switzerland has radioactive waste

nagra

annual report 2004
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Through dialogue to decision: the time is ripe to tackle the issue of geological disposal of radioactive waste with commitment. The year 2004 saw the enactment of new legal provisions on waste management and clarification of the requirements for a transparent site selection procedure.

How should long-term isolation of radioactive waste be achieved? The new Nuclear Energy Act, which entered into force on 1st February 2005, specifies deep geological disposal as the path to be followed. This disposal strategy should be realised in a stepwise manner: for a period of time, the repository can be monitored and – if necessary – the waste can be retrieved. How such a repository can be implemented has been demonstrated for high-level waste with the “Entsorgungsnachweis” project, based on the example of the Opalinus Clay in the Zürcher Weinland area. The technical reports supporting the project were submitted to the federal authorities in December 2002 for review. The first reactions came in 2004: an independent international expert group established by the OECD/NEA recognised the high quality of the work and came to the conclusion that the safety demonstration rests on a solid scientific basis. The reviews of the safety authorities of the Federal Government and their experts are expected for summer 2005 and the entire documentation will then enter a period of public consultation.

Where should deep repositories be constructed? The site selection procedure assigns highest priority to the criterion of safety. However, spatial planning and socio-economic aspects also have to be taken into consideration. In December, the Federal Council decided that the site selection procedure and the criteria to be applied are to be set out in a sectoral plan (Sachplan) for geological repositories. This approach, which is part of spatial planning legislation, ensures that all impacts of a project that are relevant from the viewpoint of land use planning are coordinated appropriately and that the affected Cantons, communities and authorities of neighbouring countries, as well as the public and other interested organisations, are involved at an early stage in the procedure. In this connection, Nagra was asked by the responsible federal department to document alternatives to the Zürcher Weinland siting region, safety remaining as the paramount criterion. This report will also be submitted for review in 2005. After careful review and public consultation, the Federal Council is expected to decide in 2006 on the Entsorgungsnachweis project and to specify future procedure in the sectoral plan mentioned previously.

Realisation of deep geological repositories still lies some time in the future but we already have the necessary technical background to allow us to proceed. Sustainable decisions now have to be made regarding dialogue and involvement of affected parties. We are ready to take the next steps and are prepared, in a spirit of partnership, to make our contribution to solving this important environmental protection issue. I would like to take this opportunity to thank all those who have supported us in our work throughout 2004.

Hans Issler, President
Our mandate – our work

“As an established national competence centre and internationally recognised partner in the field of nuclear waste management, our aim is to construct safe deep repositories for all categories of radioactive waste arising in Switzerland, without delay and at reasonable cost.”

Our mandate

Radioactive wastes arise in Switzerland from the operation and later decommissioning of the five nuclear power plants and from the use of radioactive materials in various areas of medicine, research and industry (MIR waste).

The new Nuclear Energy Act states that the waste producers are responsible – under the supervision of the federal authorities – for the permanent, safe management and disposal of all categories of radioactive waste. The Federal Government has responsibility for MIR waste. With a view to fulfilling this task of safe disposal, the operators of the nuclear power plants and the Federal Government set up Nagra in 1972.

The Nuclear Energy Act, which entered into force in February 2005, calls for deep geological disposal for all categories of waste. Two types of repository are planned: one for low- and intermediate-level waste (L/ILW) and one for spent fuel, high-level and long-lived intermediate-level waste (SF/HLW/ILW).

Nagra’s task is to provide the scientific and technical basis for realising safe, long-term management of radioactive wastes. This involves proposing a waste management concept, assessing the suitability of potential repository sites and preparing concrete projects. Nagra also ensures ongoing inventorying of wastes and advises the producers on conditioning of wastes into forms suitable for final disposal. In order to meet these responsibilities, Nagra has been pursuing a broadly based research programme since the mid-seventies. The work is carried out in close collaboration with the Paul Scherrer Institute (PSI, Villigen) and various universities and scientific institutions, both in Switzerland and abroad.

Our work

- Characterisation and ongoing inventorying of radioactive waste as a basis for planning disposal projects; checking waste specifications as part of official waste clearance procedures and as a service to the Members of the Nagra Cooperative.
- Acquisition and evaluation of the field data required for site selection, safety assessment and disposal projects.
- Project studies providing input for designing repository installations and engineered barriers and for planning operating procedures.
- Ongoing analysis of results and data within the context of performance assessment and evaluation of information in terms of licensing procedure requirements.
- Development of databases and fine-tuning of the methods used to analyse disposal system behaviour; verification and validation of the data and models used in performance assessment.
- Active participation in international collaborative projects, with the aim of coordinating and optimising planning and development activities.
- Fulfilling responsibilities in terms of communication and information requirements, in particular keeping the public informed on the current status of disposal programmes and proposals for management solutions.
- Providing expert services to third parties.
Developments in 2004

Radioactive waste
The five operating nuclear power plants, with a total output of 3220 MWe, produced 25.43 billion kWh of electricity in 2004. This represents around 40 percent of total Swiss electricity production. Each change of fuel elements generates spent fuel for disposal. Operation of the power plants also produces low- and intermediate-level waste. On behalf of the Federal Office of Health (BAG), the Paul Scherrer Institute once again carried out a collection campaign for radioactive waste from the areas of medicine, industry and research.

Federal Council
In December, the Federal Council approved the new Nuclear Energy Ordinance. This Ordinance implements the provisions of the Nuclear Energy Act in more concrete detail. The Act and the Ordinance entered into force together on 1st February 2005. A draft version of the Nuclear Energy Ordinance was put into circulation for comment by the Federal Council in May. The resulting call for better integration with spatial planning legislation, particularly in the area of radioactive waste management, has been met with a new article in the Ordinance on a sectoral plan (Sachplan) for geological repositories (see page 8).

Federal authorities
The Federal Interagency Working Group on Nuclear Waste Management (AGNEB) is responsible for following work being carried out in Switzerland and for preparing statements on behalf of the Federal Council. AGNEB also monitors licensing procedures on a federal level and considers questions relating to international disposal options. In 2004, AGNEB was involved in reviewing the Entsorgungsnachweis documentation and establishing a time plan for disposal of high-level waste (a copy of AGNEB’s annual activity report is available from the Federal Office of Energy). In September, the Federal Office of Energy published a study on the status of research and development in the field of radioactive waste management.

The supervisory authorities of the Federal Government, in particular the Swiss Federal Nuclear Safety Inspectorate (HSK), were also occupied in 2004 with reviewing the Entsorgungsnachweis project for spent fuel, high-level waste and long-lived intermediate-level waste, which was submitted by Nagra in December 2002. The review work should be completed by the middle of 2005. In September, HSK published its assessment of Nagra’s safety analysis for a high-level waste repository constructed in the crystalline basement of Northern Switzerland (more information can be found in the activity reports of HSK and KSA).

Waste management and decommissioning funds
The purpose of these funds is to cover the costs of disposing of operational waste and spent fuel after shut-down of the NPPs and the costs of decommissioning and dismantling of nuclear installations that are no longer operational and disposal of the waste arising from these decommissioning activities. The two funds are supervised by the Federal Government and their management is regulated in various ordinances. The financial contributions come from the NPP operators and fund growth is proceeding as planned. More information can be found on the websites www.entsorgungsfonds.ch and www.stilllegungsfonds.ch (in French and German).
Legal framework

The legal framework for management of radioactive waste consists of the Nuclear Energy Act (KEG) and the Nuclear Energy Ordinance (KEV). Both entered into force on 1st February 2009.

The following principles apply:

• Radioactive materials should be treated in such a way as to minimise waste production.
• Radioactive waste has to be managed in such a way as to ensure the long-term protection of man and the environment.
• In principle, Swiss radioactive waste must be disposed of within Switzerland.
• The duty of disposal lies with the waste producers.
• Monitored deep geological disposal is prescribed. The waste producers are required to prepare a waste management programme (see Article 32 of the KEG) and submit this to the Federal Government for approval.
• Licensing procedures are focused at the federal level. The general license for a nuclear installation is subject to an optional referendum. The participation of the siting Canton, neighbouring Cantons and neighbouring countries is prescribed.
• The financing of decommissioning and waste management activities is to be secured in independent funds supervised by the Federal Government.

Nuclear Energy Act calls for a waste management programme

Nagra’s activities to date have been based on a long-term waste management programme formulated by the waste producers; the programme was updated periodically to keep pace with developments. The new Nuclear Energy Act (KEG) now requires this waste management programme to be reviewed by the federal authorities and approved by the Federal Council (Article 32 of the KEG). The Federal Council thus plays the lead role in guiding future procedure to be followed in the Swiss waste management programme. Article 52 of the Nuclear Energy Ordinance defines the content of the waste management programme in some detail.

In 2004, Nagra was requested by the waste producers – the power plant operators and the Federal Government as the body responsible for MIR waste – to prepare such a waste management programme. However, important boundary conditions still have to be clarified (decision of the Federal Council on the Entsorgungsnachweis project, specification of the site selection procedure in the sectoral plan (Sachplan)) and, for this reason, Nagra restricted its activities during the year to preparing background information. The focus was on compiling and reviewing information on the geology of Switzerland that is relevant for disposal studies. Based on this, a geologically oriented evaluation of siting possibilities for geological repositories for both L/ILW and SF/H/LW/LW has been initiated.

The Model Inventory of Radioactive Materials (MIRAM) is also being updated for future work. Finally, an evaluation will be made of the current status of research and development, with a view to identifying the direction and focus for future work. Current planning assumes that, once the necessary framework has been specified by the Federal Government, it will be possible to prepare the waste management programme within a relatively short time on the basis of current groundwork.

Sectoral plan (Sachplan) for spatial planning aspects

Article 5 of the Nuclear Energy Ordinance requires the objectives and guidelines for geological repositories be defined in a special sectoral plan. The Federal Office of Energy has been requested by the Federal Council to prepare the necessary materials; this should be done with the participation of interested parties.

The aim of the sectoral plan is to ensure full coordination and integration of all aspects of deep geological disposal that impact on land use planning, and to ensure early involvement of the affected Cantons, communities and authorities from neighbouring countries, as well as the interested public and other organisations.

Inventory of radioactive materials

Waste inventory

For the project on a deep geological repository for HLW, supplementary studies were carried out on the radioactive waste inventory. These looked, among other things, at the heat output of high-level waste and spent fuel and the consequences for later emplacement in a geological repository.

Services and contract work

An important service performed for the waste producers was the continued running of the centralised inventory of waste that has already been produced in Switzerland. This presently contains around 21,500 waste packages (corresponding to approx. 5000 m³), which are held in storage either in facilities at the power plants, in the Federal Government’s storage facility at PSI or at ZWILAG. The waste consists mainly of 200-litre drums with conditioned low- and intermediate-level waste arising from operation of the power plants and from medicine, industry and research. In addition, there are spent fuel elements and alpha-toxic and high-level wastes arising from the reprocessing of spent fuel. These wastes will be stored primarily at ZWILAG on the medium- to long-term. By the end of 2004, 13 canisters with spent fuel and five contain- ers with vitrified high-level waste from reprocessing were stored at ZWILAG. Work also continued on developing and checking waste products at PSI; the results of this work flow into the centralised waste inventory. The aim is to have, at all times, accurate information on the inventory of radioactive waste in Switzerland and to keep this information up to date.

Work continued on updating the Model Inventory of Radioactive Materials (MIRAM). This documents the properties and volumes of all waste already produced, as well as expected future arisings. MIRAM serves as a basis for planning geological repositories. Compared to earlier versions, waste that already exists is now documented in more detail and there is sufficient flexibility to take into account various nuclear energy scenarios.

As contract work for PSI and ZWILAG, various waste specifications were prepared, with waste from the Lucens reactor being evaluated for the first time. The Information System for Radioactive Materials (ISRAM) was installed at CERN, allowing all radioactive materials in Switzerland to be managed for the first time using this universal tool. A further multi-year project was initiated with CERN on preparing a waste register and an inventory of the waste from the accelerator facilities. Extensive work on inventorying of activated reactor components was also carried out for the Gösgen-Däniken and Leibstadt power plants. A comprehensive study on inventorying of spent fuel was also carried out for a Japanese customer.

Several waste certification (of suitability for disposal) procedures were carried out for waste from the power plants, PSI and ZWILAG. On an international level, work was conducted on an IAEA databank which contains worldwide waste data, and for an NEA working group on management of NPP decommissioning projects, as well as for two expert groups on characterisation of activated reactor wastes and waste from reprocessing.
Entsorgungsnachweis

Review and decision
Federal Council
Federal Office of Energy (BFE)
Federal Commission for the Safety of Nuclear Installations (KSA)
Swiss Federal Nuclear Safety Inspectorate (HSK)
Commission for Nuclear Waste Management (KNE)
Nuclear Energy Agency (NEA)

Transparency of the review procedure
Public consultation period (Cantons, communities, interested parties)
Committee of government representatives
Working Group Information and Communication (BFE)
Technical Forum

Entsorgungsnachweis at the end of 2002, Nagra submitted the “Entsorgungsnachweis” feasibility demonstration for spent fuel, high-level waste and long-lived intermediate-level waste (SF/HLW/ILW) to the Federal Council. The review of the documentation by the safety authorities and government experts was still underway at the end of the year. During 2004, Nagra was called on by the federal safety authorities (HSK, KNE, KSA) to answer and document numerous technical follow-up questions on the project.

Entsorgungsnachweis

Programme for spent fuel (SF), high-level waste (HLW) and long-lived intermediate-level waste (ILW)

Presentation of the expert report of the OECD/NEA in Marthalen (Canton Zürich) in April 2004.

Clear expert opinion.

The demonstration by Nagra of the favourable properties of the Opalinus Clay in the Zürcher Weinland and of the safety of the engineered barrier system rests on a strong scientific foundation.

Wellenberg project completed
By the end of 2003, all the exploratory boreholes at Wellenberg had been filled, the drill-sites recultivated and handed back to the respective landowners. The final report on the filling activities was then prepared in 2004 and submitted to the authorities. The Wellenberg project is thus finally at an end. The experience gained and the level of knowledge achieved in this project will be of considerable value for future work on the L/ILW project and have been comprehensively documented.

New guidelines from the Federal Government
During the course of 2004, it became clearer how the Federal Government will formulate its requirements for future procedure in the L/ILW programme. The evaluation criteria for future site selection will be specified in a sectoral plan for geological repositories (see page 8).

Preparations for site selection
On behalf of the Members of the Cooperative, Nagra compiled the geological and technical background for a criteria-based site selection procedure. In carrying out this work, Nagra was able to draw on more than 30 years of investigations and studies, as well as comprehensive data from third parties. The level of knowledge achieved should make it possible to reach the necessary decisions at a later date within a reasonable time and without additional costly investigations.

Programme for low- and intermediate-level waste (L/ILW)

Developments in 2004

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Developments in 2004
safety analysis was based on a solid scientific foundation and that, in many areas, it was at the forefront of international scientific development.

Transparency in the review of the Entsorgungsnachweis
Following the technical review of the Entsorgungsnachweis documentation, it is planned to publish the entire project documentation, together with the reviews by HSK and KSA. Cantons, local communities and other interested parties will then have the opportunity to express their views on the project. The decision of the Federal Council is expected for 2006.

With regard to the review of the Entsorgungsnachweis project, the responsible federal body – the Federal Office of Energy – places great weight on early and complete provision of information, particularly for the Cantons Zürich, Aargau, Thurgau and Schaffhausen and the neighbouring German region of Baden-Württemberg. A committee consisting of government representatives from the Cantons Zürich, Aargau, Thurgau and Schaffhausen and Baden-Württemberg and representatives of BFE and HSK are following the review of the project. The committee, chaired by the Director of Public Construction for Zürich, met for the first time on 8th April and for the second time on 2nd December. To ensure the involvement of the Swiss and German authorities, the BFE has also set up a Working Group on Information and Communication, as well as a Technical Forum.

Working Group on Information and Communication
Under the leadership of the BFE, this group coordinates information and communication activities associated with the Entsorgungsnachweis project and ensures timely information of the German and Swiss authorities. The group also organised the information event held in Marthalen on 27th April to announce the publication of the expert review of the OECD/NEA.

Technical Forum
The Forum is led by HSK and is responsible for answering questions from the public and local communities. Questions on geological topics have been answered and discussed at a series of meetings. Questions and responses are published continuously on the internet (see www.technischesforum.ch).

Studies on socio-economic aspects
In April 2004, the BFE commissioned a study on the social, demographic, ecological and economic impacts of waste management facilities. The aim of the study is to compile and analyse existing knowledge and to extend this, based on experience with facilities in Switzerland and abroad and with the failed Wellenberg project. At the same time, a second study has been commissioned by the communities of Benken, Marthalen and Trüllikon – which together make up the Opalinus Working Group – on the socio-economic impact of constructing and operating a repository in the Zürcher Weinland. Based on the polluter pays principle, the costs of the two studies are being borne by Nagra.
Information and dialogue

Information on the Opalinus Clay project and the current status of work was provided at a series of events and presentations held in the Weinland region. In fact, Nagra’s activities have been met not only with interest but often with increasing understanding in both the region itself and in neighbouring areas, both in Switzerland and abroad. Nagra invests considerable effort in informing all sectors of the public openly and comprehensively and engaging them in dialogue.

Alternatives to the Zürcher Weinland

On 28th September, a discussion took place in Bern between Federal Councillor Leuenberger (Head of DETEC), Nagra and representatives of the electricity industry (swisselectric). With respect to the site selection procedure for a high-level waste repository, the Energy Minister called for alternatives to the Zürcher Weinland to be considered. He stressed that the Entsorgungsnachweis does not represent a siting decision; such a decision will not be made before 2010. The selection procedure will be specified as part of the sectoral plan (Sachplan) according to spatial planning legislation. Whether other rock types should be included for the siting decision or whether it is meaningful to focus on areas with Opalinus Clay can only be decided once the safety authorities have completed their review of the Entsorgungsnachweis and this has been published openly (planned for 2005).

Nagra and swisselectric saw the discussions in Bern as constructive. In 2005, Nagra will submit a report on alternatives to the Zürcher Weinland. Studies to date have identified reserve areas for the Opalinus Clay host rock (besides the Zürcher Weinland), as well as for the reserve sediment option Lower Freshwater Molasse. The possibilities for deep disposal in the crystalline basement of Northern Switzerland were documented by Nagra in 1976. The intention of the Federal Council to regulate the path leading to site selection in a sectoral plan for geological disposal (see page 8), and to involve the Cantons and neighbouring Germany in the procedure, was also welcomed. From Nagra’s point of view, the procedural steps and criteria for site selection should now be specified without delay and, as far as possible, approved at the same time as the decision of the Federal Council on the Entsorgungsnachweis. The criteria and procedural steps should be such that they allow timely decisions to be made.

The decision by Federal Councillor Leuenberger for a more transparent site selection procedure also received a positive reaction from Switzerland’s German neighbours.

Review of the crystalline line option

HSK’s review of the crystalline option (documented in the Kristallin-I project in 1996) was published on 28th September. HSK comes to the conclusion that, even if the crystalline basement of Northern Switzerland represents an option for safe disposal of high-level waste, it would be difficult to convincingly demonstrate the safety of a repository at an actual site. In general, Nagra’s safety analysis for a deep repository in a crystalline host rock was considered by HSK to be of high quality.

Technical background

During the year, the focus was on specific studies for the HLW programme, but some of these also serve as input for the L/ILW programme. Most of the work described was carried out in collaboration with the Waste Management Laboratory (LES) at PSI, with Nagra bearing 50 percent of the research costs. Some of these projects were also carried out as part of the European Union’s Fifth and Sixth Framework Research Programmes.

A highpoint of the year was the audit of the Waste Management Laboratory (LES) that was conducted in spring by an international group of experts. The result was extremely positive: “The performance of LES is considered to be very good...LES plays in many areas a leading role on an international level and maintains a very strong international cooperation” (quote from the audit report). Independently of this audit, the International Review Team (IRT) responsible for reviewing the Entsorgungsnachweis safety assessment came to similar conclusions in its final report published in April 2004 (see also pages 10/11): “The IRT observes that Nagra has strong programmes in specific areas such as geochemistry and site characterisation carried out in-house and in external institutes, such as the Paul Scherrer Institute (PSI) and the University of Bern.” Once again, the collaboration with PSI brought Nagra very valuable results in 2004.

Modelling radionuclide transport

The modelling studies are aimed at providing an understanding of processes that are relevant for radionuclide transport. The scales considered range from sub-nanometre (X-ray absorption spectral to decametre (diffusion profiles in the Opalinus Clay), with specific methods being used to investigate processes in the ranges between these two extremes. For most of these methods, suitable modelling tools are already available or are in development. In this respect, work began in 2004 on constructing tools that image processes on the nanometre scale – so-called molecular modelling.

Laboratory studies, geochemical models and datasets

Modelling of radionuclide sorption in claystones and bentonite forms a key component of the work being carried out by the LES. Work in the past year has again focused on the migration and retention of radionuclides in clays. Sorption measurements for radionuclides on clay minerals also continued and were complemented by spectroscopic studies such as laser fluorescence and X-ray absorption measurements (XAS). For the first time, tests for future XAS experiments were carried out on a new measurement line in the SLS (Synchrotron Light Source) facility at PSI. The LES was extensively involved in constructing the line. These methods provide an insight into the nature of the bonding of radionuclides with clay and make an important contribution to the understanding of sorption mechanisms. For diffusion measurements in clays, the trend is towards analysis of strongly sorbing nuclides and, in this connection, a new method with a high spatial resolution has been developed.
A further focal point has been sorption measurements and investigations on mixed phase formation with cement and cement minerals. The aim of this work is to provide an improved understanding of the radionuclide retention properties of the cement barrier in the ILW and L/ILW repositories.

The experiments on cellulose degradation, relevant mainly for L/ILW waste, and investigations of the persistence of the degradation products in a cementitious environment continued with the financial support of Nirex (UK) and SKB (Sweden). These experiments look at the extent to which degradation products in such an environment can increase the mobility of radionuclides.

The LES is also involved in building up a broadly based international databank in which thermodynamic data for key radioelements are compiled and published as a basis for geochemical modelling in the context of performance assessment.

**Engineered barriers**

Work on the engineered barriers was carried out almost exclusively within the framework of EU projects extending over several years. The work addressed the following issues (see Tables on pages 22 and 24):

**Fifth Framework Research Programme:** Influence of heat production from high-level waste and spent fuel on engineered barriers in the Opalinus Clay (HE project) and in granite (FEBEX project); release of gas from geological repositories (GASNET project), an important topic that was investigated in depth in the Entsorgungsnachweis; long-term behaviour of spent fuel elements (SFS project), in which it was confirmed that the fuel matrix acts as an extremely effective barrier to radionuclide release.

**Sixth Framework Research Programme:** Understanding key processes in the near-field (NF-PRO project); development of disposal concepts in rock laboratories, focusing on development of criteria for the bentonite barrier (ESDRED project).

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*Effective clay particles.* Clay is a component of the engineered barrier system and the host rock. The microscopically small lamellar clay minerals can effectively immobilise particles of toxic substances over geological time periods and thus isolate them from the human environment. This phenomenon has been the subject of numerous experiments.
The Grimsel Test Site (GTS)
The rock laboratory located on the Grimsel pass celebrated 20 years of research work in September 2004. Over the years, the GTS has evolved into an important research centre for both the Swiss programme and for international collaborative studies in the field of radioactive waste management. A wide range of experiments and projects has been carried out with partner organisations in the fields of geoscience and engineering; the results have provided input for the Swiss national programme and for foreign programmes.

In 2004, ten projects were ongoing. The focus of the field work was on long-term experiments aimed at demonstrating the emplacement concepts for spent fuel and radioactive waste (FEBEX and GMT), investigations of the effect of cement (alkaline) waters in fractured rock (HPF) and on the geometry of the pore space in the rock (PSG). The final reports were compiled for the project on colloid and radionuclide retardation in the host rock (CRR). Work programmes and test concepts were formulated for the experiments that are still in the planning phase. An overview of the experiments being conducted at Grimsel can be found on the English language website www.grimsel.com.

In the coming decades, many disposal studies worldwide will evolve into concrete projects. The investigations at the GTS are paving the way for this implementation phase. The Phase VI (2003 – 2013) projects are aimed at demonstrating, validating and optimising techniques that will be used in geological repositories. Together with partner organisations, detailed work programmes have been prepared for a new generation of field experiments which focus on improving the understanding of the engineered barrier system and demonstrating its implementation on a 1:1 scale under realistic conditions (construction and operating phase of a repository). The transport of radionuclides will also continue to be the subject of field experiments at the GTS, with the test concepts being matched to the boundary conditions found in a repository.

It is very important that existing know-how should be passed on to future generations. Together with the ITC School (School of Underground Waste Storage and Disposal, www.itc-school.org), and as a member of the IAEA initiative “Centres of Excellence”, the GTS is making an important contribution to maintaining know-how on the long term.

Mont Terri Rock Laboratory (MFL)
The international Mont Terri research project is located in the security gallery and a specially constructed gallery adjacent to the Mont Terri tunnel on the A6 motorway, close to St-Ursanne in Canton Jura. The project is managed by the Federal Office for Water and Geology (FOWG) and the Canton supports and monitors the project through a “Commission de Suivi”. A total of twelve organisations from six countries are involved in the comprehensive research programme. The project allows Nagra to investigate and confirm the properties of the Opalinus Clay that are relevant for radioactive waste disposal. Because of the similarity between the Opalinus Clay at Mont Terri and the corresponding geological formation in the Zürcher Weinland, it is possible to transfer the experimental findings from the laboratory to the region in Northern Switzerland.

Projects at the Grimsel Test Site

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<td>CRR</td>
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<td>LCS</td>
<td>Long-term interactions between cement (solutions) and porewaters and rock (planning phase)</td>
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<td>Long-term diffusion of radionuclides</td>
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<td>LTM</td>
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<td>PSG</td>
<td>Determination of pore space geometry in the matrix</td>
</tr>
<tr>
<td>RH</td>
<td>Demonstration and testing of concepts for emplacement of SF/HLW under realistic conditions (remote handling) (planning phase)</td>
</tr>
</tbody>
</table>

The Grimsel Test Site (GTS)
The international Mont Terri research project is located in the security gallery and a specially constructed gallery adjacent to the Mont Terri tunnel on the A6 motorway, close to St-Ursanne in Canton Jura. The project is managed by the Federal Office for Water and Geology (FOWG) and the Canton supports and monitors the project through a “Commission de Suivi”. A total of twelve organisations from six countries are involved in the comprehensive research programme. The project allows Nagra to investigate and confirm the properties of the Opalinus Clay that are relevant for radioactive waste disposal. Because of the similarity between the Opalinus Clay at Mont Terri and the corresponding geological formation in the Zürcher Weinland, it is possible to transfer the experimental findings from the laboratory to the region in Northern Switzerland.

Recognised research centre. The Grimsel Test Site has become an internationally recognised research centre in the area of radioactive waste management.

In September 2004, Nagra celebrated 20 years of the Test Site together with its research partners and other invited guests.
In the first half of the year, the work programme for the ninth phase of experiments was completed according to plan; Nagra was involved in 18 of the 27 experiments. Nagra’s activities for the tenth phase (July 2004 – June 2005) have been directed mainly towards preparing an experiment on radionuclide migration in the Opalinus Clay, as well as a large-scale experiment on the migration of gases and their transport along sealing systems. In addition to this, synthesis studies were carried out in the areas of geochemistry, hydrogeology (including solute transport) and rock mechanics. The experiments being conducted at Mont Terri are described in more detail on the website www.mont-terri.ch (French and English).

In spring 2003, a long-term research programme extending over the next ten years was drawn up; this contains a substantial number of new experiments. The initiation of the first experiments required additional infrastructure to be provided in the form of an extension of around 100 metres of tunnel (including niches) to the Rock Laboratory.

International services and projects
Nagra’s 30 years of experience in the area of waste management has proved to be valuable for other national waste management programmes and for technical applications outside the nuclear field. Support has been provided to projects in the areas of strategic programme planning, specification of waste inventories, site selection and characterisation, development of repository concepts, performance assessment and communication. The Grimsel Test Site serves as a hub for international projects (see page 19).

The majority of direct support projects in 2004 involved Japanese organisations. These projects were carried out as part of the various bilateral agreements between Nagra and CRIEPI, JNC, JNFL, NUMO, RWMC and Obayashi.

2004 also saw an increase in direct contract work for organisations in Europe and Asia, including evaluation of reference waste disposal concepts (Nirex, UK), technical review and evaluation of alternative disposal systems (Saanio & Riekko OY, Finland) and input for geological disposal of low-level wastes (INER, Taiwan).

The Japanese radioactive waste management programme is currently in a very active phase, with NUMO preparing for responses to its call for volunteers to host a high-level waste repository. Nagra provided continued support for the development of repository concepts tailored to potential volunteer sites, use of multi-attribute analysis to compare designs/sites and running a series of ‘International Tectonics Meetings’. In addition, Nagra and NUMO initiated a series of collaborative projects aimed at further enhancing the transparency and traceability of decision-making in a staged siting approach and determining the direction for future code development.

For intermediate-level waste, JNFL is moving forward rapidly with the project for a medium-depth geological repository at the Rokkasho site. Construction of an access tunnel is ongoing and the Nagra-Obayashi Consortium is providing technical support in several areas. In 2004, technology developed by Nagra was tested at Rokkasho and will contribute to the detailed underground characterisation activities that will start in 2005.

An important aspect of general research activities is the support provided to JNC in its rock laboratory programme, which involves parallel development of two underground facilities (Mizunami in crystalline rock and Horonobe in sediments). Other projects with JNC are also ongoing, for example a range of natural analogue studies, project documentation support and review of JNC’s second progress report on TRU disposal. A special focus in 2004 was the contribution to international conferences organised at the two URL sites.

Further projects include production of a range of information and synthesis reports on specific topics. Technical translation and linguistic services continued, with an increasing trend towards producing technical documentation also in Japanese.

Services for Members of the Cooperative
A major project was successfully completed in August, with the delivery to the power plant operators of the draft project report for the PEGASOS seismic hazard analysis study for the Swiss NPP sites.
A regular exchange of information takes place as part of the different formal bilateral agreements between Nagra and its foreign partner organisations. Joint projects are also carried out with many partners; these are either multilateral (e.g. as part of rock laboratory projects) or conducted together with international organisations (particularly the Nuclear Energy Agency NEA and the EU).

In 2004, joint research work continued in the Grimsel and Mont Terri rock laboratories in Switzerland and Nagra staff were also involved in the activities at Andra’s Bure rock laboratory in France. The rock laboratory projects were supported by a series of joint laboratory projects and model development studies, including in particular the projects carried out on sorption and on the thermo-chemical databank under the auspices of the NEA. Participation in the EU Framework Programmes has evolved to become an important component of the research and development activities carried out by Nagra.

Beyond these diverse specific joint projects, Nagra continues to be represented in various working groups of the NEA/OECD and the IAEA.

The European Union Framework Programmes

With its Research Framework Programmes, the European Union (EU) promotes research and technological development within Europe. Bilateral agreements between Switzerland and the EU allow Swiss researchers to participate in these research projects. Nagra’s interests are currently focused in the following areas:

- Conceptual and strategic studies on safe handling and disposal of radioactive waste.
- Experiments on the behaviour of the engineered barriers and the host rock over long time periods.
- Laboratory studies aimed at building up the databases required for performing safety assessments.
- Work in rock laboratories for developing new instrumentation and investigation techniques, for characterising rock properties, on the influence of the engineered barriers on the surrounding rock and demonstration experiments on the practical feasibility of deep geological disposal.

Fifth Framework Programme

With the exception of the MODEX-REP project, all projects in which Nagra participated were completed successfully (for abbreviations see the adjacent table and the glossary on page 45).
Sixth Framework Programme
In 2004, Nagra’s participated in the following projects:

- CETRAD: this project has drawn the interest of 20 partners from 17 European countries, including Nagra in the role of national correspondent and the ITC. Under the leadership of a research group from the University of Cardiff [Wales, UK], training requirements in the areas of radiation protection and geological disposal are being identified and proposals for corresponding European initiatives prepared. The project will be completed, after a 15-month duration, in spring 2005.

- ESDRED: 13 project partners from nine European countries are involved in this project, which was initiated in February and will continue for a period of five years. It is being led by the French organisation Andra. Nagra’s activities are focusing on emplacement technology for backfill materials, development of low-pH cements, training, communication and integration of results.

- FUNMIG: at the end of December 2004, the contract was signed between the EU Commission, a series of European waste disposal organisations and various research institutes. The official starting date for the project is 1 January 2005.

- NF-PRO: this project brings together 46 partners from ten European countries, including PSI as a sub-project leader. The work is being led by the Belgian organisation SCK•CEN. The project has been running since January 2004 and will extend over four years. Nagra’s involvement is focused on the following aspects: near-field sorption associated with redox processes, continuation of the FEBEX project (GTS), characterisation and evolution of the excavation disturbed zone, coupled processes and their integration into safety analysis.

- SAPIERR: this study is being headed by Decom Slovakia. The attendance of 21 organisations from 14 European countries at a first meeting was indicative of the level of interest, particularly from countries with small nuclear programmes. The aim of the two-year project is to investigate, within the EU, the possibilities and limitations of collaboration in developing regional/multinational disposal concepts for radioactive waste. The project will clarify the legal boundary conditions and specific technical aspects of such possibilities, but it will not propose concrete projects.

Finally, at the instigation of the Federal Office for Education and Science (BBW), Nagra has been participating in a European working group with the aim of preparing the research and training programme in the area of nuclear energy for the seventh EU Framework Programme. The working group was made up of around 20 representatives of key waste disposal organisations and research institutes from Belgium, Germany, the UK, Finland, France, Italy, Portugal, Switzerland, Sweden, Spain and the Czech Republic.

Public relations
Nagra as a willing and open discussion partner
Radioactive waste disposal is a subject that brings with it a wealth of technical knowledge but, at the same time, the keen interest of a wide spectrum of social groups. In a society that is becoming ever more complex, simple answers are being sought. Dialogue with different sectors of the public is an important prerequisite to the implementation of sustainable waste management strategies. Nagra is fully aware of the key importance of direct and open communication with scientists, the media, the authorities and the public.

Information tour – before Parliament House
In June, Nagra’s information tour visited nine cities in the German-speaking part of Switzerland. This provided the ideal opportunity to come into direct contact with several thousand members of the public. Special events for politicians and the media rounded off the appearances at the different locations. The tour ended on 16th June in front of Parliament House in Bern. Many Members of Parliament took the opportunity to obtain first-hand information on the status of waste disposal at Nagra’s stand.

Exhibitions, presentations and tours
Nagra was present at the autumn fairs in Schaffhausen and Winterthur. The rock laboratories at Grimsel (Canton Bern) and Mont Terri (Canton Jura) continue to be a favourite destination for a wide range of visitor groups; during the year, more than 2500 people visited the facilities to experience underground research at first-hand. Public presentations also expanded during the year, with invitations being accepted from clubs, associations and organisations to present waste management topics to an interested audience. Two information trips to Sweden and Finland gave politicians and authorities the opportunity to form an impression of waste management activities in other countries. In these two countries, repositories for low- and intermediate-level waste are already in operation. Finland is the first country in the world to begin construction on a high-level waste repository.

20 years of the Grimsel Test Site – a special celebration
The Grimsel Test Site celebrated its 20th anniversary in September. The official celebration on 17th September was attended by more than 150 guests from politics, economics and partner organisations, both from Switzerland and abroad. The following day, almost 700 members of the public took advantage of the open day to visit the site. 20 years of research aimed at solving an environmental problem – an event of such significance that it even merited articles in two major Japanese newspapers.

Working with the media
Nagra issued nine media releases in 2004. The main topics were the Entsorgungsnachweis project, 20 years of the Grimsel Test Site and the meeting with Federal Councillor Leuenberger mentioned previously. The topic of waste management appeared more than 400 times in articles and contributions in the Swiss media. The main items of interest were the report of the NEA experts on the Entsorgungsnachweis, the right of the public to be involved in the siting process and alternative sites for HLW disposal. Nagra was the contact point for numerous questions from journalists, which called at times for intensive collaboration with editorial staff and media representatives.
Nagra also published a series of articles on its work in the field of waste management in various technical publications.

**A source of information for individuals and schools**

In 2004, Nagra received around 300 requests for information by telephone, letter and e-mail. On more than 600 occasions, the information service mailed brochures, DVDs and videos to individual persons, schools and clubs. Measuring radioactivity is of interest mainly to schools. Nagra has around 50 sets of measuring equipment that are constantly in circulation.

**Information brochures and electronic media**

2004 saw the publication of an attractive annual report, one issue of the "nagra Bulletin", a French version of "nagra Focus 04", three editions of "nagra News" (in German) and a range of smaller print products in several languages. Seven existing publications and three DVDs and videos had to be re-issued to meet demands. An overview of the new publications that appeared in 2004 can be found on page 44.

Nagra’s website ([www.nagra.ch](http://www.nagra.ch)) was modified in terms of content and design during the year. The new website will be on line some time in 2005.

**Documentation centre and translation service**

Nagra maintains a documentation centre (Info-Centre), which works together with a number of external libraries and organisations. The most important tasks of the Info-Centre include maintaining a technical library, compiling and archiving project documentation and conducting literature research. Maintenance of an intranet ensures flow of information within the company.

Translations were carried out during the year for Nagra’s in-house publications (periodicals, brochures, electronic media, etc.). Translations were also carried out for external customers, mainly for Japanese organisations. Part of the external support services involved preparing comprehensive reports on various aspects of the Swiss programme, as well as proof-reading and editing of technical and communication documents.
Organisation and headquarters

Organisation

The ordinary general meeting of the Nagra Cooperative took place in Bern on 23rd June 2004. The Members approved the annual report and accounts for 2003. On the occasion of the ordinary general meeting, H.R. Gubser of Nordostschweizerische Kraftwerke (NOK) and J.L. Pfäffli of Energie Ouest Suisse (EOS) announced their resignation. Dr. Manfred Thumann was elected as the new NOK representative and Guillaume Gros as the EOS representative. H.R. Gubser was elected to the Board of Management in 1999 and held the office of Vice-President. J.L. Pfäffli had been a member of the Board of Management since the year 2001. Representation of the Federal Government was taken over by Martin Jermann of PSI, who replaces Dr. B. Michaud (member of the Board since 1987), who retired at the end of 2003. All gentlemen were thanked for their active contribution to the progress of work over the years and their support of Nagra’s activities.

At a meeting held on 8th December 2004, the Board of Management authorised an outline credit of 30.9 million CHF for research and project work in the year 2005. Four meetings of the Board of Management were held to deal with ongoing business. Discussions on important issues were held by the different commissions (Technical Committee, Commission for Legal Issues, Finance Commission and Commission for Information).

Headquarters

At the end of 2004, 73 people were employed at the Nagra headquarters in Wettingen, corresponding to 67.6 full-time positions (63.2 in the previous year). In addition, 14 people (corresponding to 6.8 full-time positions; 7.7 in the previous year) were employed as advisers, part-time employees, support staff and students. At the end of the year, Ian McKinley, Head of International Services and Projects, left the company to become an independent technical consultant. He is succeeded by S. Vomvoris.

At the end of 2004, 74 people were employed. Among them were 14 people (corresponding to 6.8 full-time positions; 7.7 in the previous year) working as advisers, part-time employees, support staff and students. At the end of the year, Ian McKinley, Head of International Services and Projects, left the company to become an independent technical consultant. He is succeeded by S. Vomvoris.
Members of the Cooperative, Board of Management, Commissions, Auditors

**Members of the Cooperative**
Swiss Federal Government
Bern
BKW FMB Energie AG
Bern
Kernkraftwerk Gösgen-Däniken AG
Däniken
Kernkraftwerk Leibstadt AG
Leibstadt
Nordostschweizerische Kraftwerke AG
Baden
Energie Ouest Suisse Lausanne

**Board of Management**
(period of office 2003 – 2006)
Hans Issler
President
Nagra
Hans Rudolf Gubser
Vice-president
Nordostschweizerische Kraftwerke AG
[until 23. June 2004]
Dr. Manfred Thumann
Vice-president
Nordostschweizerische Kraftwerke AG
[from 23. June 2004]
Guillaume Gros
Energie Ouest Suisse
[from 23. June 2004]
Peter Hirt
Kernkraftwerk Gösgen-Däniken AG
Hermann Ineichen
BKW FMB Energie AG
Martin Jermann
Paul Scherrer Institute
Jean-Louis Plaeffli
Energie Ouest Suisse
[from 23. June 2004]
Mario Schönemberger
Kernkraftwerk Leibstadt AG

**Technical Committee**
[31st December 2004]
Mario Schönemberger
Chairman
Kernkraftwerk Leibstadt AG
Dr. Jörg Hadermann
Paul Scherrer Institute
Dr. Marcel Lips
Kernkraftwerk Gösgen-Däniken AG
Dr. Dave McGinnes
Nordostschweizerische Kraftwerke AG
Jean-Louis Plaeffli
Energie Ouest Suisse
Dr. Anton von Gunten
BKW FMB Energie AG
Dr. Piet Zuidema
Nagra

**Finance Commission**
[31st December 2004]
Michael Sieber
Chairman
Nordostschweizerische Kraftwerke AG
Kurt Bachmann
Kernkraftwerk Gösgen-Däniken AG
Thomas Gysel
Kernkraftwerk Leibstadt AG
Erich Keller
Federal Office of Energy
Patrick Neuhaus
BKW FMB Energie AG
Marc Meyer
Nagra

**Commission for Legal Issues**
[31st December 2004]
Dr. Jürg Marti
Chairman
Kernkraftwerk Leibstadt AG
Peter Dubach
BKW FMB Energie AG
Franco Gaffuri
Kernkraftwerk Gösgen-Däniken AG
Dr. Olivier Robert
Nordostschweizerische Kraftwerke AG
Martin de Techtermann
Energie Ouest Suisse
Valentin Egloff
Nagra

**Commission for Information**
[31st December 2004]
Peter Hirt
Chairman
Kernkraftwerk Gösgen-Däniken AG
Leo Erne
Kernkraftwerk Leibstadt AG
Philippe Furrer
Energie Ouest Suisse
Verena Martignier
Axpo und Nordostschweizerische Kraftwerke AG
Sebastian Vogler
BKW FMB Energie AG
Armin Murer
Nagra

**Auditors**
PricewaterhouseCoopers AG
Zürich
In 2004, the gross result was 36.4 million CHF, an increase of 2.1 million CHF compared to the previous year. The contributions of the Members of the Cooperative increased by 6.1 million CHF to 27.9 million CHF.

Taking into account ongoing contracts, income from deliveries and services decreased by 3.6 million CHF to 8.3 million CHF. This decrease is due mainly to the following:

- Research and partner contributions decreased by 0.3 million CHF to 0.5 million CHF, compared to the previous year.
- GNW was dissolved and the corresponding income was reduced by 4.2 million CHF.
- Direct contracts for services to Members of the Cooperative decreased by 1.5 million CHF. Of the total of 1.8 million CHF, 1.3 million were due to the PEGASOS project alone.
- Taking into account ongoing contracts, services to other third parties increased by 2.4 million CHF to 5.9 million CHF, compared to the previous year.

Total expenditure increased by around 2.1 million CHF. Documented external expenditure increased by 1.8 million CHF to 21.8 million CHF. Compared with the previous year, personnel costs increased by around 0.2 million CHF or 1.6%.

Further information on selected positions can be found in the appendix to the annual accounts.

Wettingen, 5. April 2005

Hans Issler, President
## Operating accounts

### Contributions to administration costs

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<tr>
<th>Year</th>
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<th>CHF</th>
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### Contributions for project expenditure

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<td>2004</td>
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### Contributions of Cooperative Members

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<tr>
<td>2004</td>
<td>27 933 082</td>
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### Research contributions

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<td>883 406</td>
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<tr>
<td>2004</td>
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### Application GNW reserve/income from GNW

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<tr>
<td>2004</td>
<td>4 607</td>
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### Income from other services for Cooperative Members

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<td>2004</td>
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### Income from services for third parties

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</thead>
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<tr>
<td>2004</td>
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### Income from deliveries and services

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### Adjustment in balance sheet for ongoing contracts

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<tr>
<td>2004</td>
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### Other operating income

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</thead>
<tbody>
<tr>
<td>2003</td>
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<td>2004</td>
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### Total performance

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## Cash flow statement

### Change in liquid assets

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<td>Research contributions</td>
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<td>4 607</td>
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<tr>
<td>Income from other services for Cooperative Members</td>
<td>3 309 925</td>
<td>1 834 876</td>
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<tr>
<td>Income from services for third parties</td>
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<td>Adjustment in balance sheet for ongoing contracts</td>
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<td>Income from third parties including adjustment for ongoing contracts</td>
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<td>Contributions of Cooperative Members</td>
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<td>Total performance</td>
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<td>36 355 545</td>
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### Change in receivables

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### Change in ongoing contracts

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<td>2004</td>
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### Change in active accruals and deferrals

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### Change in liabilities

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### Change in short-term bank loans

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### Change in passive accruals and deferrals

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### Cashflow from company activities

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### Change in receivables

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### Change in ongoing contracts

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<td>2003</td>
<td>-947 707</td>
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<tr>
<td>2004</td>
<td>-</td>
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### Change in active accruals and deferrals

<table>
<thead>
<tr>
<th>Year</th>
<th>CHF</th>
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<tbody>
<tr>
<td>2003</td>
<td>-2 865</td>
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<tr>
<td>2004</td>
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### Change in liabilities

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>2003</td>
<td>-1 594 233</td>
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<tr>
<td>2004</td>
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</table>

### Change in short-term bank loans

<table>
<thead>
<tr>
<th>Year</th>
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</tr>
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<tbody>
<tr>
<td>2003</td>
<td>-</td>
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<tr>
<td>2004</td>
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</table>

### Change in passive accruals and deferrals

<table>
<thead>
<tr>
<th>Year</th>
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<tbody>
<tr>
<td>2003</td>
<td>-3 390 612</td>
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<tr>
<td>2004</td>
<td>-</td>
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### Change in reserve

<table>
<thead>
<tr>
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</tr>
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<tbody>
<tr>
<td>2003</td>
<td>-43 503</td>
</tr>
<tr>
<td>2004</td>
<td>-</td>
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</table>

### Cashflow from investments

<table>
<thead>
<tr>
<th>Year</th>
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<tbody>
<tr>
<td>2003</td>
<td>-1 600</td>
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<tr>
<td>2004</td>
<td>-</td>
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</tbody>
</table>

### Change in long-term financial obligations

<table>
<thead>
<tr>
<th>Year</th>
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<tbody>
<tr>
<td>2003</td>
<td>-</td>
</tr>
<tr>
<td>2004</td>
<td>650 000</td>
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</table>

### Reserve GNW

<table>
<thead>
<tr>
<th>Year</th>
<th>CHF</th>
</tr>
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<tbody>
<tr>
<td>2003</td>
<td>4 756 678</td>
</tr>
<tr>
<td>2004</td>
<td>-</td>
</tr>
</tbody>
</table>

### Cashflow from financing activities

<table>
<thead>
<tr>
<th>Year</th>
<th>CHF</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>4 756 678</td>
</tr>
<tr>
<td>2004</td>
<td>650 000</td>
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</tbody>
</table>

### Change in liquid assets

<table>
<thead>
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<tbody>
<tr>
<td>2003</td>
<td>814 633</td>
</tr>
<tr>
<td>2004</td>
<td>3 891 388</td>
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</table>
## Accumulated accounts

(Contributions of the Cooperative Members and their application since the founding of Nagra in 1972)

### Accumulated accounts

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Contributions for administration costs</strong></td>
<td>CHF</td>
<td>CHF</td>
<td>CHF</td>
<td></td>
</tr>
<tr>
<td>Swiss Confederation</td>
<td>81 320 000</td>
<td>600 000</td>
<td>81 920 000</td>
<td></td>
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<tr>
<td>BKW FMB Energie AG</td>
<td>22 693 761</td>
<td>885 234</td>
<td>23 578 995</td>
<td></td>
</tr>
<tr>
<td>Kernkraftwerk Gösgen-Däniken AG</td>
<td>77 143 161</td>
<td>3 259 866</td>
<td>80 403 027</td>
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<tr>
<td>Kernkraftwerk Leibstadt AG</td>
<td>236 994 424</td>
<td>10 694 044</td>
<td>247 692 468</td>
<td></td>
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<tr>
<td>Nordostschweizerische Kraftwerke AG</td>
<td>170 380 475</td>
<td>6 714 116</td>
<td>177 094 591</td>
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<tr>
<td><strong>Contributions to project expenditure</strong></td>
<td>CHF</td>
<td>CHF</td>
<td>CHF</td>
<td></td>
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<tr>
<td>Project expenditure still to be covered by Members of Cooperative</td>
<td>-783 712</td>
<td>-3 141 501</td>
<td>-3 925 213</td>
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<tr>
<td>Balancing of income/expenditure excess</td>
<td>-783 712</td>
<td>-3 141 501</td>
<td>-3 925 213</td>
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<tr>
<td><strong>Contributions of Members of Cooperative</strong></td>
<td>CHF</td>
<td>CHF</td>
<td>CHF</td>
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<tr>
<td>Research contributions</td>
<td>5 695 612</td>
<td>544 470</td>
<td>6 242 082</td>
<td></td>
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<tr>
<td>Application GNW reserve/income from GNW</td>
<td>65 260 724</td>
<td>4 607</td>
<td>65 265 331</td>
<td></td>
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<tr>
<td>Income from other services for Cooperative Members</td>
<td>12 515 647</td>
<td>1 834 876</td>
<td>14 350 523</td>
<td></td>
</tr>
<tr>
<td>Income from services for third parties</td>
<td>23 400 874</td>
<td>4 978 500</td>
<td>28 379 374</td>
<td></td>
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<tr>
<td><strong>Total performance of accumulated accounts</strong></td>
<td>CHF</td>
<td>CHF</td>
<td>CHF</td>
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</table>
| Explanations in appendix pages 40 / 41

### Total expenditure

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<tr>
<th></th>
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<tbody>
<tr>
<td>Administration costs</td>
<td>71 513 378</td>
<td>600 000</td>
<td>72 113 378</td>
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<tr>
<td>General project expenditure, contributions</td>
<td>9 806 622</td>
<td>-</td>
<td>9 806 622</td>
<td></td>
</tr>
<tr>
<td>Administration and general project expenditure</td>
<td>81 320 000</td>
<td>600 000</td>
<td>81 920 000</td>
<td></td>
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<tr>
<td>Generic studies</td>
<td>172 118 899</td>
<td>7 880 787</td>
<td>179 999 686</td>
<td></td>
</tr>
<tr>
<td>Planning of facilities (repository concepts)</td>
<td>22 423 556</td>
<td>4 311 868</td>
<td>26 735 424</td>
<td></td>
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<tr>
<td>Geological investigations for site selection</td>
<td>407 715 370</td>
<td>7 610 152</td>
<td>415 325 522</td>
<td></td>
</tr>
<tr>
<td>Experimental programmes (rock labs)</td>
<td>72 132 925</td>
<td>2 134 681</td>
<td>74 267 606</td>
<td></td>
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<tr>
<td>Public relations, documentation</td>
<td>60 174 955</td>
<td>4 830 734</td>
<td>65 005 689</td>
<td></td>
</tr>
<tr>
<td>Project-related expenditure</td>
<td>734 565 705</td>
<td>26 768 222</td>
<td>761 333 927</td>
<td></td>
</tr>
<tr>
<td>Administration, general and project-related expenditure</td>
<td>815 885 705</td>
<td>27 368 222</td>
<td>843 253 927</td>
<td></td>
</tr>
<tr>
<td>Project expenditure for GNW</td>
<td>62 765 130</td>
<td>215 685</td>
<td>62 980 815</td>
<td></td>
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<tr>
<td>Project expenditure for Cooperative Members</td>
<td>13 014 354</td>
<td>2 025 510</td>
<td>15 039 864</td>
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<tr>
<td>Project expenditure for third parties</td>
<td>28 818 737</td>
<td>6 746 128</td>
<td>35 564 865</td>
<td></td>
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<tr>
<td>Project-related expenditure from deliveries and services</td>
<td>104 598 221</td>
<td>8 987 323</td>
<td>113 585 544</td>
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<tr>
<td><strong>Total expenditure for accumulated accounts</strong></td>
<td>CHF</td>
<td>CHF</td>
<td>CHF</td>
<td></td>
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</tbody>
</table>
| Explanations in appendix pages 40 / 41

### Expenditure according to repository project

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Low- and intermediate-level waste project</td>
<td>272 119 625</td>
<td>9 064 296</td>
<td>281 183 921</td>
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<tr>
<td>High-level waste project</td>
<td>462 446 080</td>
<td>17 703 926</td>
<td>480 150 006</td>
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</tr>
<tr>
<td>Wellenberg project</td>
<td>62 765 130</td>
<td>215 685</td>
<td>62 980 815</td>
<td></td>
</tr>
<tr>
<td><strong>Expenditure in accumulated accounts according to repository project</strong></td>
<td>CHF</td>
<td>CHF</td>
<td>CHF</td>
<td></td>
</tr>
</tbody>
</table>
| Explanations in appendix pages 40 / 41

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Explanations in appendix pages 40 / 41
Notes on the annual accounts

1 Liquid assets
Liquid assets increased by 3.9 million CHF compared to the previous year. As of 31st December 2004 and 2003, there were no fixed-term deposits.

2 Receivables from deliveries and services
Receivables from deliveries and services increased by a total of 0.4 million CHF to 4.8 million CHF.
Receivables from deliveries and services with respect to third parties decreased by 0.3 million CHF to 0.5 million CHF. The largest single debtor is the Obayashi Corporation, Tokyo (Japan), with 0.1 million CHF. Also included in this position are claims against the Members of the Cooperative in the amount of 4.3 million CHF (3.6 million CHF in the previous year). The largest claim relates to Kernkraftwerk Leibstadt AG, with 1.4 million CHF.

3 Ongoing contracts
Ongoing contracts for third parties increased compared to the previous year by 0.7 million CHF to 2.9 million CHF.
Passive prepayments for ongoing contracts increased by 0.3 million CHF and now amount to 2.2 million CHF.
Activated ongoing contracts result exclusively from work performed for third parties.

4 Fixed assets
During the year, a small transport vehicle was replaced; otherwise, no fixed assets were activated during 2004. Small acquisitions are contained in other operating expenditure. Depreciation is documented separately. The income from sale of fixed assets is contained in other operating income; in 2004 this amounted to 0.06 million CHF.
The facilities at Nagra headquarters and at the Grimsel Test Site are insured against fire damage for a total of 7.5 million CHF (same amount as in the previous year). The fire insurance value of the storage hall and contents in Mellingen is 3.7 million CHF.

5 Payables from deliveries and services
Payables from deliveries and services increased during 2004 by around 1.4 million CHF to 4.1 million CHF.
As in the previous year, the position contains liabilities towards Members of the Cooperative in the amount of 0.2 million CHF.

6 Passive accruals and deferrals
Passive accruals and deferrals increased in 2004 by around 3.4 million CHF.
The balance shown contains liabilities towards Members of the Cooperative of around 3.9 million CHF (0.8 million CHF in the previous year) for claimed project costs that have not yet been applied.
Passive accruals and deferrals towards third parties increased by 0.3 million CHF and amount to 0.5 million CHF.

7 Reserves
As before, reserves include amounts for vacation and overtime hours of employees, tax reserves and various other items. In 2003, Nagra took over responsibility for the Wellenberg site from the liquidated company GNW for a one-off payment of 4.8 million CHF. For a period of ten years, this amount will be used in particular for recultivation work, production of project documentation and final reports and payment of various fees and charges.

8 Contributions of Members of the Cooperative
The contributions of Members of the Cooperative increased during the year by around 6.1 million CHF and are made up as follows:
Administrative costs of 0.6 million CHF, passed-on taxes for nuclear facilities of HSK of 3.9 million CHF (2.8 million CHF in the previous year), contributions to project costs of 23.4 million CHF (18.5 million CHF in the previous year).

9 Income from deliveries and services
Research contributions decreased by 0.3 million CHF to 0.5 million CHF. The GNW reserve was charged with services amounting to 5000 CHF.
Other services to Members of the Cooperative decreased by 1.5 million CHF to 1.8 million CHF; around 1.3 million CHF of this can be attributed to the PEGASOS project alone (2.7 million CHF in the previous year). The PEGASOS project was a seismic hazard study extending over 3 years that was effectively completed in 2004.
Income from deliveries and services to third parties increased in 2004 by 1.3 million CHF to 5.0 million CHF. Taking into account the increase in ongoing contracts (for third parties), services to third parties increased by around 2.4 million CHF compared to the previous year.

10 Other operating income
Other operating income decreased during 2004 by around 0.4 million CHF to 0.1 million CHF.

11 External expenditure
External expenditure increased in 2004 by 1.8 million CHF. All direct project costs are now shown under external expenditure. Figures for the previous year were modified accordingly.

12 Other operating expenditure
New is that this position now contains only operating expenditure of Nagra. Project-related expenditure now comes under external expenditure. Figures for the previous year were modified accordingly.
Notes on the accumulated accounts

The accumulated presentation of the contributions from the Members of the Cooperative and the application of these contributions forms the basis for any adjustment payments between the Members. It also shows which work gives rise to project-related expenditure.

13 Contributions of Members of the Cooperative

The contributions of the Members of the Cooperative towards covering project costs are determined annually as a percentage, based on the thermal output of the individual power plants.

In 2004, the Members of the Cooperative made net payments to Nagra in the amount of 31.1 million CHF. Taking into account prepayments by Members of the Cooperative that have not yet been applied in the amount of 3.9 million CHF, as well as the balance from the previous year of 0.8 million CHF, this results in contributions of the Members in the total amount of 27.9 million CHF (21.9 million CHF in the previous year).

Included in this is the contribution to administrative costs in the amount of 0.6 million CHF, as well as taxes passed on for nuclear facilities in the amount of 3.9 million CHF.

14 Income from deliveries and services

The entries for accumulated income from deliveries and services agree with the operating accounts and are explained there.

15 Adjustment for ongoing contracts

Adjustments to the status of initiated work agree with the operating accounts and are explained there.

16 Other operating income

The entries for other accumulated operating income agree with the operating accounts and are explained there.

17 Project-related expenditure

Project-related expenditure in 2004 amounted to around 26.8 million CHF. These monies were applied as follows:

a) Non-site-specific [generic] studies (7.9 million CHF)

Site-independent studies include proportional expenditure on documenting and inventorying radioactive wastes, development of disposal concepts, development of safety assessment methodologies and carrying out performance assessments. Also included are costs of the safety report for the Entsorgungsnachweis Project.

b) Planning of facilities (4.3 million CHF)

This includes expenditure on the project for a deep geological repository in the Opalinus Clay, documenting of this work in the Entsorgungsnachweis project and conceptual studies for low- and intermediate-level waste.

c) Geological investigations for site selection (7.6 million CHF)

Geological investigations included studies in the investigation area of Northern Switzerland associated with disposal of high-level waste. Also included are the costs of the geosynthesis prepared for the Entsorgungsnachweis project.

d) Experimental work (2.1 million CHF)

This relates to research activities at the Grimsel Test Site and Mont Terri Rock Laboratory.

e) Public relations and documentation (4.8 million CHF)

This expenditure results mainly from editing, translating and producing information brochures, media activities and costs of exhibitions and information events.

18 Project-related expenditure from deliveries and services

This expenditure in the amount of 9.0 million CHF results from contracts included under income from deliveries and services and covers the following positions:

Project expenditure for GNW of 0.2 million CHF for recultivation work on the drill sites at Wellenberg. This amount was charged to prepayments made by GNW in 2003 and does not relate to the GNW reserve mentioned in note 7.

The position also includes project expenditure for Members of the Cooperative of 2.0 million CHF and project expenditure for third parties of 6.7 million CHF.

19 Expenditure according to repository project

The position “Expenditure according to repository project” allows – at the time of realisation of the repositories – the proportional emplacement quota per repository and Cooperative Member to be determined.

Of the around 26.8 million CHF for project-related expenditure, [see note 17], for the year 2004 9.1 million CHF can be assigned to the programme for low- and intermediate-level waste and 17.7 million CHF to the programme for high-level waste. Following the negative decision by Canton Nidwalden, the Wellenberg project was charged in 2004 with subsequent project costs of 0.2 million CHF.
Bericht der Revisionsstelle
an die Generalversammlung der
NAGRA Nationale Genossenschaft für
die Lagerung radioaktiver Abfälle
Wettingen


Für die Jahresrechnung und die Geschäftsführung ist die Verwaltung verantwortlich, während unsere Aufgabe darin besteht, die Jahresrechnung und die Geschäftsführung zu prüfen und zu beurteilen. Wir bestätigen, dass wir die Anforderungen hinsichtlich Befähigung und Unabhängigkeit erfüllen.


Gemäss unserer Beurteilung entsprechen die Buchführung, die Jahresrechnung und die Geschäftsführung dem schweizerischen Gesetz und den Statuten.

Wir empfehlen, die vorliegende Jahresrechnung zu genehmigen.

PricewaterhouseCoopers AG
Armin Bantli Ivo Bischofsberger

Zürich, 5. April 2005
Nagra Technical reports (NTB)

A complete list of reports published to date (including price list) can be obtained from Nagra’s offices in Wettining or downloaded from Nagra’s website.

NTB 04-08

NTB 04-07
“Mat’s Diffusion for Performance Assessment – Experimental Evidence, Modelling Assumptions and Open Issues”; A. Jakob, Paul Scherrer Institute, Villigen PSI; (July 2004).

NTB 04-06

NTB 04-04
“Comparison of ORIGEN2.1 with Selected Computer Codes”; E. Kolbe; (March 2004). Also available on CD-ROM (PDF).

NTB 04-03
“Nuclide Transport and Diffusion for Vein Opalinus Clay: Effect of confining pressure, sample orientation, sample depth and temperature”; L. R. Van Loon Paul Scherrer Institute, Villigen PSI; (April 2004).

NTB 03-07

NTB 03-06

NTB 03-01

Publications for a wider audience

The publications “nagra Bulletin”, “nagra Focus” and “nagra News” do not appear on a regular basis, but rather as required depending on topics of current interest. They can be subscribed to free of charge and can be ordered in large numbers.

Nagra News
Three issues of “nagra News” in German, French and Italian appeared in 2004.
Number 13 is dedicated to Nagra’s participation in the Framework Programmes of the European Union.
Number 14 reports on the NEA review of Nagra’s safety assessment for the Entsorgungsnachweis project and on Nagra’s 2004 information tour.
Number 15 reports on the events that took place during the 20th year celebration of the Grimsel Test Site and on two websites set up by the authorities on the Entsorgungsnachweis project.

Nagra Focus
This publication deals with nuclear waste management topics; one issue appeared in 2004 on high-level waste in German and French.

Nagra Bulletin
The Bulletin contains technical-scientific contributions on waste management topics. 2004 saw the publication of one issue (no. 35) in German and English on the Entsorgungsnachweis project for high-level waste. The journal presents the motivation for, and results of, the Opalinus Clay Project. individual articles address the geological synthesis, the concept for facilities and operation and the analysis and demonstration of long-term safety.

Nagra’s full range of information material can be found on the website “www.nagra.ch”; Nagra can also provide an overview sheet on request.

Internet addresses

Nagra
National Cooperative for the Disposal of Radioactive Waste
www.nagra.ch

BAG
Federal Office of Health
www.bag.admin.ch

BFE
Federal Office of Energy
www.energia-schweiz.ch

Decommissioning fund
www.stilllegungsfonds.ch

DETEC
Federal Department for the Environment, Transport, Energy and Communications
www.uev.admin.ch

Entsorgungsnachweis (BFN)
www.entsorgungsnachweis.ch

FMT
Mont Terri Rock Laboratory
www.mont-terri.ch

Forum VERA
www.forumvera.ch

OTS
Grimsel Test Site
www.grimsel.com

HSK
Swiss Federal Nuclear Safety Inspectorate
www.hsk.ch

ITC
International Training Center, School of Underground Waste Storage in Switzerland
www.itz-schule.org

KSA
Federal Commission for the Safety of Nuclear Installations
www.ksa.admin.ch

LES
Waste Management Laboratory
les.web.psi.ch

NuklearForum
www.nuklearforum.ch

PSI
Paul Scherrer Institute
www.psi.ch

swissnuclear
Nuclear Energy Group of swisselectric
www.swissnuclear.ch

Technical Forum Entsorgungsnachweis (HSK)
www.technischesforum.ch

Waste Management Fund
www.entsorgungsfonds.ch

ZWILAG
Zwischenlager Würenlingen AG (interim storage)
www.zwilag.ch
<table>
<thead>
<tr>
<th>Glossary Term</th>
<th>Description</th>
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<tbody>
<tr>
<td>Andra</td>
<td>Agence nationale pour la gestion des déchets radioactifs, France.</td>
</tr>
<tr>
<td>BBW</td>
<td>Federal Office for Education and Science. Under the Department of Internal Affairs (EDI).</td>
</tr>
<tr>
<td>BFE</td>
<td>Federal Office of Energy. Under DETEC.</td>
</tr>
<tr>
<td>CERN</td>
<td>European Organization for Nuclear Research.</td>
</tr>
<tr>
<td>Criepi</td>
<td>Central Research Institute of Electric Power Industry, Japan.</td>
</tr>
<tr>
<td>EDI</td>
<td>Department of Internal Affairs.</td>
</tr>
<tr>
<td>ELF</td>
<td>Certification of suitability of waste for emplacement in a repository.</td>
</tr>
<tr>
<td>EU</td>
<td>European Union.</td>
</tr>
<tr>
<td>FMT</td>
<td>Mont Terri Rock Laboratory. Underground laboratory in Opalinus Clay near St-Ursanne, Canton Jura. Managed by FOWG.</td>
</tr>
<tr>
<td>FOWG</td>
<td>Federal Office for Water and Geology. Under DETEC. Project manager for the Mont Terri Rock Laboratory.</td>
</tr>
<tr>
<td>GTS</td>
<td>Grimsel Test Site. Nagra’s underground laboratory in crystalline rock on the Grimsel pass, Canton Bern.</td>
</tr>
<tr>
<td>HLW</td>
<td>High-level waste; striffled waste from reprocessing.</td>
</tr>
<tr>
<td>IAEA</td>
<td>International Atomic Energy Agency.</td>
</tr>
<tr>
<td>ILW</td>
<td>Long-lived intermediate-level waste.</td>
</tr>
<tr>
<td>INER</td>
<td>Institute of Nuclear Energy Research, Taiwan.</td>
</tr>
<tr>
<td>IRT</td>
<td>International Review Team of the OECD/NEA.</td>
</tr>
<tr>
<td>ISRAM</td>
<td>Information System for Radioactive Materials.</td>
</tr>
<tr>
<td>ITC</td>
<td>International Training Center, School of Underground Waste Storage and Disposal, Innerskirchen (Canton Bern).</td>
</tr>
<tr>
<td>JNC</td>
<td>Japan Nuclear Cycle Development Institute.</td>
</tr>
<tr>
<td>JNFL</td>
<td>Japan Nuclear Fuel Limited.</td>
</tr>
<tr>
<td>KEG</td>
<td>Nuclear Energy Act.</td>
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<td>KEY</td>
<td>Nuclear Energy Ordinance.</td>
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<tr>
<td>KNE</td>
<td>Commission for Nuclear Waste Management.</td>
</tr>
<tr>
<td>KSA</td>
<td>Federal Commission for the Safety of Nuclear Installations.</td>
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<tr>
<td>LES</td>
<td>Waste Management Laboratory, PSI.</td>
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<tr>
<td>L/ILW</td>
<td>Low- and intermediate-level waste.</td>
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<tr>
<td>MIR</td>
<td>Radioactive waste from medicine, industry and research.</td>
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<tr>
<td>MIRAM</td>
<td>Model Inventory of Radioactive Materials.</td>
</tr>
<tr>
<td>NEA</td>
<td>Nuclear Energy Agency.</td>
</tr>
<tr>
<td>Nirex</td>
<td>United Kingdom Nuclear Industry Radioactive Waste Executive.</td>
</tr>
<tr>
<td>NPP</td>
<td>Nuclear Power Plant.</td>
</tr>
<tr>
<td>NUMO</td>
<td>Nuclear Waste Management Organization of Japan.</td>
</tr>
<tr>
<td>Obayashi</td>
<td>Obayashi Corporation, Japan.</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Cooperation and Development.</td>
</tr>
<tr>
<td>PEGASOS</td>
<td>Probabilistic Seismic Hazard study for the Swiss NPP sites.</td>
</tr>
<tr>
<td>PSI</td>
<td>Paul Scherrer Institute, Villigen, Canton Aargau.</td>
</tr>
<tr>
<td>RWMC</td>
<td>Radioactive Waste Management Funding and Research Center, Japan.</td>
</tr>
<tr>
<td>SCK-CEN</td>
<td>Studiezentrum voor Kernenergie • Centre d’étude de l’énergie nucléaire, Belgium.</td>
</tr>
<tr>
<td>SF</td>
<td>Spent fuel elements.</td>
</tr>
<tr>
<td>SKB</td>
<td>Svensk Kärnbränslehanter AB, Sweden.</td>
</tr>
<tr>
<td>SLS</td>
<td>Synchrotron Light Source Switzerland (at PSI).</td>
</tr>
<tr>
<td>TRU</td>
<td>Transuranic waste.</td>
</tr>
<tr>
<td>XAS</td>
<td>X-ray absorption spectroscopy.</td>
</tr>
<tr>
<td>ZWILAG</td>
<td>Zwischenlager Würenlingen AG. Centralised interim storage facility of the Swiss NPPs for all waste categories.</td>
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</tbody>
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