC concerning common rules for the internal market in natural gas and the related Regulation (EC) No 715/2009 on conditions for access to the natural gas transmission networks also aim at technical safety including technical reliability of the European gas system. These aspects are also in the scope of CEN/TC 234 standardization. In this respect, CEN/TC 234 evaluated the indicated EU legislation and amended this technical standard accordingly, where required and appropriate.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard covers the functional recommendations for the design, construction, testing, commissioning, operation, maintenance and abandonment of the surface facilities for underground gas storage (UGS), between the wellhead and the connection to the gas grid.

It specifies practices which are safe and environmentally acceptable.

For necessary subsurface facilities for underground storage, the relevant part of EN 1918-1 to EN 1918-4 applies.

In this context, "gas" is any hydrocarbon fuel:

— which is in a gaseous state at a temperature of 15 °C and under a pressure of 0,1 MPa (this includes natural gas, compressed natural gas (CNG) and liquefied petroleum gas (LPG). The stored product is also named fluid);

— which meets specific quality requirements in order to maintain underground storage integrity, performance, environmental compatibility and fulfils contractual requirements.

This European Standard specifies common basic principles for underground gas storage facilities. Users of this European Standard should be aware that more detailed standards and/or codes of practice exist. A non-exhaustive list of relevant standards can be found in Annex A.

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

In the event of conflicts in terms of more restrictive requirements in the national legislation/regulation with the requirements of this European Standard, the national legislation/regulation takes precedence as illustrated in CEN/TR 13737 (all parts).

NOTE CEN/TR 13737 (all parts) contains:

— clarification of relevant legislation/regulations applicable in a country;

— if appropriate, more restrictive national requirements;

— national contact point for the latest information.

This European Standard is not intended to be applied retrospectively to existing facilities.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1918-1, *Gas infrastructure - Underground gas storage - Part 1: Functional recommendations for storage in aquifers*

EN 1918-2, *Gas infrastructure - Underground gas storage - Part 2: Functional recommendations for storage in oil and gas fields*

EN 1918-3, *Gas infrastructure - Underground gas storage - Part 3: Functional recommendations for storage in solution-mined salt cavities*

EN 1918-4, *Gas infrastructure - Underground gas storage - Part 4: Functional recommendations for storage in rock caverns*

3 Requirements for underground gas storage

3.1 General

The main equipment that may be required for both the withdrawal and the injection operations of gas storage facility is described below.

Where no specific mention of LPG or natural gas is made, the following statements refer to both.

3.2 Underground gas storage

3.2.1 Overview and functionality of underground gas storage

EN 1918 covers storage of natural gas, Compressed Natural Gas (CNG) and Liquefied Petroleum Gas (LPG). Because of the relevance of underground gas storage of CNG the major part of this introduction is related to the storage of natural gas.

The underground gas storage (UGS) is an efficient proven common technology and is in use since 1915. UGS became an essential indispensable link in the gas supply chain for adjusting supply to meet short-term and seasonal changes in demand.

Natural gas produced from oil and gas fields is increasingly being used to supply energy requirements. As the gas supply from these fields does not match with the variable market demand, natural gas is injected into subsurface storage reservoirs when market demand falls below the level of gas delivery or if there is an economic incentive for injection. Gas is withdrawn from storage facilities to supplement the supply if demand exceeds that supply or withdrawal is economically attractive.

The primary function of UGS is to ensure that supply is adjusted for peak and seasonal demand. Apart from this, the storage facilities can provide stand-by reserves in case of interruption of the planned supply. Increasingly UGS is applied for commercial storage services.

Thus, in summary underground gas storage facilities can be used for:

— security of supply;

— providing flexibilities;

— balancing of seasonal demand variabilities;

— structuring of gas supply;

— provision of balancing energy for the optimization of transport grids;

— trading and arbitrage purpose;

— stand-by provisions and strategic reserves;

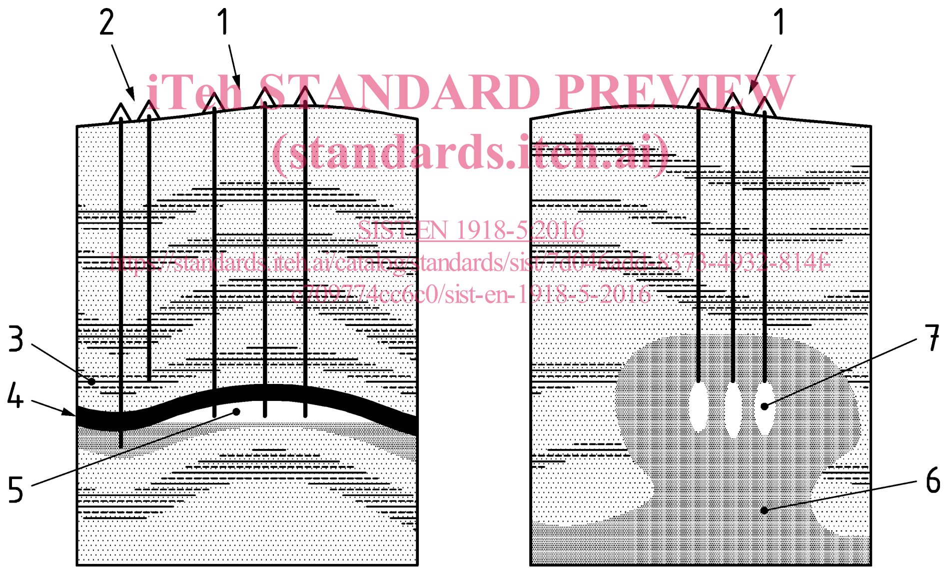
— structuring renewable energy sources – power to gas;

— storage of associated gas as service for production optimization and resultant environmental conservation.

3.2.2 Types of UGS

For storage of natural gas, several types of underground gas storage facilities can be used which differ by storage formation and storage mechanism (see Figure 1):

- pore storage:
  - storage in aquifers;
  - storage in former gas fields;
  - storage in former oil fields.
- caverns:
  - storage in salt caverns;
  - storage in rock caverns (including lined rock caverns);
  - storage in abandoned mines.



Key

1 operating wells
2 monitoring wells
3 indicator horizon
4 caprock
5 storage reservoir and stored gas
6 salt dome
7 cavern

Figure 1 — Storage in aquifers, oil and gas fields, solution mined salt caverns

For LPG storage, only salt or rock caverns can be applied.

The UGS type applied is dependent on the geological conditions and prerequisites as well as on the designed capacity layout.

3.2.3 General characterization of UGS

UGS are naturally or artificially developed reservoirs respectively artificially developed caverns in subsurface geological formations used for the storage of natural gas (or LPG). A UGS consists of all subsurface and surface facilities required for the storage and for the withdrawal and injection of natural gas (or LPG). Several subsurface storage reservoirs or caverns may be connected to one or several common surface facilities.

The suitability of subsurface geological formations have to be investigated individually for each location, in order 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 or cavern and the surface facilities at the well head. 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 to monitor the storage performance with respect to pressures and saturations and the quality of reservoir water as well as to monitor any interference in adjacent formations.

For the handling of gas withdrawal and gas injection, the surface facilities are the link between the subsurface facilities and the transport system, comprising facilities for gas dehydration/treatment, compression, process control and measurement.

Gas is injected via the operating wells into the pores of a reservoir or into a cavern, thus building up a reservoir of compressed natural gas (or LPG).

Gas is withdrawn using the operating wells. With progressing gas withdrawal, the reservoir or cavern pressure declines according to the storage characteristic. For withdrawal, re-compression may be needed.

See Figure 2 for the injection mode and withdrawal mode.

The working gas volume can be withdrawn and injected within the pressure range between the maximum and minimum operating pressure. In order to maintain the minimum operating pressure, it is inevitable that a significant quantity of gas, known as cushion gas volume, remains in the reservoir or cavern.

The storage facility comprises the following storage capacities:

— working gas volume;

— withdrawal rates;

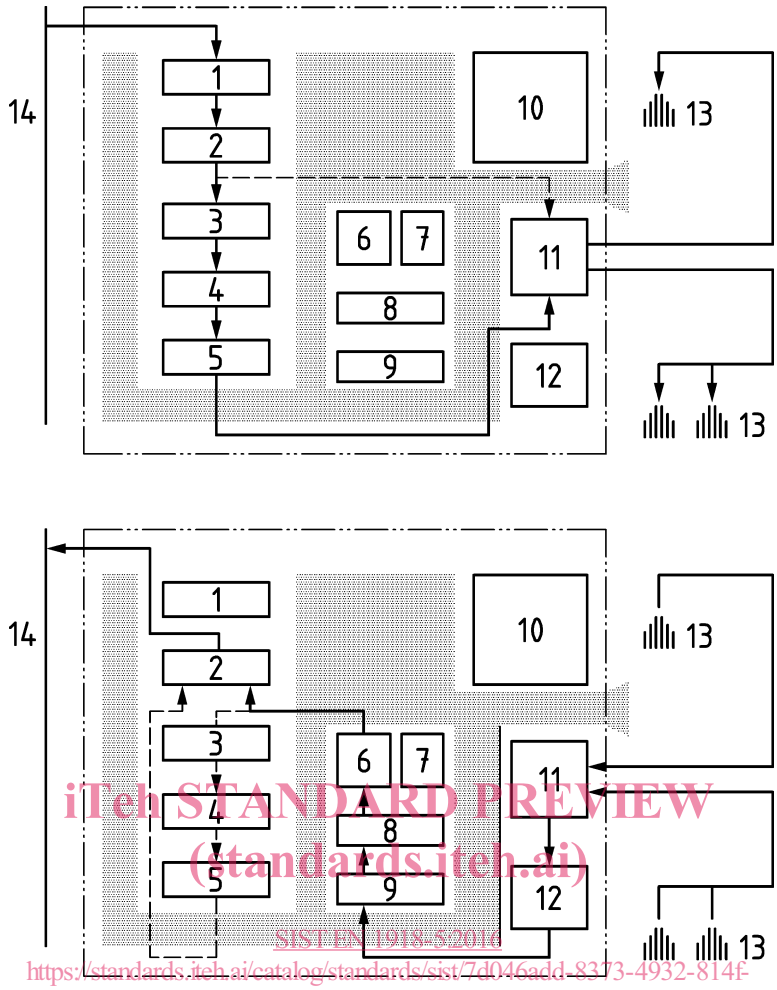
— injection rates.

The technical storage performance is given by withdrawal and injection rate profiles versus working gas volume.

Recommendations for the design, construction, testing and commissioning, operation and abandonment of underground storage facilities are described in Clauses 5, 6, 7, 8 and 9.

Construction of a storage facility begins after the design and exploration phase and should be carried out in accordance with the storage design. It is based on proven experience from the oil and gas industry.

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



Key

1	filter	9	gas heaters
2	gas metering	10	control room
3	compressors	11	manifold
4	coolers	12	solid & liquid separation
5	oil separator	13	storage well
6	gas conditioning (e. g. glycol)	14	gas transport system
7	glycol regeneration	- - - - -	withdrawal with compression
8	pressure reduction	.....	injection without compression

Figure 2 — Example of flow path injection (above) and withdrawal (below)

3.3 Injection facilities

3.3.1 Liquid and solid separation

Liquids and solid particles that the gas stream may contain should be removed by filters and/or separators to prevent damage to or incorrect operation of the equipment.

3.3.2 Gas analysis and metering

Mass and/or volumetric flow rates are normally measured and recorded when injected into a storage facility. Gas analysis may be required to check gas quality before injection into a storage facility.

3.3.3 Gas compression

Compression will normally be required to inject natural gas into the storage reservoir and cavern, unless the storage system pressure is lower than the pressure in the supplying transport system. Gas or electrical power may be used to drive the compressors.

3.3.4 Gas cooling

After compression, the natural gas is cooled to ensure the maximum temperature allowable for equipment like separators, compressors, piping, etc., especially for the protection of pipe coatings, is not exceeded.

In order to maintain the pressure of the stored LPG at a suitable level, cooling of the incoming LPG or condensation of the vapour phase may be required.

3.4 Withdrawal facilities

3.4.1 Prevention of hydrate formation

Hydrate formation in a gas stream of known composition can be predicted by means of experimental data or calculated using vapour/liquid/solid equilibrium constants.

The formation of hydrates can be prevented by inhibiting, heating and/or dehydrating the gas.

3.4.2 Solid and liquid separation

Natural gas produced from underground storage may contain solids and/or liquids that shall be separated upstream of the other treatment facilities.

3.4.3 Gas heating

To avoid excessively low temperatures due to pressure reduction heating may be required.

3.4.4 Pressure reduction

Pressure reduction from wellhead pressure to the transmission system pressure may be obtained by specific equipment, for example control valves, choke valves or expanders.

3.4.5 Gas conditioning

Gas from underground gas storage facilities may contain water and shall be dehydrated to meet the required water dew point specifications.

Gas from storage facilities may contain higher hydrocarbon components and shall be treated to meet the hydrocarbon dew point.

Natural gas from underground storage may contain minor components (e.g. hydrogen sulfide, carbon dioxide, carbonyl sulfide) that shall be reduced to the required concentrations according to the gas specification.

If the specification requires LPG with a water content below that in saturated conditions, then a dehydration of the LPG may be required.

Each component to be reduced may require a separate and different conditioning process.

3.4.6 Re-Compression

The operating pressure of the storage is usually higher than the gas transport system pressure. Storage facilities and/or plant may be operated at a pressure lower than the gas transport system pressure to increase the working gas volume. In this case, compressors are required.