

**Federal Council confirms
safe long-term management of
all waste types in Switzerland**

nagra ● we care

**annual report
2006**

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Foreword



Grimsel Test Site.



The year 2006 saw two main themes dominate the Swiss nuclear waste management programme: the decision of the Federal Council on the "Entsorgungsnachweis" for high-level waste and preparation of the strategy part of the sectoral plan for deep geological repositories.

With its decision of 28th June 2006, the Federal Council confirmed that, from the point of view of safety, construction of a deep geological repository for high-level waste is feasible in Switzerland. The decision was based on the results of more than 30 years of intensive research and development work, also with close international collaboration, and represents an important milestone in the Swiss waste management programme.

The Entsorgungsnachweis, or demonstration of disposal feasibility, is a legal requirement and a precondition to the construction of new nuclear power plants. However, it is not a siting decision or a licence application for a specific repository project.

Technical solutions have now been identified for the safe, long-term isolation of radioactive waste in geological repositories; the next step is the site selection procedure, which is a socio-political process. We therefore welcome the decision of the Federal Council to conduct the procedure together with the Cantons within the framework of a sectoral plan (Sachplan) for deep geological repositories. The first drafts of the strategic part of the plan were prepared by the Federal Office of Energy in 2006 and subjected to a broad consultation process. While top priority in site selection is assigned to safety-related criteria, socio-economic and spatial planning factors also have to be taken into consideration, as does the involvement in the process of the affected Cantons and regions.

Experience has shown that proceeding in a timely and efficient manner with site selection as part of the sectoral plan procedure places high demands on all those involved, in terms of both the technical quality of the work and the availability of sufficient manpower resources.

The current business year will revolve around the sectoral plan procedure. The Federal Council plans to announce its decision on the strategic part of the plan in late summer 2007; the implementation phase of the plan will then be initiated. Nagra's role in this procedure will be that of an expert and project planner. We are ready, when the time comes, to propose potential siting regions for the two repositories – one for low- and intermediate-level waste and one for high-level waste – to the federal authorities.

I would like to take this opportunity to thank all those involved in the programme, particularly the staff of Nagra, for their great commitment and effort over the last year. That the work carried out is of a high technical standard has been confirmed by the positive review of the Entsorgungsnachweis by the federal safety authorities and by international experts.

Hans Issler, President

Our mandate – our work

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



Grimsel Test Site.

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, industry and research (MIR waste).

The Nuclear Energy Act of 2003 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 is responsible 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.

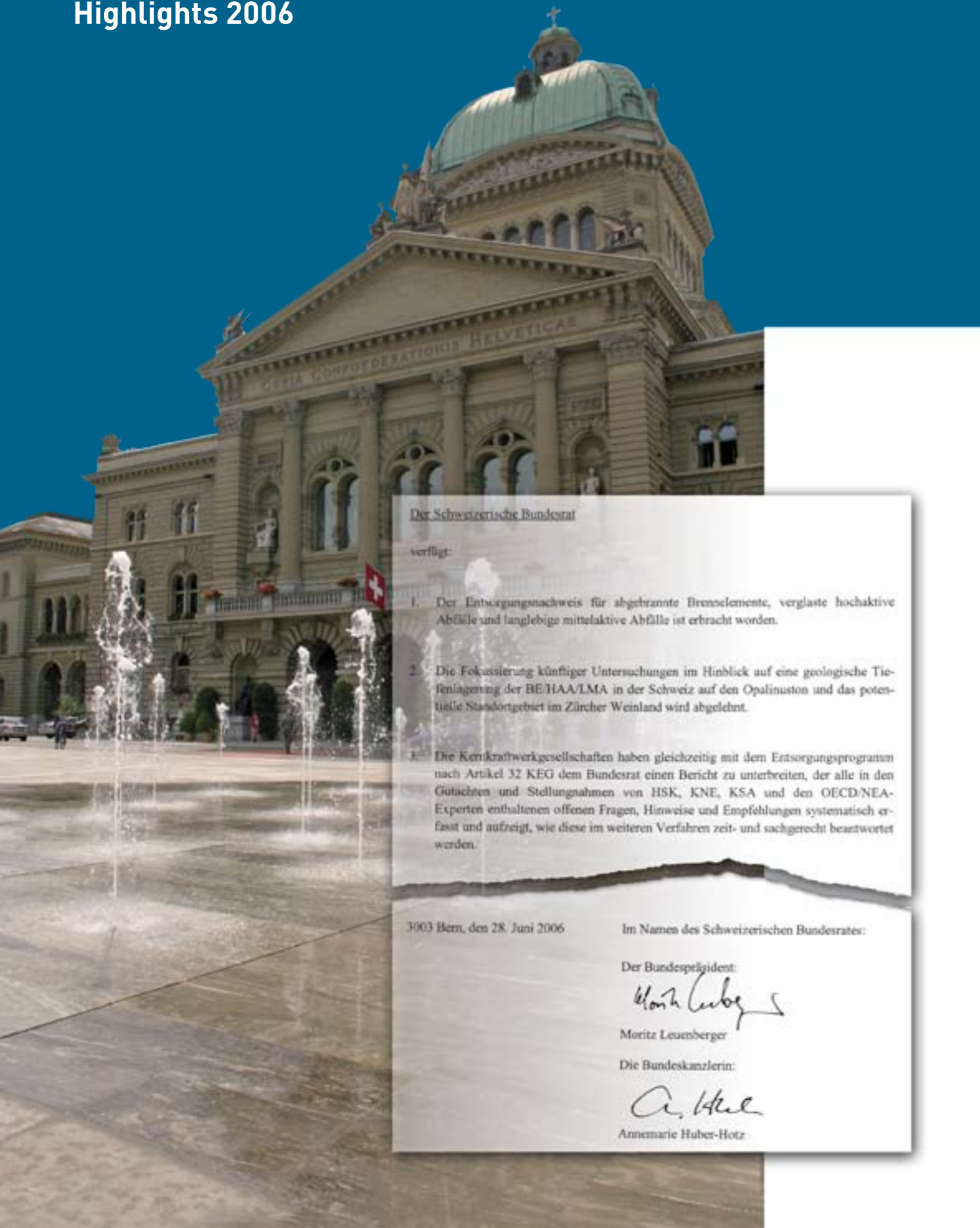
The Nuclear Energy Act, which came into force in February 2005, calls for monitored deep geological disposal for all categories of waste. Two types of repository are planned: one for low- and intermediate-level waste (L/ILW) and one for spent fuel, high-level and long-lived intermediate-level waste (SF/HLW/ILW).

Nagra's role is to provide the scientific and technical basis for implementing safe, long-term management of radioactive wastes. This involves proposing a waste management concept, evaluating the suitability of potential repository sites and preparing concrete projects. Nagra also ensures ongoing inventorying of radioactive materials and advises the waste producers on conditioning of wastes into forms that are suitable for disposal. In order to meet these responsibilities, Nagra has been pursuing a broadly based research and development 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 materials 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 barrier systems, and for planning operating procedures.
- Ongoing analysis of results and data within the context of safety assessment studies and evaluation of information with a view to licensing procedures.
- 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 the areas of communication and information, in particular keeping the public informed on the current status of disposal programmes and proposals for waste management solutions.
- Providing expert services to third parties.

Highlights 2006



Swiss Federal Department for the Environment, Transport, Energy and Communications:

Bern, 28.06.2006

"Disposal of high-level waste in Switzerland is technically feasible"
"Spent fuel, vitrified high-level waste and long-lived intermediate-level waste from the nuclear power plants can be disposed of safely in Switzerland. In a meeting held today, the Federal Council confirmed its approval of the demonstration of disposal feasibility. The search for a suitable site will be conducted as part of the sectoral plan procedure for deep geological repositories."

March

The Federal Office of Energy submits a first draft of the strategic part of the sectoral plan for deep geological repositories to the Cantons for comment. The sectoral plan will regulate the site selection procedure (page 9).

May

The second Swiss national report prepared under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management is discussed by the Contracting Parties of the IAEA in Vienna and receives a positive response (page 10).

May

A series of events involving the international research partners was held to mark the occasion of the 10-year anniversary of the Mont Terri Rock Laboratory. The research installations at the two rock laboratories – Grimsel and Mont Terri – were visited by more than 3800 people during 2006 (pages 23 and 29).

June

A reworked second draft of the strategic part of the sectoral plan is published by the Federal Office of Energy, with wide involvement of interested parties. The third draft entered the official consultation phase on 12th January 2007 (page 9).

June

In its decision of 28th June, the Federal Council approves the Entsorgungsnachweis for high-level waste. The project documentation was submitted by Nagra in December 2002. Following an extensive review by the safety authorities of the Federal Government and a team of international experts, the documents were opened to the public for comment in 2005 (page 14).

June

The Federal Council takes note of a study commissioned by the Federal Office of Energy on the socio-economic impact of waste management facilities (page 17).

June

Nagra's information tour visits eight towns in the German-speaking part of Switzerland. With the motto "Switzerland has radioactive waste. We are taking care of it. Nagra. Who else.", the aim of the tour was to increase public awareness of upcoming tasks and activities in the programme (page 29).

August

Nagra submits an updated cost estimate for the two planned geological repositories for low- and intermediate-level waste and high-level waste. This is used as the basis for calculating the financial reserves to be set aside by the NPP operators in the corresponding funds administered by the Federal Government (page 26).

Developments in 2006

Energy policy, legislation, authorities

Radioactive waste

With a total output of 3220 MWe, the five nuclear power plants produced around 26.3 billion kWh of electricity in 2006, making a contribution of approximately 40 percent to overall Swiss power production. The annual exchange of fuel elements gives rise to spent fuel for disposal, while the operation of the power plants also produces low- and intermediate-level waste. An up-to-date overview of waste types and volumes can be found on page 49 of this report.

Sectoral plan for deep geological repositories

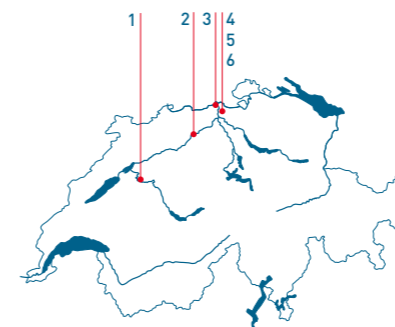
Article 5 of the Nuclear Energy Ordinance requires the objectives and criteria for the disposal of radioactive waste in deep geological repositories to be specified by the Federal Government in a sectoral plan. The sectoral plan approach is designed to allow integrated coordination of all spatial planning impacts of a geological repository in a potential siting region and to ensure timely involvement in the siting procedure of the affected Cantons, communities and authorities of neighbouring countries, as well as the affected public and other interested organisations. At the end of 2004, the Federal Office of Energy (FOE) was requested by the Federal Government to prepare the necessary background for the sectoral plan procedure. The plan consists of two parts: a strategic part and an implementation part with fact-sheets for potential siting regions. The procedures and criteria to be followed in site selection are specified in the strategic part, while the fact-sheets of the implementation part will be used to record the stepwise results of the siting process.

2006 was dominated by the decision of the Federal Council on the Entsorgungsnachweis and by the preparation of the strategic part of the sectoral plan by the FOE. The first draft of the strategic part was published on 15th March 2006 and submitted to the cantonal planning authorities for consultation up to the end of April. Between June and August, the FOE led a wide consultation procedure on the reworked second draft of 6th June 2006. This version was made available for comment to the Cantons, interested federal authorities, neighbouring countries, organisations and political parties. In June and November, the FOE discussed the draft strategic part with more than 60 representatives of various organisations and national parties in two workshops. In summer, focus group discussions were also held at several locations in Switzerland (Rapperswil, Bern, Lausanne, Neuenburg, Olten), each with 10 to 14 members of the public. The final reports from these all events were published by the FOE on 13th October and, together with the written opinions of the federal authorities, Cantons, neighbouring countries, organisations and political parties, formed the basis for reworking the draft of 6th June.

The third version of the draft entered the formal hearing phase on 12th January 2007. The Federal Council is expected to make a decision on the first part of the sectoral plan in late summer 2007; this will be followed by the start of the site selection procedure for the two repository projects.



Grimsel Test Site.



- Nuclear power plants and interim storage facilities**
- 1 NPP Mühleberg
 - 2 NPP Gösgen-Däniken
 - 3 NPP Leibstadt
 - 4 NPP Beznau
 - 5 ZWILAG
 - 6 Federal Government interim storage facility

Legal framework

The legal provisions applying to radioactive waste management are contained in the Nuclear Energy Act and the associated Nuclear Energy Ordinance. Both entered into force on 1st February 2005.

The following principles apply:

- Radioactive materials should be handled in such a way as to minimise waste production.
- Radioactive waste must be disposed of in a way that ensures the long-term protection of man and the environment.
- In principle, radioactive waste arising in Switzerland must be disposed of domestically.
- The duty of disposal lies with the waste producers.
- The selected strategy is monitored deep geological disposal.
- The waste producers are required to produce a waste management programme (Article 32 of the Nuclear Energy Act), which has to be reviewed and approved by the Federal Government.
- The licensing procedures are focused at federal level. The general licence for a nuclear installation is subject to an optional referendum. Participation of the siting Cantons, neighbouring Cantons and neighbouring countries is assured.
- Site selection procedure: the Federal Government has to define the objectives and requirements in a sectoral plan.
- The costs of decommissioning and waste management are to be covered in funds supervised by the Federal Government.

Systematic compilation of federal legislation

Kernenergiegesetz (Nuclear Energy Act), 21. March 2003 (KEG)
www.admin.ch/ch/d/sr/c732_1.html

Kernenergieverordnung, 10. December 2004 (KEV)
www.admin.ch/ch/d/sr/c732_11.html

An English version of the Nuclear Energy Act is available from the OECD/NEA Nuclear Law Bulletin, supplement to No. 72 (Switzerland, Act on Nuclear Energy), 2003.

Second review meeting on the International Convention

The Federal Department of the Environment, Transport, Energy and Communications (DETEC) submitted the second Swiss national report on the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management to the International Atomic Energy Agency (IAEA) in October 2005. The report was prepared by the Swiss Federal Nuclear Safety Inspectorate (HSK) and outlines how Switzerland is fulfilling its obligations under the Convention. The formal review meeting of the 41 Contracting Parties took place from 12th to 26th May 2006 at the IAEA headquarters in Vienna. Nagra was requested by HSK to answer questions on the national report at the meeting. The Swiss programme received a positive evaluation.

Waste management and decommissioning funds

The purpose of these funds is to cover the costs of disposing of operational waste and spent fuel after the decommissioning of the power plants, as well as the costs of decommissioning and dismantling nuclear installations and disposing of the waste arising from these activities. The funds are administered by the Federal Government and are regulated by ordinance. They are fed by contributions from the nuclear power plant operators and are on course in terms of financial development. More detailed information can be found on the websites www.entsorgungsfonds.ch and www.stilllegungs-fonds.ch (in French and German).

The cost estimates that form the basis for calculating the payments into the funds are reviewed periodically. An update was carried out in 2006. At the request of the power plant operators, Nagra revised the cost estimates for deep geological disposal (see also page 26).

Preparatory work for the waste management programme under the Nuclear Energy Act

The Nuclear Energy Act calls, in Article 32, for a waste management programme to be prepared for all waste types by the waste producers. The programme will be reviewed by the federal authorities and approved by the Federal Council. Together with the sectoral plan, the programme will provide a sound basis for deciding on the way forward in the Swiss waste management programme and securing the necessary political support. Article 52 of the Nuclear Energy Ordinance requires the waste management programme to provide information on waste types and volumes, interim storage facilities, geological repositories and plans for their realisation.

Nagra has been requested by the waste producers to prepare the programme, based largely on the decision of the Federal Council on the Entsorgungsnachweis, the specification of the site selection procedure in the sectoral plan and input from the 2006 cost study (see page 26). As in the previous year, activities in 2006 focused on preparation of background material.



In 2006, the draft of the strategic part of the sectoral plan for geological repositories was discussed at various workshops and forums under the lead of the Federal Office of Energy.



Background images on pages 11, 15, 20, 22, 25 and 30: rock structures at the Grimsel Test Site.

12 Inventory of radioactive materials

Nagra continued in 2006 to maintain the centralised inventory of existing radioactive wastes and materials. The inventory includes all waste packages currently stored at the nuclear power plants, in ZWILAG and in the Federal Government's interim storage facility and provides, at all times, a complete overview of all wastes and materials produced and stored in Switzerland. During the year, the waste packages produced from successful incineration campaigns with the ZWILAG plasma furnace were included in the inventory.

The Model Inventory of Radioactive Materials (MIRAM) was completely reworked and now allows flexibility in making calculations for a range of nuclear energy production scenarios. Besides inventories, characteristics and volumes of both existing and future waste arisings, additional key information that is required for planning the geological repositories was also included. The tool was used to publish information on volumes and inventories of waste and materials that will arise in the future (see page 49).

Important input was prepared for the 2006 cost study (see page 26) and Nagra's waste management programme; this included the volumes of existing and future radioactive waste for a range of NPP operating scenarios. Beginning from the year 2006, transport campaigns to the interim storage facilities and the repositories and their associated costs were also determined.

A project on detailed 3D modelling of activation processes was initiated for the inventorying of activated reactor components. In order to validate these complex calculations, results are now available from the dismantling of a reactor at the Gundremmigen power plant in Germany; these date from the year 2006.

Important research and development work at the Paul Scherrer Institute (PSI) on conditioning of waste products continued with success. Activity measurements on waste samples from the ZWILAG plasma furnace being carried out by the Radiochemical Institute of the Technical University of Munich were also completed.

In terms of contract work, the project started in 2004 for CERN on preparing a waste register was completed. A contract has been granted for a follow-up project and preparatory work is already underway.

In 2006, waste certification procedures were again carried out for waste from the nuclear power plants and from PSI; these certify the suitability of the waste for disposal. A certification procedure was also initiated for high-level waste from reprocessing and will be completed in 2007. This is a prerequisite for waste being returned to Switzerland from reprocessing abroad.

Once again, the work described above was carried out in collaboration with the waste producers. They ensure that the conditioning and characterisation of radioactive waste fulfil the requirements set out by the regulatory authorities and are carried out in accordance with internationally recognised standards.

13 Low- and intermediate-level waste (L/ILW)

In the perception of the public, the management of L/ILW has moved somewhat into the background. Attention was focused in 2006 on the Entsorgungsnachweis for SF/HLW/ILW and the discussion of alternatives to the potential siting region of the Zürcher Weinland.

The site selection procedure and corresponding criteria will be defined for both L/ILW and HLW in the sectoral plan. Over the last year, Nagra has been working intensively on preparing the geological and technical background information, in so far as this is possible without definitive information being available on the procedures and criteria that will be applied. The information base on waste properties and volumes, technical waste containment concepts and the safety-relevant properties of potential host rocks has been expanded. Many countries already have operating repositories for L/ILW and the resulting knowledge and experience will be integrated into the new site selection procedure in Switzerland.

In the late 70s and 80s, the focus was on L/ILW repository concepts with a horizontal access tunnel leading to the disposal caverns. To ensure a sufficient rock overburden above the caverns, repositories in mountainous areas accessed from the valley floor were foreseen. Today, however, transport of heavy loads is also possible via shafts and ramps and this removes the restriction of potential sites to locations in the Alps, Pre-Alps or the Jura Mountains. This means that, for L/ILW, the geologically less complex area of Northern Switzerland now comes into question.

Input for implementation of the new sectoral plan procedure

Information on the geological structure of the Swiss midlands and on the rock formations that would come into question is recorded in a geographic information system (GIS); this dataset was further consolidated during the year. In particular, the new geological and tectonic map of Switzerland (1:500,000) prepared by the Federal Office of Topography (Swisstopo) was integrated into the Nagra GIS. A re-evaluation of numerous 2D seismic profiles from the oil industry is also underway. The previously separate databanks for boreholes and geothermal energy investigations have been integrated to form a single databank that contains information for more than 6000 boreholes in varying degrees of detail. As before, Nagra takes advantage of investigations being carried out by third parties on the geological structure of Switzerland, for example measurements in geothermal boreholes. This extensive database will allow potentially suitable siting areas to be identified for a L/ILW repository. Studies are also ongoing on the design of the disposal caverns and containment concepts for various host rock options. The option of having one disposal site for all waste types is also being investigated.

Ready for action

Based on the criteria set out in the draft version of the sectoral plan since June 2006, preliminary work has begun on testing the procedure for narrowing down to potential, geologically justified siting areas and their evaluation. All this work will then have to be reviewed in the light of the requirements specified by the Federal Council, before the corresponding documentation is handed over to the authorities. In our opinion, the sectoral plan is an instrument that will lead to socially acceptable siting decisions for deep geological repositories in Switzerland.

Spent fuel (SF), high-level waste (HLW) and long-lived intermediate-level waste (ILW)

The operators of the nuclear power plants are obliged by law to demonstrate the feasibility of safe disposal of all radioactive waste in Switzerland. This demonstration – the so-called Entsorgungsnachweis – has to show that disposal in Switzerland is feasible in principle and that a host rock in a specific region would, in principle, be suitable for constructing a geological repository. This feasibility demonstration is neither a siting decision nor a licence application for a concrete disposal project.

In 1988, the Federal Council accepted that the feasibility of disposal had been demonstrated fully for L/ILW, but only partly for HLW. This led to Nagra submitting the Entsorgungsnachweis for SF/HLW/ILW to the Federal Government on 19th December 2002; the project is based on the Opalinus Clay of the Zürcher Weinland.

Federal Council: successful demonstration confirmed

The Federal Council reached its decision on the Entsorgungsnachweis on 28th June 2006 as follows:

- The Entsorgungsnachweis for SF/HLW/ILW is approved.
- The request to focus future investigations on the disposal of SF/HLW/ILW on the Opalinus Clay in the potential siting region of the Zürcher Weinland is refused.
- Together with the waste management programme as required by Article 32 of the Nuclear Energy Act, the electricity utilities must submit to the Federal Council a report that systematically lists all the open questions and recommendations raised in the reviews of the Entsorgungsnachweis by HSK and other experts (KNE, KSA, NEA; see below) and indicates how these will be addressed in future procedure.

The decision of the Federal Council confirms that it is feasible to construct a geological repository for SF/HLW/ILW in Switzerland. It thus represents an important milestone in the national waste management programme and marks the end of a phase of intensive research and development work lasting more than 30 years.

In-depth review by a wide range of experts

The decision of the Federal Council was preceded by a comprehensive review of Nagra's technical documentation by the federal safety authorities between 2003 and 2005. The reports received a positive response from the Swiss Federal Nuclear Safety Inspectorate (HSK), the Commission for Nuclear Waste Management (KNE), the Federal Commission for the Safety of Nuclear Installations (KSA) and from a team of international experts from the Nuclear Energy Agency (NEA). The reviews all recommended the Federal Council to accept the Entsorgungsnachweis. The German group AkEnd (working group on selection procedures for repository sites) also gave the Swiss site selection procedure good marks in 2002.

The components of the Entsorgungsnachweis project

Safety demonstration

This has to show that the selected host rock has the required geological and hydrological properties and, together with the engineered barriers, can ensure the long-term safety of the geological repository.

Siting demonstration

Based on documented investigation results, this has to show that a sufficiently large body of host rock with the properties required by the safety assessment exists and that implementation of a geological repository can be initiated with a prospect of success.

Feasibility demonstration

This has to show that a geological repository can be constructed, operated and closed on the long term in the selected host rock using present-day technologies, at the same time observing the applicable safety standards.



Spent fuel and high-level waste require to be stored for several decades prior to disposal to allow cooling. They are transported for this purpose to the centralised interim storage facility in Würenlingen.



Approval of the Entsorgungsnachweis marked the end of many years of intensive work that is documented in numerous technical reports.



All of the reviews identified open questions and recommended that further investigations be carried out to address them. However, the experts were all of the opinion that these questions do not call the fundamental feasibility of constructing a safe repository into question. The recommendations made in the reviews represent important guidelines for future research and development programmes. Various questions have already been answered, for example through experiments being carried out at the Mont Terri Rock Laboratory. Nagra has been requested to submit a report outlining its plans for answering the open questions at the same time as submitting the waste management programme to the Federal Council (see page 10).

Reports, reviews and expert opinions opened to the general public

Before the decision of the Federal Council in June 2006, all of the reports, reviews and expert opinions associated with the Entsorgungsnachweis were opened to the public for comment between 13th September and 12th December 2005. A total of around 6800 responses were received by the Federal Office of Energy (FOE) from Switzerland (23.3%), Germany (51.5%), Austria (25.1%) and France (0.1%). The Cantons Solothurn, Schaffhausen, Aargau and Thurgau, various Swiss interest groups and most of the participating Swiss political parties considered the feasibility of disposal to have been demonstrated successfully. Canton Zürich had no objections to the technical reviews, but did not consider the feasibility demonstration to be fulfilled as important social and economic issues had not yet been clarified. As was to be expected, the Green Party and the Social Democrats rejected the Entsorgungsnachweis. Neither the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety nor the Federal State of Baden-Württemberg spoke out against the project.

Transparency and involvement, both in Switzerland and across the border

In the review of the Entsorgungsnachweis, the lead organisation FOE attached key importance to providing timely and comprehensive information, particularly to the Cantons Zürich, Schaffhausen, Aargau and Thurgau and the neighbouring Federal State of Baden-Württemberg in Germany. In order to ensure that the Swiss and German authorities were involved in the process, the FOE set up an "Information and Communication" working group and a "Technical Forum". The former ensured timely provision of information to the politically responsible Swiss and German authorities. The Technical Forum, headed by HSK, answered questions from the general public or interested groups. Questions and answers were published continuously on a website.

Under the chairmanship of the Director of Works for Canton Zürich, a committee consisting of representatives from Cantons Zürich, Schaffhausen, Aargau and Thurgau, Baden-Württemberg and from the FOE and HSK was also set up to accompany the review process.

The way forward

In 2002, Nagra also requested that further investigations in the HLW programme be focused on the potential siting region of the Zürcher Weinland. In the meantime, the Federal Government had decided to follow the sectoral plan procedure. Nagra's request was refused because focusing in this way would be prejudicial to the new procedure. As for L/ILW, the site selection process will be conducted within the framework of the sectoral plan procedure (page 9), as soon as the requirements and criteria have been specified.

In 2005, Nagra presented a report to the Federal Council, outlining and evaluating potentially suitable (from a geological and safety viewpoint) host rocks and regions for deep disposal of high-level waste (Nagra Technical Report NTB 05-02, downloadable from Nagra's website). Nagra's evaluation leads to the conclusion that, compared with other potential host formations, the Opalinus Clay offers advantages in terms of geology and safety and that various areas with Opalinus Clay could come into consideration. The report was opened to the public together with the Entsorgungsnachweis documentation. It is presently being reviewed by HSK and will serve as a decision-basis for future activities.

Impact of waste management facilities on the regional economy

On 16th June 2006, the Federal Council approved the report prepared as a result of the motion of Hans-Jürg Fehr (member of the National Council) calling for an investigation of the surface impact of a radioactive waste repository. The report is based on a study commissioned by the FOE on the socio-economic impact of waste management facilities. The Federal Council comes to the conclusion that waste management facilities can be constructed and operated in an environmentally sound manner and, taken overall, have a positive effect on the economy of a region. Before siting decisions can be accepted, it is essential that the affected parties are provided with comprehensive information and involved in the selection process.

According to the FOE, the study represents important input for further development of the sectoral plan. It can be found (in German only) on the website www.radioaktiveabfaelle.ch. It consists of two volumes: volume I (summary and key conclusions) contains an explanation of the objectives and methods used, a comparison of the results in table form and the most important conclusions from the case studies. Volume II presents the five case studies – ZWILAG (Switzerland), Centre de l'Aube (France), Gorleben (Germany), Olkiluoto (Finland) and Wellenberg (Switzerland) – as well as a report on the results of the trans-regional opinion poll conducted as part of the study. The report also takes into account the results of a socio-economic study commissioned by the Opalinus Clay Working Group; this was published in September 2005 and reached similar conclusions regarding the impact of a potential repository in the Zürcher Weinland region.

The next steps on the way to implementing deep geological repositories for HLW and L/ILW will be set out in the sectoral plan. The focus of research activities is currently on completing and consolidating existing material. Particularly for the HLW programme, this will involve taking into account the recommendations made as part of the review of the Entsorgungsnachweis.

Geochemical retardation processes and transport mechanisms

Most of the work on characterising geochemical retardation processes and transport mechanisms is carried out in collaboration with the Waste Management Laboratory (LES) at PSI, with Nagra contributing fifty percent of the research costs. The investigations are looking at how diffusive transport of radionuclides through the clay barriers of a deep repository (bentonite and Opalinus Clay) is retarded by chemical processes, as well as radionuclide retention in the near-field of a repository and how this is affected by the presence of cement (cementitious near-field). The work is divided as follows:

HLW programme: Sorption (retention) of various actinides on the clay mineral montmorillonite (the principal component of bentonite) was further investigated and described using mechanistic models. These models help not only in understanding the mechanisms involved, but also allow a consistent description of sorption for various nuclides as a function of their tendency to form hydroxides. The influence of carbonate dissolved in the porewater of the bentonite and the Opalinus Clay was also investigated for selected nuclides. In order to investigate retention processes on the atomic scale, various spectroscopic methods were used, including Micro-XAS (X-ray absorption spectroscopy). The latter uses a beam line that went into operation this year at the Swiss Synchrotron Light Source at PSI. The applicability of these retention mechanisms to diffusion, which is the dominant transport process in compact clays, was investigated for medium to strongly sorbing radionuclides. Diffusion mechanisms in compact bentonite and montmorillonite samples were investigated for a range of anions and cations. The anions also include iodide, which, in the form of ^{129}I , makes a significant contribution to calculated dose for disposal of spent fuel.

L/ILW programme: The cement in the disposal tunnels of a L/ILW repository, and also in an ILW repository, functions as an effective chemical barrier for many radionuclides. For cement and pure cement phases, these retention mechanisms have been investigated quantitatively in more detail and the mechanistic understanding improved. In the latter case, spectroscopic methods such as laser fluorescence spectroscopy were also used. Investigations on the persistence of cellulose degradation products in a cementitious environment were carried out with financial support from Nirex and SKB (for abbreviations see page 51) and showed that these products are unstable under oxidising conditions. Under reducing conditions, such as will be expected in a deep repository, no indications were found of further degradation of these products. Cellulose degradation products can enhance the mobility of radionuclides.

Background activities: These include preparing and improving the information base and modelling tools used to describe the behaviour of radionuclides in the near-field and host rock of a deep repository, providing input to both the L/ILW and HLW programmes. One example is the further development of the software used for chemical-thermodynamic modelling. The Waste Management Laboratory is also involved in building up a comprehensive international thermodynamic databank which serves as a basis for geochemical modelling within the context of safety analysis. Modelling on a molecular scale was applied to clay and cement systems; this is used for interpretation of spectroscopic data with respect to macroscopic observations such as sorption measurements. The objective is to obtain a better consistent understanding of radionuclide behaviour from the molecular scale to the decametre range, for example diffusion profiles in the Opalinus Clay.

Some of these investigations on the retention and transport of radionuclides are carried out as joint projects of the Sixth Framework Research Programme of the EU (see page 28).

Engineered barriers

As part of the European Union's Sixth Framework Programme, Nagra is participating in the NF-PRO project, which is aimed at building up an understanding and model descriptions of key processes in the near-field of a deep repository for various host rock types and disposal concepts. Nagra is also involved in the new MICADO project aimed at modelling the dissolution behaviour of spent fuel elements.

A conceptual study on the design of a packaging plant for spent fuel and vitrified high-level waste has now been completed. The study looked at the overall layout of the plant, as well as specific design and infrastructure elements, and included an analysis of operating procedures. A new programme on development of disposal containers has been initiated. The first step, involving input from internationally recognised experts, will consist of evaluating potential container materials for packaging of spent fuel and HLW.

The programme on the behaviour of bentonite backfill at increased temperatures includes both experimental work and model simulations. An important milestone was the successful excavation and sampling of a bentonite package that had been heated to a temperature of up to 130 degrees Celsius in a borehole in the Äspö rock laboratory in Sweden (LOT experiment). The University of Bern is currently analysing the data on the thermally stressed material. A further important activity towards the end of 2006 was the experimental work on highly compacted bentonite granulate carried out by the company Clay Technology (Lund, Sweden). The aim of the work was to investigate the swelling capability and hydraulic properties of this backfill material at different temperatures.

Rock laboratories

CFM Formation and transport of colloids and radionuclides under realistic conditions

1) Laboratory programme, 2) field experiments for characterisation of the experiment site, 3) hydraulic and transport modelling, 4) long-term field experiments.

FEBEX 1:1 Demonstration of the emplacement concept for high-level waste (part of the EU NF-PRO project)

1) Laboratory programme for optimisation of measurement techniques, 2) long-term behaviour of the engineered barrier system under natural conditions.

ESDRED (EU project)

Use of low-pH cements

1) Filling of a tunnel section with bentonite, 2) sealing installation, 3) monitoring of system behaviour.

FUNMIG (EU project) Fundamentals of radionuclide migration

1) Geophysical and hydraulic characterisation of the tunnel near-field, 2) geochemical interactions.

GMT Gas transport through the engineered barriers and surrounding rock (completed in 2006)

1) Laboratory programme, 2) synthesis and modelling.

LCS Long-term interactions between cement solutions and porewaters and rock

1) Development and testing of low-pH cements, 2) testing cement properties, 3) long-term tests on interactions between rock and cement solutions, 4) determining the effects on radionuclide transport (planned).

LTD Long-term diffusion of radionuclides

1) Monopole experiment, 2) dipole experiment, 3) natural tracers, 4) in situ measurement of porosity, 5) diffusion processes of radionuclides.

PSG Determination of pore space geometry in the matrix

Field campaign.

TEM Testing of monitoring methods

Comparison of geophysical monitoring methods and wireless data transfer with conventional monitoring techniques.

An overview of the experiments at the Grimsel Test Site, including a list of key publications in recent years, can be found on the English-language website www.grimsel.com.

Grimsel Test Site (GTS)

Nagra has been operating a rock laboratory in the Grimsel region since 1984. Nineteen partner organisations from ten different countries are presently involved in the investigations at the GTS. In addition, numerous universities and research institutes, both from Switzerland and abroad, make a significant contribution to the success of the experiment programme. Some of the experiments are supported financially by the European Union and the Swiss State Secretariat for Education and Research (SER).

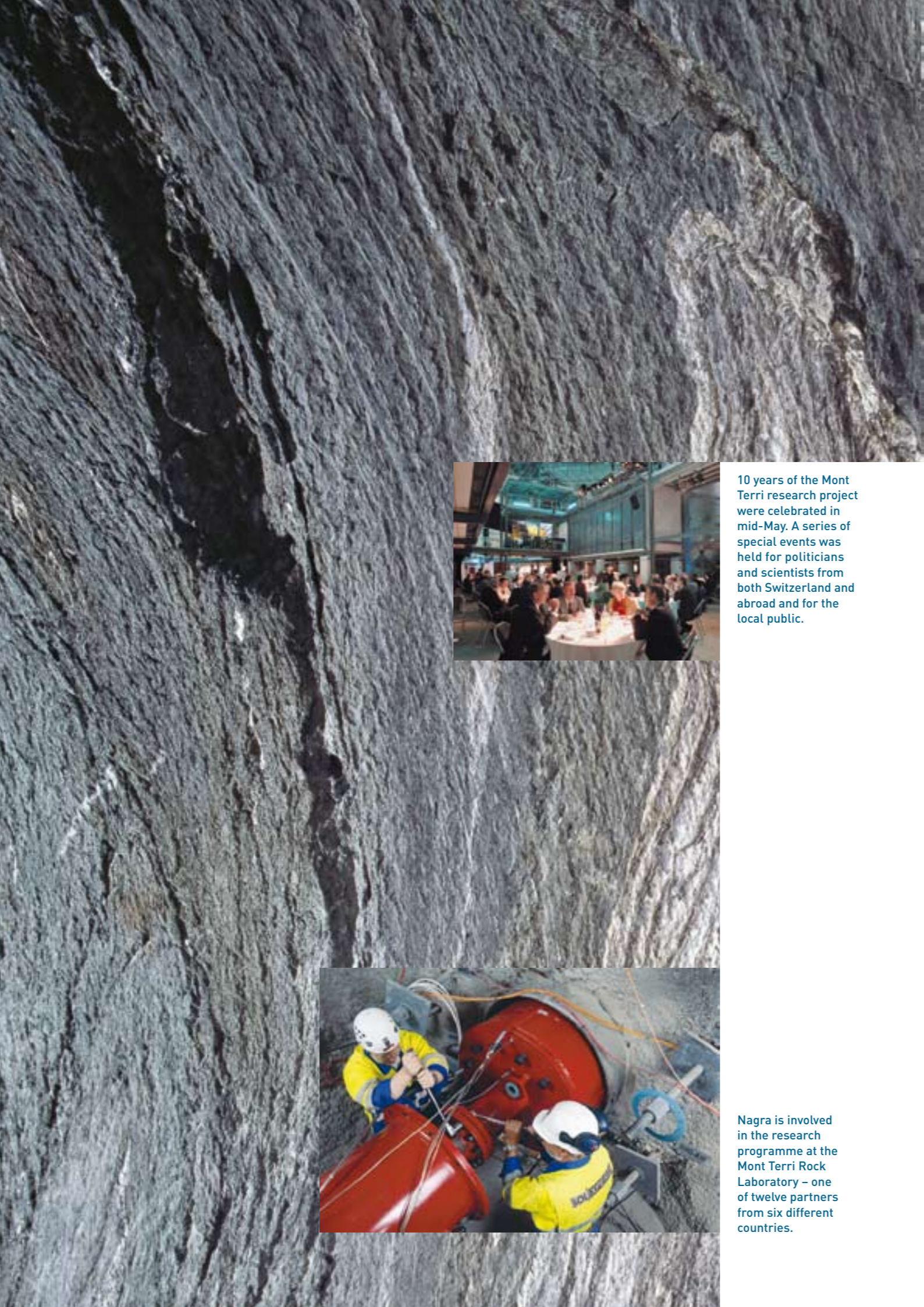
At the centre of the activities in Phase VI (2003 – 2013) are projects aimed at enhancing the understanding of engineered barrier systems and their practical implementation under realistic conditions on a 1:1 scale (construction and operational phase of a repository). A further focus is on projects looking at the transport behaviour of radionuclides under realistic, repository-relevant conditions. The projects generally have a duration of around five to seven years, with laboratory and modelling studies forming part of every programme. Shorter-duration experiments are also being carried out, for example testing of new methods, tools and equipment. What all the projects have in common is a close collaboration among different scientific disciplines, which is the only effective way to address the complex questions involved. As the work at Grimsel is regularly breaking new ground in scientific terms, projects generally begin with an intensive planning and preparatory phase, followed by a first phase of experiments in the field. Based on the results from work in 2006, decisions will be made in 2007/2008 on the continuation or new orientation of the experiments.

New experiments were also included in the programme in 2006. The concept of monitored deep geological disposal involves monitoring of a so-called pilot facility and Nagra has initiated a project to look at requirements and recent developments in this area. The new international TEM project offers the possibility to compare a wide range of measuring technologies, to check their suitability for use in deep geological repositories and to integrate the results into initial work on monitoring concepts. Three types of measurement technique are being tested: conventional sensors with signal transfer by cable, wireless data transfer and measurement of key parameters using geophysical methods. The work is being carried out together with sister organisations from Spain (Enresa) and England (Nirex). Collaboration with Japanese organisations has also intensified. With a view to further developing geophysical investigation methods, extensive work was carried out at the GTS in autumn by the Radioactive Waste Management Funding and Research Center (RWMC). This involved the use of first prototypes of seismic sources and analysis techniques that allow important rock properties (e.g. permeability distribution in the rock) to be derived directly from the geophysical data.

Together with the ITC (International Training Centre, www.itc-school.org), the GTS is contributing to the training of young scientists as part of the IAEA "Centres of Excellence" initiative.



Research at the Grimsel Test Site. The rock laboratory makes a key contribution to answering questions related to safety analysis and evaluating the technical feasibility of deep geological disposal of radioactive waste.



Key experiments at the Mont Terri Rock Laboratory

- CI** Mineralogical interaction between clay and cement
- DR** Diffusion and retention of radionuclides
- GM-A** Geomechanical long-term monitoring
- HG-A** Gas flowpaths through clay and along sealing structures
- HG-C** Long-term migration in undisturbed clay formations
- NT** Concentration profiles of natural water components in the Mont Russelin tunnel
- SE-H** Self-sealing of fissures in the excavation disturbed zone, taking into account thermal influences
- SF** Self-sealing processes in fault zones
- VE (III)** Ventilation experiment



10 years of the Mont Terri research project were celebrated in mid-May. A series of special events was held for politicians and scientists from both Switzerland and abroad and for the local public.



Nagra is involved in the research programme at the Mont Terri Rock Laboratory – one of twelve partners from six different countries.

Mont Terri Rock Laboratory (FMT)

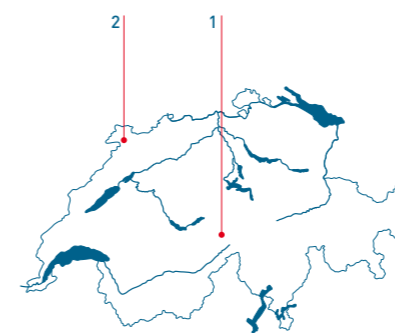
The international Mont Terri research project (St-Ursanne, Canton Jura) has been underway since 1996 in an extended section of the security gallery of the Mont Terri motorway tunnel. The experiments are aimed at the geological, hydrogeological, geochemical and geotechnical characterisation of clay formations, in particular the Opalinus Clay. The project allows Nagra to further investigate the properties of this host rock option that are relevant for disposal of radioactive waste.

Currently, twelve partner organisations from six countries (Belgium, Germany, France, Japan, Switzerland and Spain) are involved in the extensive research programmes. The project is directed by the Federal Office of Topography (Swisstopo) and, since 1st July 2006, the responsibilities of the Federal Government and the siting Canton have been regulated by the revised "Convention 2005". New is that, from the Federal Government side, the project is accompanied by a "Commission stratégique", while the interests of Canton Jura continue to be represented by the "Commission de suivi".

The 11th programme phase was completed successfully in the first half of the year; Nagra was involved in 15 of a total of 23 experiments. Participation in the current project phase 12 (July 2006 – June 2007) includes continuation of all the experiments from the previous phase, as well as setting up nine new experiments in the areas of rock mechanics, geochemistry and long-term monitoring. This includes participation in the 6th Framework Programme of the EU (GM-A, SE-H and VE (II) experiments). Based on the recommendations made by the authorities during the review of the Entsorgungsnachweis, the focus of Nagra's planned experimental activities is on the diffusion of radionuclides in the Opalinus Clay (DR and NT experiments), gas migration (HG-A and HG-C), the evolution with time of the excavation disturbed zone (self-sealing; SE-H, SF and VE (III)) and setting up a long-term experiment on the interaction between cement (as a barrier/construction material) and clay (CI).

In spring 2006, the occasion of the 10th anniversary of the Mont Terri project and its associated rock laboratory was marked by a series of events in St-Ursanne organised by the Swiss project partners (Swisstopo, HSK and Nagra), together with Canton Jura. These extremely successful events included a technical/scientific anniversary workshop, an official anniversary celebration and open days for political delegates and the public.

Construction activities have been undertaken with a view to improving the infrastructure for visitors and project workers, mainly in the former lime factory. As the planned building renovations and associated work will mostly benefit the Swiss waste management programme, the costs of the work will be borne by Nagra.



1 Grimsel Test Site
2 Mont Terri Rock Laboratory

An overview of the experiments can be found on the English-language websites:
www.grimsel.com
www.mont-terri.ch

24 Commercial services

International services and projects

With more than 30 years of experience in the field of radioactive waste management, Nagra's know-how continued to be recognised in 2006 as a valuable resource for other national waste management programmes, as well as for projects outside the nuclear area. The support offered ranges from strategic programme planning, specification of waste inventories and site selection, characterisation and evaluation to repository concept development, safety assessment and public communication. With the services it offers to the international scientific community, Nagra makes every effort to provide high quality, cost-effective solutions. Priority is given to projects that have synergies with activities in the Swiss national programme or expand Nagra's existing knowledge base.

A large proportion of the direct contract work in 2006 came from partners in Japan. Work was carried out as part of the various bilateral collaboration agreements between Nagra and CRIEPI, JAEA, JNFL, NUMO, RWMC and Obayashi (see page 51 for abbreviations). The year also saw a further increase in the number of projects in Europe and North America. Examples include evaluation of alternative disposal systems taking into account the evolution of near-field processes (Saanio & Riekkola OY, Finland), a contribution to the construction concept for the Hungarian deep geological repository and advising on the site investigation and evaluation programme for a L/ILW repository in Canada. Nagra's geoscientific staff also continued to play an advisory role in major infrastructure projects (e.g. railway tunnels), environmental issues (e.g. CO₂ sequestration) and technology development (e.g. measurement technologies for rocks); this represents a small but enriching part of its activities.

In Japan, the search is underway for volunteer communities to host a HLW repository. Nagra is supporting the HLW disposal organisation NUMO in the development of repository concepts tailored to potential sites. The main objectives are: 1) to further enhance transparency and traceability of decision-making in a staged site selection approach, 2) to evaluate the procedures and methods used for safety assessment of potential volunteer sites, 3) to produce training manuals for performing site characterisation investigations and 4) to exchange know-how during the investigation programme.

For higher-activity low-level waste, JNFL is moving forward with its project for a medium-depth geological repository at the Rokkasho site (L1 project). Construction of a test cavern at a depth of around 80 metres is underway and the Nagra-Obayashi consortium is providing technical support in several areas. For example, technologies developed by Nagra for characterising excavation disturbed zones and their resaturation behaviour are being used. This work is linked with the installation of sealing structures in the tunnels of geological repositories.



At the Grimsel Test Site, Nagra works together with various international partners.

Nagra and JAEA continued their long-standing and successful collaboration. Activities focused on supporting the JAEA rock laboratory programme, with parallel development of two facilities (Mizunami in crystalline rock and Horonobe in sediments) and completion of the second report on the disposal of long-lived intermediate-level waste (TRU).

Collaboration with RWMC during 2006 focused on the final analysis of the Grimsel GMT project (gas transport through engineered barriers and the surrounding rock), testing of new geophysical investigation techniques (also at the GTS), development of new analytical techniques for hydraulic tomography and summarising and production of a report analysing technical and political developments in the Swiss programme. Two additional highpoints of this collaboration were the international workshop held in Switzerland to review RWMC's "Site Investigation Flow Diagram (SIFD)" tool and the start of a demonstration experiment in the Rokkasho test cavern.

Review of disposal costs (2006 cost study)

To secure the costs of waste management, the NPP operators put aside financial reserves, the amount of which is calculated from estimated disposal costs. The cost estimates have to be reviewed periodically and updated. The last update from 2001 has been revised based on new estimates made by Nagra during the year of the costs of the L/ILW and HLW repositories. The concept of monitored deep geological disposal has been adopted for both repositories. The cost estimates also now assume a 50-year operating lifetime for the power plants, as well as taking into account the sectoral plan procedure for site selection. Once again, estimates for HLW were based on the option of the Opalinus Clay in the Zürcher Weinland. The open issues raised by the authorities during the review of the Entsorgungsnachweis were also taken into account. A new conceptual study was initiated on packaging of spent fuel and vitrified high-level waste.

The revised figures more or less confirmed the costs estimated for the HLW repository in the year 2001 (variant with 50-year operating lifetime for the NPPs). After the Wellenberg project had been abandoned, a new project had to be assumed for the L/ILW repository; this is based on a model site in the Opalinus Clay. The costs of the L/ILW repository are estimated as being considerably higher than in the previous study because the considerable investments made for the Wellenberg project (site selection, characterisation from the surface, facility design, safety reports, etc.) have to be written off and started again from the beginning for the new site.

International collaboration

A regular exchange of information between Nagra and its foreign partner organisations takes place as part of the various formal bilateral agreements. Joint projects are also carried out with several partners, either on a multilateral basis (e.g. rock laboratory projects) or together with international organisations (particularly the OECD/NEA and the EU). In addition to the formal collaboration structure, international contacts have also resulted in a close network of personal contacts, which provides Nagra with a wealth of opportunities to discuss technical issues. This network includes not only the partner organisations but also the wider scientific community that is integrated into Nagra's daily activities through review of its scientific work.

The joint research projects at the Grimsel Test Site and the Mont Terri Rock Laboratory moved forward in 2006 and Nagra staff continued to be involved in Andra's Bure rock laboratory. These projects were all complemented by joint laboratory and modelling programmes; this includes the projects run under the auspices of the OECD/NEA on sorption and on the thermochemical databank. Nagra's involvement in EU Framework Programmes has now become an important component of its research and development activities (see page 28).

Nagra staff are also involved in advisory bodies of foreign sister organisations (e.g. Belgium, Germany, Finland, France and Canada) and are able to benefit directly from this experience.

Over and above the wide range of specific collaborative arrangements, Nagra is also represented in working groups of the NEA/OECD and works together with the IAEA. In 2005, DETEC submitted the Swiss national report under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management to the IAEA. In 2006, Nagra was requested by HSK to participate in the conference at which the report was presented and discussed. The Swiss report received a positive evaluation.

Key results of international collaborative work are presented in the project-related sections of this report.

As in previous years, Nagra took part in important international meetings on the topic of waste disposal, frequently making presentations on the Swiss programme. Nagra is also represented on the programme committees of several international events.

As part of what is now an annual event, Nagra attended the meeting of the German-Swiss Commission (DSK, working group 4), which was held in Germany in 2006.

Sixth Framework Programme (2002 – 2006)

CARD Coordination of research, development and demonstration focal points for deep geological disposal of long-lived radioactive waste

Coordination: Nirex (United Kingdom). Participation: 10 disposal organisations. Duration: 12 months.

ESDRED Engineering studies and demonstration of repository designs in underground rock laboratories

Overall lead: Andra (France). Participation: 13 project partners from 9 European countries. Duration: 2004 – 2008.

FUNMIG Fundamental processes of radionuclide migration in the geosphere

Overall lead: FZK/INE (Germany). Participation: 51 organisations from 15 countries. Duration: 2005 – 2008.

MICADO Model uncertainty for the mechanism of dissolution of spent fuel in a nuclear waste repository

Lead: Armines Nantes (France). Participation: 19 organisations from 7 countries. Duration: 2006 – 2009.

NF-PRO Building up understanding and model descriptions of key processes in the near-field for various host rock types and disposal concepts

Lead: SCK•CEN (Belgium). Sub-project leader: PSI. Participation: 46 partners from 10 European countries. Duration: 2004 – 2007.

PAMINA Performance assessment methodologies in application to guide the development of the safety case

Lead: GRS mbH (Germany). Participation: 26 organisations from 10 countries. Duration: 2006 – 2009.

TIMODAZ Thermal impact on the damaged zone around a radioactive waste repository in clay host rocks

Coordination: ESV EURIDICE GIE (Belgium). Participation: 14 partners from 8 countries. Duration: 2006 – 2010.

Framework Research Programmes of the European Union (EU)

Since 1984, the Framework Research Programmes of the EU have functioned as an important instrument for financing research projects in Europe. Many of the challenges faced by industry and society today can no longer be solved in isolation by one country alone. The 6th Framework Programme (2002 – 2006) is aimed specifically at creating a European Research Area (ERA). The aim is to promote excellence in scientific and technological capacities and to encourage European competitiveness and innovation by supporting improved cooperation among researchers and the coordination of their projects.

Based on the research agreement between Switzerland and the EU, Swiss researchers have been able, since 2004, to participate fully in the 6th Framework Programme. In return, Switzerland makes a direct contribution to the total budget of the EU Framework Programme.

The research projects planned in the area of deep geological disposal of radioactive waste developed as part of the EURATOM programme allow Nagra to expand its technical knowledge base efficiently and continuously and to be instrumental in shaping important developments in Europe. In the final outline of proposals for the 6th Framework Programme issued in 2005, Nagra applied together with its European sister organisations for the support of the EU in the following areas:

- Coordination of research and development on deep geological disposal of spent fuel and long-lived radioactive waste.
- Improvement and harmonisation of methods and tools for demonstrating long-term safety.
- Investigation of the dissolution mechanisms of the spent fuel matrix.
- Thermal effects on the excavation disturbed zone of a deep repository in clay.

In 2006, Nagra's participation included continuation of the ESDRED, FUNMIG and NF-PRO projects. Based on the recently concluded contracts between the EU and the participating partner organisations, preparations for the projects CARD, MICADO, PAMINA and TIMODAZ have also been underway since 1st October 2006 (see Table).

Public relations

Nagra in the public eye

As is their right, the citizens of Switzerland expect clear answers to all questions surrounding the issue of radioactive waste disposal. The interests of the widest possible range of societal groups are involved, with economic, ecological, energy policy and ethical issues being reflected in the ongoing debate. The drafting of the first part of the sectoral plan on geological repositories in 2006 had the effect of increasing the information needs of politicians and the public alike. Nagra is aware of the social significance of direct, open communication with the public, the media, the authorities, political circles, research partners and the scientific community as a whole and makes every effort to fulfil its responsibilities in this respect.

Nagra was in contact with the public on more than 200 days in 2006 – at trade fairs and exhibitions, tours of the rock laboratories, invited presentations and the information tour.

Two information trips to Sweden and Finland were organised for politicians and authorities, giving them the opportunity to experience first hand the status of the waste management programmes in these countries. Representatives of cantonal governments and parliaments and politicians from the neighbouring German state of Baden-Württemberg also visited the Swiss rock laboratories.

Open dialogue during the information tour, exhibitions and guided tours

In summer 2006, the information tour visited eight towns in the German-speaking part of Switzerland. With the slogan "Switzerland has radioactive waste. We are taking care of it. Nagra. Who else.", the aim was to make the public more aware of the important task entrusted to Nagra. Six regional information events held during the tour for politicians were also well attended. Large numbers of the public took advantage of the opportunity to obtain information on waste management first hand and to discuss issues of interest with Nagra staff.

Local exhibitions and trade fairs are popular meeting points and offer a very direct form of contact with the public. Nagra was represented during the year at local trade fairs in Frauenfeld and Däniken and at the larger autumn fairs in Schaffhausen and Winterthur. We were also present at a meeting for women's information and had an information stand at the Swiss Tunnel Congress in Lucerne.

The rock laboratories at Grimsel (Canton Bern) and Mont Terri (Canton Jura) continue to be a favourite destination for visitors. During 2006, more than 3800 people visited the two facilities and were able to experience the underground research projects first-hand. Many people also took advantage of the opportunity to attend one of the two open days at the Grimsel Test Site. The events surrounding the 10-year celebration of the Mont Terri Rock Laboratory also provided an important opportunity for politicians, international guests and members of the local public to visit the facility.



In 2006, Nagra was represented at exhibitions in Däniken, Frauenfeld, Schaffhausen and Winterthur.



The annual information tour in summer 2006 visited the towns of Aarau, Basel, Brugg, Bern, Schaffhausen, Winterthur, Zug and Zürich.

Working with the media

In 2006, more than one hundred articles on radioactive waste management were published in the Swiss media. Key topics were the start of the sectoral plan procedure and the approval of the Entsorgungsnachweis for high-level waste. Nagra produced four media releases (ordinary general meeting, approval of the Entsorgungsnachweis, information tour and new Nagra CEO), as well as numerous articles and advertisements in technical publications.

Information service for individuals and schools

During the year, the in-house information service sent out almost 200 packages with brochures, DVDs and videos to individuals, organisations and clubs. Schools were also supported fairly intensively: around 100 inquiries were received from teaching staff for information, teaching materials and measuring equipment. As in previous years, measuring radioactivity is of particular interest and the 40 sets of measuring equipment were constantly on loan.

Print product palette reduced, more focus on the website

The information brochure series "nagra Bulletin" and "nagra Focus" have been discontinued and will be replaced in the future by topical publications. A brochure on natural analogues was completed in 2006 and will be published early in 2007. Three issues of "nagra Info", with news on current waste management activities, reached around 60,000 readers in Switzerland. The 10-year anniversary of Mont Terri was marked with a commemorative brochure and a technical journal. A book on the topic of rock, with information on the geology of Switzerland, was in print at the end of the year.

The website was redesigned in 2005 and its content revised and, during 2006, the English and French versions went online. The site is continually being improved and kept up to date. During 2006, an average of around 400 people per day visited the site.

Organisation

Management and headquarters

Organisation

Headquarters

At the end of 2006, 76 people were employed at Nagra's headquarters, corresponding to 70.0 full-time positions (69.1 in the previous year). 15 people – corresponding to 5.7 full-time positions (5.2 in the previous year) – were also employed as advisers, part-time and support staff and trainees. A large part of Nagra's work is carried out together with research institutes, technical universities and geological and engineering consultants. On 1st December, Thomas Ernst joined the organisation as designated Chief Executive Officer; he will take up office on 1st May 2007.

Board of Directors and general meeting

The Board of Directors held four meetings to deal with ongoing business. Focal points included the first draft of the strategic part of the sectoral plan proposed by the Federal Office of Energy, expansion of Board membership in view of the upcoming site selection procedure and the age-related change in the leadership of the Executive Board. Based on the recommendation of the Nominations Committee, Thomas Ernst was elected as Nagra's new Chief Executive Officer as of 1st May 2007. Manfred Thumann was confirmed as Vice-President of the Board of Directors for the period 2006 to 2009. At a meeting of 30th November, the Board was informed of the planned research and project work for the year 2007. A corresponding outline credit was discussed and will be approved in the first quarter of 2007.

Important technical questions were discussed by the various commissions. The Technical Committee held four meetings and the Commission for Information met three times. The Finance Commission commented on the closing of the annual accounts and on the budget for 2007.

The ordinary general meeting of the Members of the Nagra Cooperative took place on 8th June 2006 in Bern. The Members approved the annual report and accounts for 2005. Total expenditure amounted to 32.02 million CHF. 5.3 million CHF could be assigned to services performed for third parties and 0.78 million CHF to services for the Members of the Cooperative. Research contributions amounted to 0.59 million CHF and other operating income to 0.11 million CHF. The net expenditure for the Members for 2005 amounted to 25.73 million CHF.

On the occasion of the ordinary general meeting, Guillaume Gros of Energie Ovest Suisse (EOS) announced his intention to step down; the new EOS representative will be Benoît Revaz. The other Members of the Board had their period of office confirmed up to 2009. Hans Issler's position as Chairman was also confirmed.

The general meeting also approved two amendments to the statutes. One creates the possibility to expand the composition of the Board to include up to three external members and the other makes the appearance of the Nagra logo uniform in all language versions.



Nagra's Executive Board: (from left to right) Piet Zuidema, Hans Issler and Markus Fritschi. On the far right is Thomas Ernst, designated Chief Executive Officer, who will take over from Hans Issler on 1st May 2007. Hans Issler will continue to serve as Chairman of the Board of Directors.

Members of the Cooperative, Board of Directors, 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 Directors

(period of office 2006 – 2009)

Hans Issler
President
Nagra

Dr. Manfred Thumann
Vice-president
Nordostschweizerische
Kraftwerke AG

Guillaume Gros
Energie Ouest Suisse
(until 8. June 2006)

Benôît Revaz
Energie Ouest Suisse
(from 8. June 2006)

Peter Hirt
Kernkraftwerk Gösgen-Däniken
AG

Hermann Ineichen
BKW FMB Energie AG

Martin Jermann
Paul Scherrer Institute

Mario Schönenberger
Kernkraftwerk Leibstadt AG

Technical Committee

Mario Schönenberger
Chairman
Kernkraftwerk Leibstadt AG

Finance Commission

Michael Sieber
Chairman
Nordostschweizerische
Kraftwerke AG

Commission for Legal Issues

Dr. Jürg Marti
Chairman
Kernkraftwerk Leibstadt AG

Commission for Information

Peter Hirt
Chairman
Kernkraftwerk Gösgen-Däniken AG

Auditors

PricewaterhouseCoopers AG
Zürich

Annual accounts 2006

Comments on the annual accounts for 2006

In 2006, Nagra's total performance increased by 1.8 million CHF compared to the previous year to 33.8 million CHF. The contributions of the Members of the Cooperative increased by 3.2 million CHF to 28.9 million CHF.

Taking into account work in progress, income from deliveries and services decreased by 1.5 million CHF to 4.7 million CHF. This decrease is due mainly to the following factors:

- The research and partner contributions decreased by 0.3 million CHF compared to the previous year.
- Direct contracts for the Members of the Cooperative dropped slightly compared to the previous year to 0.7 million CHF.
- Taking into account work in progress, services for third parties decreased by 1.1 million CHF to 3.7 million CHF compared to the previous year.

Total expenditure increased by around 1.8 million CHF. Documented external services increased by 0.5 million CHF to 19 million CHF. Personnel costs increased compared to the previous year by around 1.4 million CHF to 12.5 million CHF.

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

Wettingen, 26th February 2007



Hans Issler, President

Balance

	31.12.2005	31.12.2006	
	CHF	CHF	
Assets			
Land and buildings	2 623 379	2 593 379	
Other fixed assets	111 200	135 700	
Capital assets	2 734 579	2 729 079	1
Ongoing contracts	2 717 514	1 598 017	2
Receivables from deliveries and services	4 305 090	3 202 348	3
Other receivables	633 189	453 257	
Active accruals and deferrals	-	10 558	
Liquid assets	12 450 792	8 378 283	4
Current assets	20 106 585	13 642 463	
Assets	22 841 164	16 371 542	
Liabilities			
Cooperative capital	120 000	120 000	
Equity capital	120 000	120 000	
Long-term financial obligations	650 000	650 000	1
Reserves	6 330 406	6 420 504	5
Payables from deliveries and services	6 177 505	4 582 152	6
Prepayments	2 501 510	1 412 334	2
Other liabilities	255 995	283 614	
Passive accruals and deferrals	6 805 748	2 902 938	7
Outside capital	22 721 164	16 251 542	
Liabilities	22 841 164	16 371 542	

Operating accounts

	2005	2006	
	CHF	CHF	
Total performance			
Contributions to administration costs	600 000	600 000	
Contributions to project costs	25 134 731	28 329 939	
Contributions of Cooperative Members	25 734 731	28 929 939	8
Research contributions	592 550	304 485	
Income from other services for Cooperative Members	786 830	677 566	
Income from services for third parties	5 296 124	3 710 801	
Change in prepayments	-288 891	1 089 176	2
Income from deliveries and services	6 386 613	5 782 028	9
Adjustment for ongoing contracts	-216 911	-1 119 497	2
Other operating income	116 214	194 743	10
Total performance	32 020 647	33 787 213	
Total expenditure			
External expenditure	18 538 514	19 019 412	11
Personnel costs	11 107 748	12 509 357	12
Depreciation of assets	103 447	92 864	
Other operating expenditure	2 165 103	2 118 652	13
Operating expenditure	31 914 812	33 740 285	
Financial income	-57 931	-92 395	
Financial expenditure	46 043	80 102	
Taxes	117 723	59 221	
Financial result and taxes	105 835	46 928	
Total expenditure	32 020 647	33 787 213	

Explanations in appendix pages 42 /43

Cash flow statement

	2005	2006	
	CHF	CHF	
Change in liquid assets			
Annual result	-	-	
Depreciation	103 447	92 864	
Formation of reserves	-	90 098	5
Application of reserves	-98 967	-	5
Cash flow	4 480	182 962	
Change in net current assets (without liquid assets)	5 340 384	-4 168 107	4
Cash flow from business activities	5 344 864	-3 985 145	
Investments	-159 647	-87 364	1
Divestments	-	-	
Cash flow from investment activities	-159 647	-87 364	
Raising of loans	-	-	
Repayment of loans	-	-	
Cash flow from financing activities	-	-	
Change in liquid assets	5 185 217	-4 072 509	4
Attestation			
Liquid assets as per 1.1.	7 265 575	12 450 792	
Liquid assets as per 31.12.	12 450 792	8 378 283	
Change in liquid assets	5 185 217	-4 072 509	4

Explanations in appendix pages 42 /43

Accumulated accounts

[Contributions of the Cooperative Members and their application since the founding of Nagra in 1972]

	Status 31.12.2005 CHF	Increase 2006 CHF	Status 31.12.2006 CHF
Total performance			
Swiss Confederation	24 370 622	699 668	25 070 290
BKW FMB Energie AG	83 374 607	2 612 073	85 986 680
Kernkraftwerk Gösgen-Däniken AG	235 760 029	7 145 990	242 906 019
Kernkraftwerk Leibstadt AG	257 448 662	8 567 624	266 016 286
Nordostschweizerische Kraftwerke AG	183 219 408	5 379 976	188 599 384
Contributions to project expenditure	784 173 328	24 405 331	808 578 659
Balancing of income/expenditure excess	-6 569 386	3 924 608	-2 644 778
Contributions to administration costs	82 520 000	600 000	83 120 000
Contributions of Cooperative Members to Nagra	860 123 942	28 929 939	889 053 881
Contributions of GNW	65 265 331	-	65 265 331
Contributions of Cooperative Members	925 389 273	28 929 939	954 319 212 14
Research contributions	-	304 485	304 485
Income from other services for Cooperative Members	15 137 353	677 567	15 814 920
Income from services for third parties	40 221 239	4 799 976	45 021 215
Income from deliveries and services	55 358 592	5 782 028	61 140 620 15
Adjustment for ongoing contracts	2 717 513	-1 119 497	1 598 016 16
Other operating income	5 394 740	194 743	5 589 483 17
Total performance for accumulated accounts	988 860 118	33 787 213	1 022 647 331

Explanations in appendix pages 44 / 45

	Status 31.12.2005 CHF	Increase 2006 CHF	Status 31.12.2006 CHF
Total expenditure			
Accrued costs L/ILW (inc. GNW)	355 641 626	-	355 641 626
Geological studies	-	2 401 239	2 401 239
Nuclear technology and safety	-	1 400 938	1 400 938
Radioactive materials	-	941 931	941 931
Planning of facilities	-	528 506	528 506
Non-site-related activities	-	3 063 933	3 063 933
General programme costs	-	3 871 178	3 871 178
Fees and compensation	-	95 824	95 824
L/ILW programme	355 641 626	12 303 549	367 945 175
Accrued costs HLW	492 815 560	-	492 815 560
Geological studies	-	824 667	824 667
Nuclear technology and safety	-	864 682	864 682
Radioactive materials	-	425 092	425 092
Planning of facilities	-	521 693	521 693
Non-site-related activities	-	5 671 082	5 671 082
General programme costs	-	4 204 523	4 204 523
Fees and compensation	-	2 560 889	2 560 889
HLW programme	492 815 560	15 072 628	507 888 188
Expenditure for repository programmes	848 457 186	27 376 177	875 833 363
Administration and general project expenditure	82 520 000	1 225 744	83 745 744
Project-related expenditure for L/ILW and HLW repository programmes	930 977 186	28 601 921	959 579 107 18
Project expenditure for Cooperative Members	15 685 933	765 895	16 451 828
Project expenditure for third parties	42 196 999	4 419 397	46 616 396
Project-related expenditure from deliveries and services	57 882 932	5 185 292	63 068 224 19
Total expenditure for accumulated accounts	988 860 118	33 787 213	1 022 647 331

Explanations in appendix pages 44 / 45

Notes on the annual accounts

The presentation of the cash flow account for 2006 now shows the cash flow indirectly and contains a confirmation of the change in liquid assets. The account for the previous year has been modified accordingly.

1 Property and equipment

In 2006, three older vehicles were replaced with new ones; otherwise there was no acquisition of assets. Small acquisitions are contained in the position for other operating expenditure. Depreciation is documented separately. Income from sale of property and equipment is contained in other operating income; for the year it amounted to 0.14 million CHF.

The facilities at Nagra's headquarters and at the Grimsel Test Site are insured against fire damage for a total of 7.2 million CHF (7.5 million CHF in the previous year). The fire insurance value of the depot and installations in Mellingen is 3.7 million CHF.

Under long-term financial obligations, a payment of 0.65 million CHF is shown for the planned sale of the parcel of land at Hägendorf.

2 Ongoing contracts

Ongoing contracts for third parties decreased compared to the previous year by 1.1 million CHF to 1.6 million CHF.

Passivated prepayments for ongoing contracts decreased by 1.1 million CHF and now amount to 1.4 million CHF.

Activated ongoing contracts result exclusively from work performed for third parties

3 Receivables from deliveries and services

Receivables from deliveries and services decreased by a total of 1.1 million CHF to 3.2 million CHF.

This position includes claims against the Members of the Cooperative in the amount of 2.6 million CHF (3.5 million CHF in the previous year). The largest claim relates to Kernkraftwerk Leibstadt AG, with 0.9 million CHF. Receivables with respect to third parties decreased by 0.2 million CHF to 0.6 million CHF.

4 Liquid assets

Liquid assets decreased by 4.1 million CHF compared with the previous year. As of 31st December 2006 and 2005, there were no fixed-term deposits.

In the cash flow account, the net circulating assets (without liquid assets) decreased by 4.2 million CHF. This change is due mainly to the decrease in ongoing contracts of 1.1 million CHF, the decrease in receivables from deliveries and services of 1.1 million CHF, the decrease in payables from deliveries and services of 1.6 million CHF, the decrease in prepayments for ongoing contracts of 1.1 million CHF and the decrease in passive accruals and deferrals of 3.9 million CHF.

5 Reserves

As before, reserves include amounts for vacation and overtime hours of employees, tax reserves and various other items. Reserves increased by 0.1 million CHF.

In 2003, Nagra took over responsibility for the Wellenberg site from the now liquidated company GNW for a one-off payment of 4.8 million CHF. For a period of ten years, this amount is to be used for site recultivation work, production of project documentation and final reports and payment of various fees. No expenditure of this nature was incurred during the year and the reserve remain unchanged.

6 Payables from deliveries and services

Payables from deliveries and services decreased during 2006 by around 1.6 million CHF to 4.6 million CHF.

The position contains liabilities towards Members of the Cooperative in the amount of 0.2 million CHF.

7 Passive accruals and deferrals

Passive accruals and deferrals decreased in 2006 by around 3.9 million CHF.

The balance shown contains liabilities towards Members of the Cooperative of around 2.6 million CHF (6.5 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 0.1 million CHF to 0.3 million CHF.

8 Contributions of Members of the Cooperative

The contributions of the Members of the Cooperative increased during the year by around 3.2 million CHF and are made up as follows:

Contribution to administration costs of 0.6 million CHF, fees for supervision by the authorities (FOE, HSK, KSA) of 2.5 million CHF (3.4 million CHF in the previous year) and contributions to project costs of 25.8 million CHF (21.7 million CHF in the previous year).

9 Income from deliveries and services

Other services to Members of the Cooperative decreased by 0.1 million CHF to 0.7 million CHF.

Income from deliveries and services for third parties decreased by 1.6 million CHF to 3.7 million CHF. Taking into account the change in ongoing contracts (for third parties) and the corresponding prepayments, services for third parties decreased by around 1.1 million CHF compared to the previous year.

10 Other operating income

This position contains inter alia income from realisation of assets.

11 External expenditure

External expenditure includes direct project costs. External expenditure increased by 0.5 million CHF to 19 million CHF. This amount contains fees of the regulatory authorities in the amount of 2.5 million CHF.

12 Personnel costs

Personnel costs increased by 12.6% to 12.5 million CHF compared to the previous year. The number of staff at the end of the year (76 full-time positions) increased by two full-time positions compared to the previous year. The increase in costs is mainly due to extraordinary pension fund premiums, an accumulation of bonuses for long-serving employees, a special one-off premium and costs of recruiting staff.

13 Other operating expenditure

This contains rents of 0.8 million CHF, as well as the repair and maintenance of vehicles, computer systems and other office installations of a total of 1.0 million CHF.

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, at the time of waste emplacement, for any adjustment payments between the Members. It also shows which work gives rise to project-related expenditure.

In 2006, the method of presenting of the accumulated accounts was changed (see comments on points 14, 15 and 18). The structure of the total performance is now oriented largely to the operating accounts. The presentation of total expenditure has been completely revised.

14 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 2006, the Members of the Cooperative made net payments to Nagra in the amount of 24.4 million CHF. Taking into account prepayments of 2.6 million CHF by the Members of the Cooperative that have not yet been applied, as well as the balance from the previous year of 6.6 million CHF, the contributions of the Members amounts to a total of 28.9 million CHF (25.7 million CHF in the previous year). Included in this is the contribution to administration costs in the amount of 0.6 million CHF, as well as fees passed on for supervision by the authorities (FOE, HSK, KSA) in the amount of 2.5 million CHF.

The contributions of GNW include the payments by GNW for contract work for the Wellenberg project, which is now complete.

As the members of the GNW cooperative are largely identical to those of Nagra and the Wellenberg project was for low- and intermediate-level waste, the positions of GNW that were operated via Nagra have been reclassified accordingly. This change was also made in the previous year.

15 Income from deliveries and services

The research contributions now contain only contributions to the national disposal programmes. The amount was previously taken together with income from third parties.

Other entries in income from deliveries and services agree with the operating accounts and are explained there.

16 Adjustment for ongoing contracts

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

17 Other operating income

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

18 Project-related expenditure

The division of project-related expenditure for the repository programmes has been revised. It was modified to coincide with the account plan of the cost study for the waste management fund. At the time when the repositories are realised, this presentation will be used to determine the emplacement quota per repository and Cooperative Member.

The repository projects are structured in the same way in the accumulated accounts and are oriented to the most important technical tasks to be performed up to the time of completion of waste management activities. Where not explicitly referred to as applying to a particular repository project, the following information can be assumed to apply to both projects.

Instead of the previous lump sum of 0.6 million CHF, the administration costs and general project expenditure now show the remaining general costs associated with the headquarters according to internal performance calculations.

Project-related expenditure in 2006 amounted to around 28.6 million CHF. 12.3 million CHF can be assigned to the L/ILW programme and 15.1 million CHF to the HLW programme. The administration costs and general project expenditure amounted to 1.2 million CHF.

a) Accrued costs of the disposal projects

The accumulated expenditure on the disposal projects was presented up till 2005 with a different structure which is shown here in one position depending on disposal project. The allocation of costs accrued to date under the new division will be done at a later stage.

b) Geological investigations for site selection

Geological investigations for site selection include studies in the investigation area of Northern Switzerland associated with geological disposal of high-level waste, as well as preparing the geological basis for a repository for low- and intermediate-level waste.

c) Nuclear technology and safety

This work includes the safety assessment of potential siting areas, laboratory investigations on the near-field and on various backfill materials.

d) Radioactive materials

Expenditure associated with the certification of suitability of wastes for disposal and ongoing documentation and inventorying of radioactive waste.

e) Planning of facilities

This position includes expenditure on the concepts for the surface and underground facilities of the deep geological repositories for both high-level and low- and intermediate-level waste.

f) Site-independent studies

This includes expenditure on development of methodologies, modelling and validation of mathematical models for safety assessment, laboratory studies, involvement in research in rock laboratories (Grimsel and Mont Terri) and in the research programmes of the EU.

g) General programme costs

This relates to expenditure arising from programme management, cost studies and public relations activities.

h) Fees and compensation

This includes mainly the fees of the safety authorities charged to Nagra.

19 Project-related expenditure from deliveries and services

This expenditure in the amount of 5.2 million CHF results from contracts included under income from deliveries and services and contains project expenditure for Members of the Cooperative of 0.8 million CHF and project expenditure for third parties of 4.4 million CHF.

Bericht der Revisionsstelle
an die Generalversammlung der
NAGRA Nationale Genossenschaft für
die Lagerung radioaktiver Abfälle
Wettingen

Als Revisionsstelle haben wir die Buchführung, die Jahresrechnung (Bilanz, Betriebsrechnung, Geldflussrechnung und Anhang / Seiten 37 – 39 sowie Seiten 42 – 43) sowie die Geschäftsführung der NAGRA Nationale Genossenschaft für die Lagerung radioaktiver Abfälle für das am 31. Dezember 2006 abgeschlossene Geschäftsjahr geprüft.

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.

Unsere Prüfung erfolgte nach den Schweizer Prüfungsstandards, wonach eine Prüfung so zu planen und durchzuführen ist, dass wesentliche Fehlaussagen in der Jahresrechnung mit angemessener Sicherheit erkannt werden. Wir prüften die Posten und Angaben der Jahresrechnung mittels Analysen und Erhebungen auf der Basis von Stichproben. Ferner beurteilten wir die Anwendung der massgebenden Rechnungslegungsgrundsätze, die wesentlichen Bewertungsentscheide sowie die Darstellung der Jahresrechnung als Ganzes. Bei der Prüfung der Geschäftsführung wird beurteilt, ob die Voraussetzungen für eine gesetzes- und statutenkonforme Geschäftsführung gegeben sind; dabei handelt es sich nicht um eine Zweckmässigkeitsprüfung. Wir sind der Auffassung, dass unsere Prüfung eine ausreichende Grundlage für unser Urteil bildet.

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

Wir empfehlen, die vorliegende Jahresrechnung zu genehmigen.

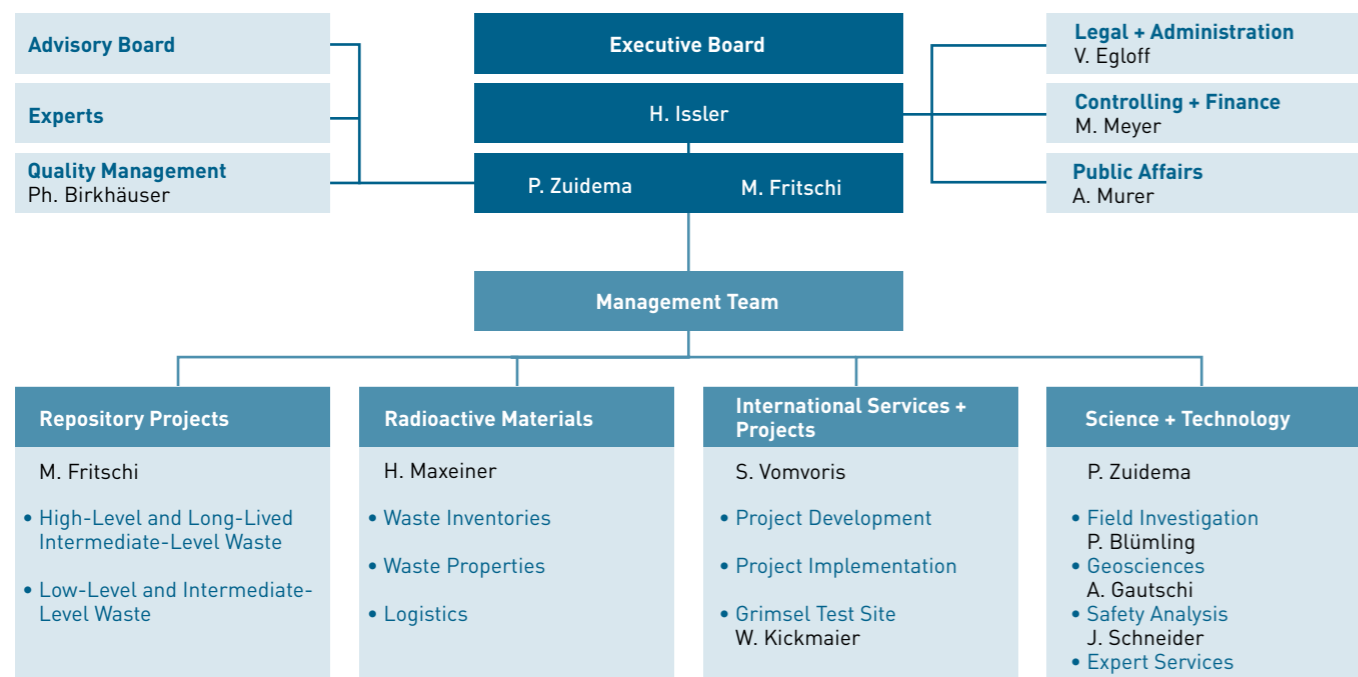
PricewaterhouseCoopers AG

Armin Bantli Peter Manz
Leitender Revisor

Zürich, 26. Februar 2007

Addendum

Organigram



Management Team: H. Issler, P. Zuidema, M. Fritschi, H. Maxeiner, S. Vomvoris
 Extended Executive Board: Management Team, V. Egloff, M. Meyer, A. Murer

December 2006

Waste inventories and volumes

Radioactive waste arises largely from electricity production in the five Swiss nuclear power plants. Waste also arises from use of radioactive materials in the areas of medicine, industry and research (MIR waste).

Waste volumes at the end of 2006

On behalf of the waste producers, Nagra maintains a centralised databank of waste packages. According to this source, the volume of conditioned waste as of the end of 2006 was 6830 m³. Of this, 6755 m³ would be allocated, using current criteria, to the L/ILW repository and 75 m³ represents long-lived intermediate-level waste (ILW). Added to this are the spent fuel elements and the high-level waste that are presently stored at the power plants or in special containers in the ZWILAG facility. At the end of the year, there were eight containers with high-level waste from reprocessing and seventeen containers with spent fuel stored at ZWILAG.

Prediction of waste volumes and inventories for deep geological disposal

For the purpose of planning geological repositories, information is also required on expected waste volumes. The total volume for disposal will be around 87,000 m³ of waste packaged in disposal containers (see Table for details). The volumes were determined assuming a 50-year operating lifetime for the existing power plants. The volume of waste from medicine, industry and research depends on the operational planning of the repositories.

Predicted waste volumes (50-year NPP lifetime)	L/ILW (m ³)		ILW (m ³)		HLW/SF (m ³)	
	Conditioned	Packaged	Conditioned	Packaged	Conditioned	Packaged
BA-KKW Operational waste from the NPPs (waste from cleaning systems and mixed wastes), inc. the post-operational phase before decommissioning	7 300	24 200				
RA-KKW Reactor waste from the NPPs (activated reactor components)	400	1 700				
SA-KKW Decommissioning waste from the NPPs	28 300	28 300				
WA-KKW Reprocessing waste from the NPPs (inc. substitution BNFL)			200	1 400		
BA-ZWI Operational waste from ZWILAG	70	200				
SA-ZWI Decommissioning waste from ZWILAG	600	600				
BA-MIF MIR waste from the Federal Office of Health and operational waste from PSI	4 300	9 300	270	700		
SA-MIF Decommissioning waste from PSI	11 000	11 000				
BEVA Waste from the future SF packaging facility in the HLW/SF repository	1 800	1 800	450	450		
HAA Vitrified waste from reprocessing (using up existing contracts, inc. substitution BNFL)					120	900
BE Spent fuel					1 150	6 600
Total volume (rounded)	54 000	77 000	900	2 600	1 300	7 500
Percentage (rounded)	96 %	89 %	1.6 %	3.0 %	2.5 %	8.0 %
Inventory	5 · 10 ¹⁷ Bq		8 · 10 ¹⁶ Bq		3 · 10 ¹⁹ Bq	
Percentage	1.7 %		0.3 %		98 %	

Publications in 2006

Nagra Technical Reports (NTBs)

A complete list of all reports published to date (including price) can be obtained from Nagra's offices in Wettingen or downloaded from the website. Some NTBs are also available as free downloads.

NTB 05-01

"Grimsel Test Site – Investigation Phase V: HPF-Experiment: Modelling Report"; J. M. Soler, W. Pfingsten, B. Paris, U. K. Mäder, B. Frieg, F. Neall, G. Källvenius, M. Yui, Y. Yoshida, P. Shi, CH. A. Rochelle and D. J. Noy; (June 2006). Also available on CD-ROM (PDF).

NTB 03-11

"GTS Phase V – GAM: Gas Migration Experiments in a Heterogeneous Shear Zone of the Grimsel Test Site"; P. Marschall and I. Lunati [Ed.]; (January 2006). Also available on CD-ROM (PDF).

Print products for the general public

Three issues of "nagra Info" appeared in 2006. The publication provides current information on waste management topics of general interest and can be subscribed to free of charge.

Nagra also distributes brochures and DVDs on selected topics as the need arises. The available materials can be found on Nagra's website under the heading "Publications". Individual products can be obtained free of charge or, in some cases, downloaded from the site.

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.bfe.admin.ch

Decommissioning Fund

www.stilllegungsfonds.ch

DETEC

Federal Department of the Environment, Transport, Energy and Communications
www.uvek.admin.ch

FMT

Mont Terri Rock Laboratory
www.mont-terri.ch

Forum VERA

www.forumvera.ch

GTS

Grimsel Test Site
www.grimsel.com

HSK

Swiss Federal Nuclear Safety Inspectorate
www.hsk.ch

IAEA

International Atomic Energy Agency
www.iaea.org

ITC

International Training Centre, School of Underground Waste Storage and Disposal
www.itc-school.org

KSA

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

LES

Waste Management Laboratory
les.web.psi.ch

Nuclear Energy Agency

www.nea.fr

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

The World's Nuclear News Agency

www.worldnuclear.org/index.cfm

Waste Management Fund

www.entsorgungsfonds.ch

ZWILAG

ZWILAG Zwischenlager Würenlingen AG
www.zwilag.ch

Glossary

AkEnd

Working group on repository site selection procedures (Germany).

Andra

Agence nationale pour la gestion des déchets radioactifs, France.

CERN

European Organization for Nuclear Research.

CRIEPI

Central Research Institute of Electric Power Industry, Japan.

DETEC

Swiss Federal Department for the Environment, Transport, Energy and Communications.

EDI

Federal Department of Home Affairs, Switzerland.

ENRESA

Empresa Nacional de Residuos Radiactivos, Spain.

EU

European Union.

FMT

Mont Terri Rock Laboratory; rock laboratory in Opalinus Clay located near St-Ursanne, Canton Jura. Project managed by Swisstopo.

FOE

Federal Office of Energy, under DETEC (Switzerland).

FZK/INE

Karlsruhe Research Centre/Institute for Nuclear Waste Disposal, Germany.

GRS

Gesellschaft für Anlagen- und Reaktorsicherheit (Germany).

GTS

Grimsel Test Site; Nagra's underground laboratory in crystalline rock on the Grimsel Pass, Canton Bern.

HLW

Vitrified high-level waste from reprocessing.

HSK

Swiss Federal Nuclear Safety Inspectorate (Villigen), under the FOE.

IAEA

International Atomic Energy Agency, Vienna.

ILW

Long-lived intermediate-level waste.

ITC

International Training Centre, School of Underground Waste Storage and Disposal, Innerkirchen (Canton Bern).

JAEA

Japan Atomic Energy Agency.

JAERI

Japan Atomic Energy Research Institute.

JNC

Japan Nuclear Cycle Development Institute.

JNFL

Japan Nuclear Fuel Limited.

KNE

Commission for Nuclear Waste Management.

KSA

Federal Commission for the Safety of Nuclear Installations.

LES

Waste Management Laboratory, PSI.

L/ILW

Low- and intermediate-level waste.

MIR

Radioactive waste from medicine, industry and research.

MIRAM

Model inventory of radioactive materials.

NEA

Nuclear Energy Agency of the OECD, Paris.

Nirex

United Kingdom Nuclear Industry Radioactive Waste Executive.

NPP

Nuclear power plant.

NTB

Nagra Technical Report. Series of scientific publications.

NUMO

Nuclear Waste Management Organization of Japan.

Obayashi

Obayashi Corporation, Japan.

OECD

Organisation for Economic Cooperation and Development.

PSI

Paul Scherrer Institute, Villigen, Canton Aargau.

RWMC

Radioactive Waste Management Funding and Research Center, Japan.

SCK•CEN

Studiecentrum voor Kernenergie, Centre d'Etude de l'Énergie Nucléaire, Belgium.

SER

Swiss State Secretariat for Education and Research

SF

Spent fuel

SKB

Svensk Kärnbränslehantering AB, Sweden.

Swisstopo

Federal Office of Topography, Mont Terri project manager from 2006.

TRU

Transuranic waste.

ZWILAG

Centralised interim storage facility of the Swiss nuclear power plants for all categories of waste (Würenlingen, Canton Aargau).

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