BS EN 1918-5:2016

BSI Standards Publication

Gas infrastructure — Underground gas storage

Part 5: Functional recommendations for surface facilities

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National foreword

This British Standard is the UK implementation of EN 1918-5:2016. It supersedes BS EN 1918-5:1998 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GSE/33, Gas supply.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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

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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of an identical text or by endorsement, at the latest by September 2016 and conflicting national standards shall be withdrawn at the latest by September 2016.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;

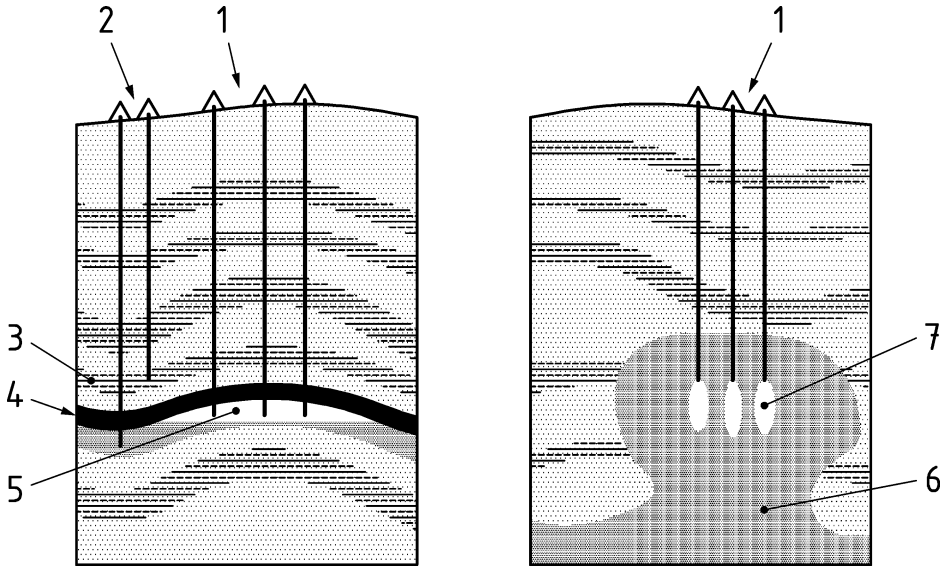
  — storage in former oil fields.

— 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;

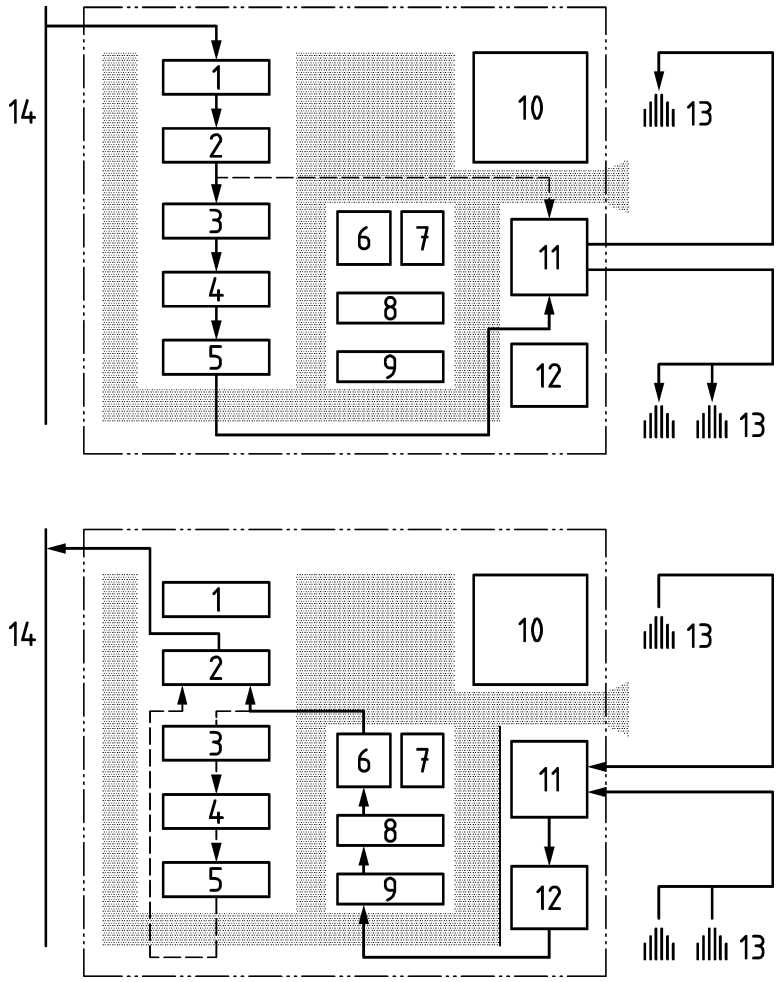
— injection rates.

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.

3.4.7 Gas analysis and metering

Mass and/or volumetric flow rates are normally measured and recorded during withdrawal from the storage facility. Gas analysis may be required to check gas quality while withdrawing from the storage facility.

3.4.8 Odorization

If required, odorization of the gas leaving the surface facilities is done downstream of the gas processing.

3.5 Utilities

3.5.1 Treatment of recovered water

If required, equipment should be provided to treat water produced from the wells and recovered during separation or conditioning before it is disposed of or reinjected.

3.5.2 Fuel gas

A fuel gas system is required for the operation of gas fired equipment such as heaters, compressor drivers or boilers.

3.5.3 Instrument system

An instrument air, a hydraulic or an electrical system may be required for the control and operation of the surface and subsurface systems.

3.5.4 Corrosion protection

Suitable corrosion protection measures for all parts of the facility are necessary, such as, e.g. cathodic protection, coating, insulation shelters, inhibition or material selection.

3.5.5 Power supplies

Suitable power supplies are necessary for the operation of all electrical equipment on site.

A backup system is required to operate the safety equipment.

3.5.6 Others

Field flow lines, process control system, venting systems, inhibition system and, if applicable, flare.

3.6 Leaching and debrining facilities for salt caverns

Leaching facilities for salt caverns may consist of:

— a system for leaching water delivery with:

  — water off take station(s) at the leaching water source with filters, pumps;

  — water wells, if required;

  — line pipe from the leaching water off take station(s) to the leaching plant;

  — in some cases water reservoirs or tanks;

  — water injection pumps, filters;

  — line pipe from the leaching plant to the well head(s);

— a system for brine discharge with:

  — line pipe for brine discharges;

  — in some cases brine reservoirs or tanks;

  — brine disposal wells, if applicable;

  — brine discharge pumps, filters, dispersers;

— a system for the cavern blanket with:

  — blanket storage, filters and pumps at the leaching plant;

  — line pipe for the blanket from the leaching plant to the wellhead(s);

  — separation equipment for the removal of blanket from brine, if required;

— a system for ensuring the safety of the facility including a shutdown system;

— equipment for process control.

A system for ensuring the safety of the facility during the first gas filling shall be provided.

3.7 LPG

3.7.1 Solid and liquid separation

For the treatment of LPG, specific equipment, for example separators or coalescers, may be used for the removal of solid particles or water droplets.

3.7.2 Liquid transfer

Liquid transfer pumps may be required for the filling of LPG storage facilities.

3.7.3 Heating

LPG may be delivered to the storage facility under cryogenic conditions. To allow the fluid to be warmed to a level suitable for the storage system, the surface facilities should include the installation of gas heaters.

3.7.4 Cooling

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.

3.7.5 Conditioning

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

3.7.6 Colourization

Prior to delivery of LPG, the contract specification may require colourization.

4 Design

4.1 General

Surface and subsurface installations shall be designed in an integrated way in order to achieve an environmentally, economically and technically optimized layout.

Surface and subsurface installations shall be designed to control the process and used 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. The key parameters and procedures at the connection with the gas transport system and the operative cooperation with the transport system operator shall be considered.

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

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.

During the design phase of the UGS, the following activities and reviews related to safety will be carried out, including but not limited to:

— HAZOP review or equivalent;

— risk analysis and pre-construction safety study.

The design should be summarized in a report which is sufficient for the purpose of demonstrating that adequate safety and reliability have been incorporated into the design, construction, operation and maintenance of the facility. This safety study will be updated at storage construction completion to take into account the actual facility to be operated.

4.2 Safety and environmental issues

The design of the plant shall enable the operator to conduct its operations in such a way as to minimize the risk of harm to its employees, contractors and all others who may be affected directly or indirectly by its activities, and to comply with standards on safety, occupational health and environmental protection.

For this, the following should be taken into consideration at the design stage:

— selection of the least harmful process materials and intermediates;

— minimization of the inventory of hazardous materials;

— minimization of emissions of harmful solid, liquid and gaseous substances;

— design of combustion plant and equipment such as gas turbines, diesel and petrol engines, flares and boilers to produce exhaust gas, which conforms to the authorized emission contents for oxides of nitrogen and sulphur and other pollutants;

— location of plant to minimize the risk to neighbours and their property;

— setting out and if necessary protection of sections of plant so that the domino effect remains the lowest reasonably practicable;

— if required, an appropriate impervious sealing material, with an appropriate and impervious retaining kerb to avoid spillage;

— treatment and handling of harmful spills in a safe and environmentally acceptable manner;

— provision for the treatment of liquid discharges to drainage systems, water courses or the sea to render them harmless or for their storage in tight tanks before removal;

— safe and environmentally acceptable storage of materials;

— monitoring of safety and environmental performance throughout the life of the facility;

— the need to close certain valves from a remote location, such as the main control room or the wellhead compound, and for automatic emergency shutdown systems.

4.3 Engineering

Construction materials for piping, vessels and ancillary equipment shall be chosen considering the most severe operating conditions. These may include gas composition, maximum wellhead static and dynamic pressure, operational temperature variations and minimum depressurization temperatures if applicable.

Aboveground pipework shall be properly anchored and supported to withstand anticipated external forces.

A sufficient number of valves shall be installed at strategic locations to enable sections to be isolated during routine testing and maintenance and in emergency.

4.4 Security

Arrangement shall be made to prevent the entry, either intentional or unintentional, of unauthorized persons to the central processing and the remote wellhead areas.

Arrangement shall be made to prevent field piping or flow lines from damage from unauthorized access and construction or farming activities.

4.5 Pumps and compressors

The pumping and compression systems (liquid or gas) shall be equipped with a control system allowing the unit to be started by station personnel or automatically. The control system shall be designed so that downstream equipment cannot be subjected to pressures higher than that for which they were designed, and so that the machine may be rapidly and safely shut down if a system malfunction occurs. Emergency shutdowns shall also be designed so that the machines are left in a safe condition.

4.6 Process control and monitoring

Control systems may be local, remote, or a combination of these. The control system shall monitor all relevant information from the processes, utilities, fire-fighting, fire and leak detection systems.

4.7 Back-up systems

Depending on the complexity and importance of the facilities back-up systems may be included.

4.8 Manning levels

The central control facility, which may be remote from the storage location, shall be permanently manned.

4.9 Maintenance and inspection

All installations shall be designed to facilitate inspections and shutdowns determined by maintenance requirements.

4.10 Flaring and venting

The plant shall be designed to minimize the need for flaring and venting.

The flares and vents shall be adequately located in order to respect the radiation and explosive zone surfaces.

4.11 Prevention and control of fires and explosions

The design of the surface facilities shall include fire and explosion prevention, protection and appropriate firefighting systems.

A gas and fire detection system should be installed in process buildings.

Flameproof and/or explosion proof equipment can be needed in certain areas.

5 Construction

The construction phase can start when the design is completed and the needed authorizations are granted.

The plant shall be constructed in accordance to the design, in compliance with national and local regulations, to specific constructions standards (Annex A can be used as a guide) and by competent persons.

A special attention to health, safety and environmental impact shall govern the construction stage:

— health and safety of personnel and neighbours shall be ensured;

— environment protection shall be controlled (e.g. noise, emissions, waste).

Before the plant and equipment are formally released to the commissioning stage, a procedure shall be followed to ensure that the completed plant has been constructed according to the designer’s intent. Special attention shall be given to documentation.

6 Testing and commissioning

The criteria for safety and environmental issues given in Clause 4 apply in the testing and commissioning stage.

In addition, during commissioning and testing, procedures written by a competent person shall be followed to ensure the safety of personnel and protection of the environment.

Before the plant and equipment is formally released to the operator, a procedure shall be followed to ensure that the completed plant has been constructed according to the designers' intent, and that all the documentation needed by the operator is available. Plant and equipment should not be accepted unless it is accompanied by the correct certification and documentation in accordance with the relevant quality assurance standard.

Plant and equipment shall be tested to demonstrate that they operate in accordance with the design. Test procedures described in European or other internationally or nationally recognized standards and codes should be used.

7 Operation and maintenance

The plant shall be operated and maintained in accordance with the design. Procedures should be specifically provided to ensure safety and proper environmental management of the plant.

Written operating and maintenance procedures shall be available. Modifications to plant and equipment, systems and procedures shall be designed and carried out by competent persons without reducing the level of safety.

Plant and equipment shall be operated and maintained so that emission levels do not increase above design limits.

A plan of inspection of pressure equipment must be set up in accordance with the regulations. Regular inspections shall be conducted to check the integrity of plant and equipment.

The operating company shall establish a training and review programme to ensure the competence of operating staff.

8 HSE

8.1 HSE management

The operator shall implement, within a reasonable time prior to start-up of the facility, a Health, Safety and Environmental (HSE) management system in accordance with applicable directives in force. It shall demonstrate that the operator takes measures to limit risks.

The HSE management system shall include operator's Health, Safety, Security and Environmental (HSSE) requirements, rules, and regulations. It will provide a manual and procedures with the objective to accomplish operator's HSSE performance standards. Subject manuals and procedures shall be auditable.

The HSE manual shall provide a structured collection of guidelines on HSE matters in all areas of underground gas storage by the storage facility operator. It covers but is not limited to the following topics: HSE management systems, HSE management in business and hazards and effects management tools & techniques.

8.2 Emergency procedures

The operator of the storage facility shall include emergency procedures in its HSE management system, which shall include but not be limited to:

— established emergency procedures, including procedures for the safe operation or the shut-down of the storage facility or parts thereof, in the event of a failure or other emergency, and safety procedures for personnel at emergency site;

— documented emergency procedures to deal with fluid releases, including mitigation of the release, notification and protection of operating personnel, documentation for notification and protection of the public in accordance with national regulation, and communications with community and regulatory bodies;

— audit and test procedures for operating personnel at frequencies determined by factors such as condition of the system and/or population density;

— a document system for audit and test results and recommendations.

9 Abandonment

9.1 General

The definitive closure and abandonment including restoration of the surface area of a storage facility shall be considered for each location, with special attention paid to long term integrity. In the case of the abandonment of one or few wells during operation, similar procedures for plugging and abandoning wells shall be applied.

In individual cases, part of the infrastructure can be reused for another purpose leading to a transfer of liability. In the present standard, only definitive abandonment will be considered.

The studies and measurements shall prove the safety of the condition left after abandonment.

The abandonment of a storage comprises:

— withdrawal of the recoverable gas from the storage and from the surface facility;

— flooding in case of a salt cavern;

— plugging and abandonment of wells;

— dismantling surface facilities;

— monitoring.

Total abandonment program has to be confirmed by relevant authorities.

All operations comprised in the abandonment process must be properly documented.

9.2 Withdrawal of the gas

See specific clauses in relevant EN 1918-1 to EN 1918-4.

9.3 Plugging and abandonment of wells

See specific clauses in relevant EN 1918-1 to EN 1918-4.

9.4 Surface facilities

After withdrawal of gas from the surface facilities, the dismantling of surface facilities shall be done according to industrial requirement and regulation in force, including potential site remediation.

9.5 Monitoring

Monitoring and testing necessary for a safe abandonment should be put in place.

Annex A
(informative)

Non-exhaustive list of relevant standards

Reference	ICS	Title
EN 1127-1	13.230	*Explosive atmospheres — Explosion prevention and protection — Part 1: Basic concepts and methodology*
EN 1594	23.040.01 75.200	*Gas infrastructure — Pipelines for maximum operating pressure over 16 bar — Functional requirements*
EN 1776	75.180.30	*Gas supply systems — Natural gas measuring stations — Functional requirements*
EN 12327	91.140.40	*Gas infrastructure — Pressure testing, commissioning and decommissioning procedures — Functional requirements*
EN 12583	23.140 75.200	*Gas infrastructure — Compression stations — Functional requirements*
EN 12732	25.160.40	*Gas infrastructure — Welding steel pipework — Functional requirements*
EN 12954	77.060	*Cathodic protection of buried or immersed metallic structures — General principles and application for pipelines*
EN 13509	77.060	*Cathodic protection measurement techniques*
EN 14505	77.060	*Cathodic protection of complex structures*
EN 15112	77.060 23.040.99	*External cathodic protection of well casings*
CEN/TR 13737-1	91.140.40	*Gas infrastructure — Implementation Guide for Functional Standards prepared by CEN/TC 234 — Part 1: General*
CEN/TR 13737-2	91.140.40	*Gas infrastructure — Implementation Guide for Functional Standards prepared by CEN/TC 234 — Part 2: National Pages related to CEN/TC 234 standards*
EN ISO 3183	75.200 77.140.75	*Petroleum and natural gas industries — Steel pipe for pipeline transportation systems*
EN ISO 10405	23.040.01 75.180.10	*Petroleum and natural gas industries — Care and use of casing and tubing*
EN ISO 10417	75.180.10	*Petroleum and natural gas industries — Subsurface safety valve systems — Design, installation, operation and redress*
EN ISO 10423	75.180.10	*Petroleum and natural gas industries — Drilling and production equipment —Wellhead and Christmas tree equipment*
EN ISO 10424-1	75.180.10	*Petroleum and natural gas industries — Rotary drilling equipment — Part 1: Rotary drill stem elements*
EN ISO 10424-2	75.180.10	*Petroleum and natural gas industries — Rotary drilling equipment — Part 2: Threading and gauging of rotary shouldered thread connections*
EN ISO 10427-1	75.180.10	*Petroleum and natural gas industries — Equipment for well cementing — Part 1: Casing bow-spring centralizers*
EN ISO 10427-2	75.180.10	*Petroleum and natural gas industries — Equipment for well cementing — Part 2: Centralizer placement and stop-collar testing*
EN ISO 10427-3	75.180.10	*Petroleum and natural gas industries — Equipment for well cementing — Part 3: Performance testing of cementing float equipment*

Reference	ICS	Title
EN ISO 10432	75.180.10	*Petroleum and natural gas industries — Downhole equipment — Subsurface safety valve equipment*
EN ISO 10870	13.060.70	*Water quality — Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters (*ISO 10870*)*
EN ISO 11960	77.140.75 75.180.10	*Petroleum and natural gas industries — Steel pipes for use as casing or tubing for wells*
EN ISO 11961	77.140.75 75.180.10	*Petroleum and natural gas industries — Steel drill pipe*
EN ISO 13500	75.180.10	*Petroleum and natural gas industries — Drilling fluid materials — Specifications and tests*
EN ISO 13533	75.180.10	*Petroleum and natural gas industries — Drilling and production equipment — Drill-through equipment*
EN ISO 13534	75.180.10	*Petroleum and natural gas industries — Drilling and production equipment — Inspection, maintenance, repair and remanufacture of hoisting equipment*
EN ISO 14310	75.180.10	*Petroleum and natural gas industries — Downhole equipment — Packers and bridge plugs*
EN ISO 15463	75.180.10	*Petroleum and natural gas industries — Field inspection of new casing, tubing and plain-end drill pipe*
EN ISO 16070	75.180.10	*Petroleum and natural gas industries — Downhole equipment — Lock mandrels and landing nipples*
EN ISO 17078	75.180.10	*Petroleum and natural gas industries — Drilling and production equipment*
EN ISO 23251	75.180.20	*Petroleum, petrochemical and natural gas industries — Pressure-relieving and depressuring systems*
ISO 5596	23.100.99	*Hydraulic fluid power — Gas-loaded accumulators with separator — Ranges of pressures and volumes and characteristic quantities*
ISO 10414-1	75.180.10	*Petroleum and natural gas industries — Field testing of drilling fluids — Part 1: Water-based fluids*
ISO 10416	75.100 75.180.10	*Petroleum and natural gas industries — Drilling fluids Laboratory testing*
ISO 10945	23.100.99	*Hydraulic fluid power — Gas-loaded accumulators — Dimensions of gas ports*
ISO 10946	23.100.99	*Hydraulic fluid power — Gas-loaded accumulators with separator — Selection of preferred hydraulic ports*
ISO 13501	75.180.10	*Petroleum and natural gas industries — Drilling fluids — Processing equipment evaluation*
ISO 13535	75.180.10	*Petroleum and natural gas industries — Drilling and production equipment — Hoisting equipment*
ISO 17824	75.180.10	*Petroleum and natural gas industries — Downhole equipment — Sand screens*
ISO 28781	75.180.10	*Petroleum and natural gas industries — Drilling and production equipment — Subsurface barrier valves and related equipment*
ISO/TR 10400	75.180.10	*Petroleum and natural gas industries — Equations and calculations for the properties of casing, tubing, drill pipe and line pipe used as casing or tubing*

Annex B
(informative)

Significant technical changes between this European Standard and the previous version EN 1918-5:1998

Clause	Title/Paragraph/Table/Figure	Change
	Introduction	More details on function and technology of underground storage, including figures
2	Normative references	Addition of this section
4	Design	Addition of activities and reviews related to safety
8	HSE	Addition of this new chapter
9	Abandonment	Addition of this new chapter
NOTE 1 The technical changes referred to include the significant changes from the European Standard revised but it is not an exhaustive list of all modifications from the previous version. NOTE 2 The previous standard was reviewed concerning environmental compatibility.		

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