GLOSSARY

A

AGNEB Federal Workgroup for Nuclear Waste Disposal

ARE Federal Office for Spatial Development

B

Barriers In a deep geological repository, barriers are used as a passive means of protecting human beings and the environment. Artificial as well as natural (geological) barriers seal the caverns in which radioactive waste is stored, and form multiple barriers that isolate it from the biosphere.

Bentonite A pale grey clay formed from the weathering of volcanic ash. It was named after Fort Benson in Montana, USA. Due to its high content of montmorillonite (a clay mineral), bentonite has pronounced swelling properties, as well as a high ion exchange and absorption capacity. Thanks to these valuable properties, bentonite is suitable for use in deep geological repositories as a barrier (filler) and sealant.

BMUB Ministry for the Environment, Nature Conservation and Nuclear Safety – a German federal authority.

C

Commission of Cantons The Commission of Cantons is the political controlling body of the cantons involved in the Deep Geological Repositories sectoral plan process. It is responsible for securing the required cooperation between official representatives of site cantons, neighbou

ring cantons and neighbouring countries. It also supports the federal government with the implementation of the site selection procedure and submits recommendations to the federal government.

Compensation measures Compensation measures may apply if negative impacts are detected for a given region resulting from the planning, construction or operation of a deep geological repository. These measures are defined in close collaboration with the site region and site canton, approved by the Swiss Federal Office of Energy and financed by the parties responsible for the disposal of radioactive waste.

Conditioning Treatment and packaging of radioactive waste.

Consultation procedure Upon completion of stages 2 and 3, all interest groups have the opportunity to comment on the reports, statements of position and expert reports of relevance to stages 2 and 3 within the scope of a consultation procedure. Comments may be submitted to the SFOE during the 30-day consultation period. An initial consultation procedure was held upon the completion of stage 1 of the site search process (Article 19, Federal Spatial Planning Ordinance).

Cosmic radiation Radiation from space.

D

Deep geological repository A storage site located deep underground. It can be sealed as long as it is possible to secure the permanent protection of human beings and the environment with the aid of passive barriers.

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Federal Office of Energy SFOE

Deep Geological Repository sectoral plan
The «Deep Geological Repository» sectoral plan concept defines the objectives of the federal government, together with the various procedures and criteria according to which the site selection procedure for deep geological repositories is to be carried out in Switzerland. Here, the long-term protection of human beings and the environment is of the highest priority. Socioeconomic and spatial planning aspects also play a role: these vary from region to region, and can only be developed with the participation of the involved cantons and regions. The sectoral plan concept specifies the procedure for identifying potential site regions for deep geological repositories, initially focusing on the entire country and gradually narrowing down the options until a suitable site is chosen, and it also regulates the regional participation procedure.

Demonstration of feasibility of disposal
Demonstration of the fundamental feasibility of disposing of radioactive waste in a specific geological layer. It is intended to demonstrate that there is a high probability of the presence of a sufficient volume of rock in Switzerland with the required properties. A demonstration of feasibility has been provided both for low and intermediate level waste and for high-level waste.

Detailed plan
Detailed plans are the core documents in the federal government's sectoral planning process. They contain detailed descriptions of specific projects. A detailed plan comprises maps and texts, and is structured in accordance with standard criteria: title, including code number of object; abstract with brief description, processing status and indication of sectoral plan category; list of involved players; description of initial situation, problem, objectives concerning the integration of the object/facility into the area concerned; components, exploration, landscape assessment, compensation measures (regional development outside the site concerned); decisions (directives concerning harmonisation, coordination, next steps, documentation).

DETEC
Federal Department of the Environment, Transport, Energy and Communications.

DKST
German Coordination Centre for Swiss Deep Geological Repositories. Establishes connections between the German government, districts and regions, ensures the reciprocal flow of information and coordinates the participation of Germany in Switzerland's planning and approval processes.

E

EGT
Expert group for deep geological repositories

End storage site
Facility for the permanent maintenance-free storage of radioactive waste (with no plans for recovery).

ESchT
In June 2006 the German Ministry for the Environment, Nature Conservation and Nuclear Safety (BMUB) formed an expert group on Swiss deep geological repositories («Expertengruppe Schweizer Tiefenlager» [ESchT]). Its main tasks are to answer questions posed by the Ministry and the German Support Commission for Switzerland concerning Switzerland's deep geological repositories and the associated site selection procedure.

Evidence of feasibility
Evidence of feasibility has to demonstrate that it is possible to construct and operate a deep geological repository, and subsequently seal it over the long term, in the chosen host rock with the currently available technical resources, while meeting the applicable safety requirements.

Evidence of safety
Evidence of safety has to demonstrate that, based on the results of exploratory drilling, the defined host rock possesses the necessary geological and hydrogeological properties, and that the long-term safety of the deep geological repository can be guaranteed through the use of artificial barriers.

Evidece of site suitability
Evidence of site suitability has to demonstrate on the basis of findings from studies that there is a sufficient volume of host rock with the properties called for in the evidence of safety so that the construction of a deep geological repository would appear feasible.

Exploratory drilling
Exploratory drilling is a means of carrying out detailed geological studies. Vertical or slightly inclined boreholes with a typical diameter of 30 to 50 centimetres are drilled into the ground. In this way, the potentially suitable host rock formations for the storage of radioactive waste, together with the rock formations that surround them, can be analysed in greater detail.

F

FDHA	Federal Department of Home Affairs
Federal Nuclear Energy Act	The Federal Nuclear Energy Act of 21 March 2003 regulates the peaceful use of nuclear energy and specifies the procedure for the disposal of radioactive waste.
Federal Nuclear Energy Ordinance	Federal Nuclear Energy Ordinance of 10 December 2004.
Filling	Process of filling storage caverns and shafts after the receptacles have been deposited (Article 67, Federal Nuclear Energy Ordinance).
FNSC	Federal Nuclear Safety Commission
FNSI	Federal Nuclear Safety Inspectorate
FOEN	Federal Office for the Environment
FOPH	Federal Office of Public Health
Fuel element	An arrangement of fuel rods that transfer nuclear fuel into the reactor. In a pressurised water reactor a fuel element contains approximately 530 kilograms of uranium, while in a boiling water reactor it contains around 190 kilograms.
Fuel rod	Geometrical form in which nuclear fuel surrounded by cladding material is inserted into a reactor. Several fuel rods are normally compiled into a fuel element.

G

Geological formation	Rock layers that belong together on the basis of their formation.
Geological repository	An interim, permanent, long-term or end storage facility in a deep geological layer.
Geological site region	A geological site region is defined on the basis of the volume of rock deep underground that is suitable for the storage of radioactive waste.
Geosphere	Refers to the entirety of geological formations between the hollow storage spaces and the biosphere (including host rock).

H

Half-life	Length of time after which half the originally present quantity of stimulated nuclei have decayed.
Healthcare, industry and research waste	Waste from sources other than nuclear power plants.
HLW	High-level radioactive waste: category of radioactive waste that includes spent fuel elements and vitrified fission products resulting from reprocessing. Decaying radioactive material results in the production of intense heat.
Host rock	The term «host rock» refers to the section of the geosphere that is of relevance for protecting artificial barriers, restricting inflow of water into the storage facility, and preventing the release of radionuclides. The storage facility itself (caverns) is constructed within the host rock.

I

Interim report	In accordance with the Federal Spatial Planning Act, an interim report is required that indicates which activities of relevance to area planning have not yet been coordinated, and what action needs to be taken in order to secure the necessary degree of coordination without delay.
Interim storage site	Specially designed facility for storing radioactive waste for a limited period.
Ionising radiation	Radiation that generates ions upon absorption.
Isotope	Atoms of the same chemical element, which differ in terms of number of their neutrons in the atomic nucleus.

J

Jura Ost	One of the site regions (Eastern Jura) to be more closely examined in stage 3.
Jura-Südfuss	Site region (southern foot of the Jura) which Nagra and the FNSI have declared will not be further examined in stage 3 and is therefore to be shelved.

K

KKB	Beznau nuclear power plant
KKG	Gösgen nuclear power plant
KKL	Leibstadt nuclear power plant
KKM	Mühleberg nuclear power plant
KKW	Kernkraftwerk

L

Long-lived intermediate level radioactive waste	Radioactive waste with a significant content of alpha emitters. These result from the reprocessing of spent fuel elements. With the entry into effect of the new Federal Nuclear Energy Ordinance, this category of radioactive waste was replaced by the category, «alphatoxic waste (ATW)».
Long-term safety	The permanent protection of human beings and the environment through the use of barriers and/or other suitable measures.
Low and intermediate level waste (L/ILW)	This category of waste primarily contains short-lived radioactive matter with a low half-life. Intermediate level waste requires additional shielding. This type of waste results from the operation and later dismantling of nuclear power plants, and from the healthcare sector, industry and research.
Lower freshwater molasses	The term «molasse» refers to deposits in the foothills of a mountain range. In Switzerland, these are found in the central plateau (Mittelland). During the sedimentation process, deposits of marine material and mainland formations alternated many times, and the resulting layers are referred to as (lower/upper) marine and freshwater molasses. Lower freshwater molasse: basins of nagelfluh stone formed in the foothills of the Alps, while further away in the molasse basin flooding resulted in deposits with sand-filled rivulets.

M

Mont Terrirock laboratory (canton of Jura)	Sixteen organisations from a variety of countries are involved in an ongoing research programme at the Mont Terri rock laboratory aimed at determining the properties of opalinus clay. Sixteen organisations from a variety of countries are involved in an ongoing research programme at the Mont Terri rock laboratory aimed at determining the properties of opalinus clay.
mSv	Millisievert: a sievert is a unit for measuring biological damage resulting from the absorption of ionising radiation (in living cells), and is normally indicated in thousandths (mSv).

N

Nagra	National Cooperative for the Disposal of Radioactive Waste. In 1972 the federal government and the operators of Switzerland's five nuclear power plants formed Nagra for the purpose of finding a solution to the problem of permanently and safely disposing of nuclear waste.
Natural barriers	This term refers to the host rock in the storage zone and surrounding geosphere (host rock and geological surroundings), which in addition to acting as support material also provides long-term protection of artificial barriers.
Natural radiation	Consists of cosmic radiation (on average, approximately 0.35 mSv), uranium decayed products from beneath the ground, in particular radon (between 0.3 and 3 mSv) and potassium-40 (internal radiation from the bones – average level, 0.4 mSv).
Nördlich Lägern	Proposed site region which is to be more closely examined in stage 3. At the beginning of 2015, Nagra proposed that this site region should be shelved and thus not examined more closely in stage 3. But in April 2017, due to a lack of relevant negative data the Federal Nuclear Safety Inspectorate (FNSI) found that Nördlich Lägern should also be examined more closely. For the consultation procedure concerning stage 2, three site regions (Jura Ost, Nördlich Lägern and Zürich Nordost) were proposed to the Federal Council for closer examination.
Nuclear fission	Physical process during which an atomic nucleus is split into two or more parts. The fission of heavy atomic nuclei results in the release of energy.
Nuclear radiation	Radiation that results from the decay of stimulated atomic nuclei.

O

Opalinus clay More than 175 million years ago, during the Jurassic period, very fine mud composed of clay particles settled on the bottom of a shallow sea. This resulted in the formation of opalinus clay, which owes its name to the frequent findings of a fossilised ammonite («Leioceras opalinum») in the sediment. Uniform layers of this clay-based sediment exist in extensive areas of northern Switzerland.

P

Planning perimeter In stage 1, a planning perimeter designated the geographical zone that is defined by the extension of the geological site region, taking account of the potential layout of the required facilities on the surface.

Plutonium A fissile radioactive element that is produced in nuclear power plants, but is otherwise very rare.

PSI Paul Scherrer Institute

Q

Quaternary borings The Quaternary period is the youngest geological era. It originated around 2.5 million years ago and is still applicable today. Quaternary borings are carried out in order to obtain drill core samples that can provide information about erosion processes and tectonic activity in the past.

R

Radiation protection Organisational and technical measures aimed at minimising the harmful effects of radiation on human beings and the environment.

Radioactive decay Spontaneous conversion of nuclei that cannot be influenced and results in the emission of nuclear radiation.

Radioactive waste Solid, liquid or gaseous waste arising from the nuclear fuel cycle or produced in minor quantities in the healthcare sector, industry and research. A distinction is made between low and intermediate level waste, and high-level and long-lived intermediate level waste.

Radioactive waste management Refers to all forms of disposal of radioactive waste. Encompasses the collection, interim storage, transport and processing of radioactive waste, as well as its end storage in deep geological repositories.

Radioactivity Property of certain substances to convert without external influence and emit a characteristic radiation. Radioactivity was discovered in uranium by Becquerel in 1896. Radioactive substances are characterised by their half-life, which refers to the time during which half the atomic nuclei convert in a given quantity. Half-lives may range from several billion years to millionths of a second. The radiation and its energy that is emitted during decay are also characteristic.

Reprocessing Application of chemical processes for the purpose of separating fissile material (uranium, plutonium) that is still present in spent fuel elements so that it can be reused. Reprocessing results in the production of radioactive waste of all types.

Responsibility for the disposal of radioactive waste Anyone who operates or decommissions a nuclear facility is obliged to dispose of all radioactive waste produced at that facility, at their own cost (Article 31, Federal Nuclear Energy Act). The federal government is responsible for the disposal of radioactive waste that has been delivered in accordance with Article 27, paragraph 1 of the Radiation Protection Act (Article 33, Federal Nuclear Energy Act). In 1972 the federal government and the operators of Switzerland's five nuclear power plants formed Nagra (National Cooperative for the Disposal of Radioactive Waste) for the purpose of finding a solution to the problem of permanently and safely disposing of nuclear waste.

Retrievability This term refers to the possibility of retrieving radioactive waste from an open, partially sealed or fully sealed storage site, with corresponding degrees of operational and financial outlay.

Rock formation Groupings of rock that belong together on the basis of their composition.

RPG Federal Spatial Planning Act of 22 June 1979.

RPV Federal Spatial Planning Ordinance of 28 June 2000

S

Safe Nuclear Waste Management Forum
In the Safe Nuclear Waste Management forum, technical and scientific questions relating to safe waste management and geology posed by the population, municipalities, site regions, organisations, site cantons and authorities in neighbouring countries are discussed and answered.

Sealing
Filling and sealing of all underground sections and the access shaft of a deep geological repository after expiry of the observation period (Article 69, Federal Nuclear Energy Ordinance).

Sectoral plan
Concepts and sectoral plans are planning tools implemented in accordance with the Federal Spatial Planning Act. They permit comprehensive planning and coordination of federal government activities that have an impact on area planning, while taking the defined spatial development of the country into account.

Sediment rock
Sediment layers are secondary rock formations. They are formed from other rocks that are transported and deposited by wind, water or ice, or broken down by chemical processes.

Seismic exploration
With seismic exploration, artificial waves are generated on the surface, which then spread outwards and downwards and are reflected by the various layers of rock. The reflected waves are recorded on the surface and used for producing a spatial depiction of geological formations.

SFOE
Swiss Federal Office of Energy

Site canton
A canton with one or more municipalities in a site region.

Site municipality
Municipality beneath the boundaries of which a geological site region partially or fully lies.

Stage 2 site region
A stage 2 site region comprises site municipalities and other municipalities that are located partially or entirely within the defined planning perimeter. In certain justified cases, other municipalities may also be included in a site region.

Stage 3 site region
A stage 3 site region comprises the designated infrastructure municipalities plus other municipalities to be incorporated. In the course of subsequent activities within the scope of the sectoral plan process the degree of involvement of the municipalities concerned is subject to change. In view of this, in stage 3 it is possible that their allocation to the infrastructure municipalities or other involved municipalities could be reviewed and where necessary adapted.

Stage 3 infrastructure municipalities

Infrastructure municipalities incorporate site municipalities (i.e. municipalities beneath the boundaries of which a geological site region fully or partially lies) and other municipalities in which an infrastructure system could be constructed on or below the surface of their territory.

Here it has to be assumed that the number of infrastructure municipalities will be reduced after the application for a general licence has been submitted because the designated underground storage area will be smaller than the size of the geological site region. In this context the term «storage area» refers to the entire area encompassing the underground structures of the deep geological repository.

Other municipalities to be incorporated in stage 3

Other municipalities to be incorporated include those municipalities involved in stage 2 that are not already designated as infrastructure municipalities, and those bordering on site regions whose involvement arises due to regional solidarity, topographic proximity to the surface infrastructure or potential socioeconomic and ecological impacts.

StSG
Federal Radiation Protection Act of 22 March 1991

StSV
Federal Radiation Protection Ordinance of 22 June 1994

Südranden
Together with Jura-Südfuss and Wellenberg, the Südranden site region will not be examined more closely and is to be shelved upon completion of stage 2.

Summarised report (specifictions and detailed plans) Summarised reports (specifications and detailed plans) are the outcome of the respective coordination processes. They comprise maps and texts, and describe the extent of the geological site regions, and in stages 2 and 3 the sites, the conclusions arising from the safety and feasibility assessments and relating to area planning and the environment. These documents also include instructions for implementing the next stage and for the approval of the general licence.

Surface infrastructure Depending on its stage of development (see «Surface facilities»), a deep geological repository comprises various structures on the surface. The largest and most important of these is the surface facility to which the radioactive waste is initially delivered and where it is prepared for storage. This means that transport infrastructure has to be provided. The surface facility is also the «gateway» via which the filled storage containers are transported to the underground storage area. In addition to this «gateway», at least another two access shafts (secondary access facilities) to the storage area are required: one for the supply of fresh air and another for construction and operational processes. The latter is used for transporting excavated and construction materials, as well as people, and for the provision of energy and water to the deep geological repository.

Surface storage facility An above-ground interim, permanent, long-term or end storage facility.

Swisstopo Swiss Federal Office of Topography: Switzerland's competence centre for geodata, i.e. for the description, depiction and archiving of spatially-related geodata (national maps, landscape models, etc.).

T

Technical (artificial) barriers Technical (artificial) barriers include the mould (e.g. glass), the waste receptacle (e.g. steel canister) and (where applicable) the filling material (e.g. bentonite) for the storage caverns and shafts.

Toxicity Toxicity is the degree to which a given substance can damage an exposed organism. In the case of radiotoxicity, the degree of damage depends on the nuclide-specific effect of nuclear radiation. The radiotoxicity of a given waste container or storage site is calculated on the basis of the total toxicity of all nuclides contained therein.

Transmutation Controlled transformation of radioactive isotopes with a long half-life into stable isotopes or isotopes with a short half-life through nuclear reactions (bombardment with neutrons or charged particles). Before this can be done, the radioactive isotopes have to be separated in a complex process.

U

Uranium A fissile radioactive element that occurs in nature.

USG Federal Environmental Protection Act of 7 October 1983.

UVPV Environmental Impact Assessment Ordinance of 19 October 1988.

V

Vitrification The radioactive substances resulting from reprocessing have to be transformed into a product that is suitable for storage in a deep geological repository, and vitrification was found to be the most suitable method.

W

Waste disposal programme In accordance with Article 52 of the Federal Nuclear Energy Ordinance, those responsible for the disposal of radioactive waste are required to provide the following information in the disposal programme: origin, type and quantity of radioactive waste; required deep geological repository, including design concept; allocation of waste to the respective deep geological repositories; plan for the construction of deep geological repositories; duration and required capacity of central and decentralised interim storage facilities; budget for disposal operations up to date of decommissioning of the respective nuclear facilities.

In addition, they are required to update the disposal programme every five years. The Federal Nuclear Safety Inspectorate (FNSI) and the Swiss Federal Office of Energy (SFOE) are responsible for monitoring compliance with the waste disposal programme.

Wellenberg According to the proposal by Nagra and on the basis of the conclusions drawn by the FNSI and the FNSC, the Wellenberg site region will not be examined in greater detail in stage 3.

Würenlingen interim storage site Interim storage site in Würenlingen, canton of Aargau.

Z

Zürich Nordost

Zürich Nordost is one of the three site regions that are to be examined in greater detail in stage 3.

1 ,2 ,3 ,4....

2D seismic measurements

2D seismic measurements form an integral part of the geological studies of the proposed site regions. Unlike 3D seismology, which produces a three-dimensional image of the underground, 2D seismic measurements are carried out along single lines. Thus 2D seismic measurements show a detailed cross-section through the underground, and for quaternary studies are only designed for depths of up to 400 metres.

3D seismic measurements

By contrast, 3D seismology is designed for greater depths and, in comparison with 2D seismology, does not depict the necessary images at shallower depths. Unlike 2D seismology, 3D seismic measurements are carried out not only along single lines, but also comprehensively. A three-dimensional image of the underground is obtained by simultaneously reaching rock layers at much greater depths.