annual report
2010
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On 26th February 2010, the Swiss Federal Office of Energy announced in a media statement that the safety authority ENSI (Federal Nuclear Safety Inspectorate) had approved the six repository siting regions proposed by Nagra in November 2008. ENSI found Nagra’s analysis of the geological database supporting the siting proposals to be technically well founded, comprehensive and transparent.

Other review bodies echoed ENSI’s very positive assessment of Nagra’s efforts. The German expert group on Swiss repositories (ESchT) also came to the conclusion that, in terms of geological and safety considerations, Nagra had proceeded in accordance with the current status of science and technology and that there was no implicit prior commitment to any particular site.

Behind this satisfactory result lies the vast amount of knowledge and effort invested by around 90 Nagra employees and for this they deserve the highest recognition.

Other issues also commanded our attention during the course of the year, for example clarifying what additional investigations are required in the individual siting regions for the next stage of the Sectoral Plan process. Also important were ensuring that budgets and schedules were adhered to and aspects of communication and participation. Providing open, technically accurate information to the Swiss public is of great importance to us. To support this communication effort, we have decided together with our project partners to construct a dedicated visitors’ pavilion at the Mont Terri Rock Laboratory.

The projects aimed at providing safe repositories for radioactive waste in Switzerland are moving forward at a measured pace – this is the only possibility given the wide support infrastructure and rights of participation foreseen by the Sectoral Plan process. Introducing additional requirements and expectations from different sides into the process carries the risk of delays, which could be detrimental when viewed in the context of the overall picture. Nevertheless, we are moving steadily forward. The next major milestone is the final decision of the Federal Council on Stage 1 of the process, which we look forward to with some degree of confidence.

I would like to thank the members of the Board of Directors for their cooperation during the year. My thanks also go to the Executive Board and to all Nagra employees for their great commitment and the successful outcome of their efforts.

Pankraz Freitag
Thomas Ernst, Chief Executive Officer

The in-depth technical review of Nagra’s proposals for geological siting regions for deep repositories for all radioactive waste arising in Switzerland was completed in 2010. All the review bodies – the Swiss Federal Nuclear Safety Inspectorate (ENSI), the Nuclear Safety Commission (NSC), the Cantonal Commission and its technical experts and the German expert group on Swiss repositories (ESCH) – were unanimous in coming to the conclusion that all the proposed siting regions should be carried through to the next stage of the process. No additional regions were brought into the discussion.

Given the complex nature of the material involved, such consensus in the assessment of the siting proposals does not go without saying; in fact it testifies to the high quality of the technical basis prepared by Nagra.

Against the background of these positive reviews, the draft of the results report prepared the Federal Office of Energy (SFOE) – the lead organisation in the Sectoral Plan process – recommends that the Federal Council should confirm all the proposed siting regions, integrate the planning perimeters into the Sectoral Plan and initiate Stage 2 of the repository siting process. Between September and November 2010, all interested parties had the opportunity to participate in a consultation process on the extensive documentation for Stage 1, including the results report and the associated explanatory report, before the Federal Council reaches its decision at the end of Stage 1.

The focus of Nagra’s technical work during the year was on preparing for Stage 2 of the Sectoral Plan process, drafting a detailed report evaluating the geological database for the provisional safety analyses and clarifying the need for additional geological investigations in Stage 2. Nagra reached the conclusion that, together with ongoing and planned investigations, the existing knowledge base provides an understanding of the geological situation that is sufficient for the provisional safety analyses and the safety-based comparison of the proposed sites in Stage 2. In its expert opinion published at the end of March 2011, ENSI also came to the conclusion that borehole investigations requiring a permit will only be necessary in Stage 3.

So-called start-up teams have been formed in the siting regions to prepare the way for the broad regional participation foreseen from Stage 2. The Sectoral Plan, with its different component parts, is thus moving forward. This is thanks, on one hand, to the intensive and constructive collaboration of all the players involved in the process. On the other hand, such progress in the area of nuclear waste management would be impossible without the technical competence and active commitment of all Nagra employees. I would like to take this opportunity to thank them for their great effort.

Dr. Thomas Ernst

Highlights in 2010

February: The Swiss Federal Nuclear Safety Inspectorate (ENSI) publishes its review of the Nagra’s proposals for repository siting regions. It finds the selection to be technically well founded and transparent and approves all six proposals.

May: The Nuclear Safety Commission (NSC) delivers its opinion on the conclusions reached by ENSI. It finds that ENSI conducted a comprehensive evaluation of the proposals made by Nagra and aligns itself with the result.

May: The Federal Office of Energy (SFOE) defines the provisional siting regions: these include the potential siting regions as well as communities that could come into question for locating the surface facilities or that could be affected by the repository from a spatial planning, economic or social perspective.

June: The exhibits at the Grimsel Test Site are expanded to include a waste emplacement model which shows the safety barriers for a high-level waste repository on a 1:1 scale. During the course of the year, Nagra guides around 1400 visitors through the Test Site facilities.

June: At the annual general meeting in Bern, Andreas Pfeiffer is elected to the Board of Directors as successor to Mario Schönenberger.

August: Construction work begins on the new visitors’ centre at the Mont Terri Rock Laboratory. The opening is planned for September 2011. Around 1750 people visit the Laboratory during the year.

September: The consultation phase for Stage 1 of the Sectoral Plan process begins. For three months, all interested parties have the opportunity to comment on the proposed siting regions, the review results of the safety authorities and other related documents. The SFOE organises information events in all the siting regions, in which Nagra representatives also participate.

October: Nagra puts the first stations of its satellite-based precision network “NaGNet” into operation. The system supplements the existing network of the Federal Office of Topography. Over the years, the stations will record highly accurate positioning data, providing information on the smallest movements in the earth’s crust.

November: In accordance with the requirements set out by the authorities, Nagra submits a report to ENSI on the current status of geological information on the siting regions. The report concludes that the available information – taken together with planned and ongoing investigations – will provide a knowledge base that is sufficient for the provisional safety analyses and for the safety-based comparison of the sites in Stage 2.
Our mandate

Radioactive waste arises in Switzerland from the operation and subsequent decommissioning of the nuclear power plants, as well as from the use of radioactive materials in the areas of medicine, industry and research (MIR waste). According to the Nuclear Energy Act of 2003, the producers of radioactive waste are responsible – under the supervision of the federal authorities – for the permanent safe management and disposal of the waste. The operators of the nuclear power plants and the Swiss Confederation, which is responsible for MIR waste, set up Nagra in 1972, with the mandate of safely disposing of all waste arising in Switzerland.

The Nuclear Energy Act, which entered into force in February 2005, calls for deep geological disposal of all types of waste produced in Switzerland. Two repositories 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 is responsible for preparing the technical and scientific basis for the safe, long-term management of radioactive waste. As part of the Sectoral Plan process for selecting sites for geological repositories, which is led by the Federal Government, Nagra’s task is to propose geological siting regions and then sites and to submit general licence applications for the repositories, in accordance with the requirements set out in the conceptual part of the Plan. Nagra ensures ongoing inventoringy of radioactive materials and advises the waste producers on conditioning of the waste to meet disposal criteria. With a view to fulfilling these responsibilities, Nagra has been conducting a broadly based research and development programme since the mid-seventies. The work is carried out in close cooperation with the Paul Scherrer Institute (PSI, Villigen) and various universities and research institutes both in Switzerland and abroad.

Our work

• Working together (on behalf of the waste producers) with the authorities and the siting regions within the framework set by the Sectoral Plan process.
• 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 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 as part 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 evaluate 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 the disposal programmes.
• Providing expert services to third parties.

Our mandate

Safe long-term disposal of radioactive waste in deep geological repositories is a challenging task that we are committed to implementing in the interests of man and the environment. The Federal Government and the Swiss people have granted a legal mandate for this work to be carried out as a matter of national importance.
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 humans and the environment.
• In principle, radioactive waste arising in Switzerland must be disposed of within Switzerland.
• The duty of disposal lies with the waste producers.
• The strategy specified for all waste types 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 national 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 set up by the waste producers and supervised by the Federal Government.

Swiss Federal Nuclear Safety Inspectorate (ENSI), Federal Nuclear Safety Commission (NSC)

The Federal Nuclear Safety Inspectorate (ENSI) is the regulatory authority for the nuclear safety and security of the Swiss nuclear installations. In this capacity, it monitors Nagra’s siting investigations and the later construction and operation of the repositories. September saw a change in the senior management of ENSI, with a new Director and a new Head of the Waste Management Division.

The Nuclear Safety Commission (NSC) advises the Federal Council, the Department for the Environment, Traffic, Energy and Communications (DETEC) and ENSI in questions of nuclear safety.

Decommissioning and Waste Management Funds

The purpose of the Waste Management Fund is to secure the costs of disposing of operational and spent fuel assemblies following the decommissioning of the nuclear power plants. The Decommissioning Fund secures the costs of decommissioning and dismantling the nuclear power plants and disposal of the resulting waste. The funds are supervised by the Federal Government. At the end of 2010, the accumulated capital in the Waste Management Fund was around 2.8 billion CHF and in the Decommissioning Fund around 1.3 billion CHF. More details can be found on the website www.entsorgungsfonds.ch. The cost estimates used as the basis for calculating contributions to the funds will be updated in 2011.

Sectoral Plan for Deep Geological Repositories

Article 5 of the Nuclear Energy Ordinance requires the objectives and criteria for the deep geological disposal of radioactive waste to be specified by the Federal Government in a Sectoral Plan. The Federal Council approved the conceptual part of the Sectoral Plan for Deep Geological Repositories, which sets out these objectives and criteria, on 2nd April 2008. The technical feasibility and safety of geological disposal had already been confirmed with the approval by the Federal Council of the ‘Entsorgungsnachweis’ HLW feasibility project in June 2006. At the same time, based on a study commissioned by the SFOE, the Federal Council also came to the conclusion that waste disposal facilities could be constructed and operated in a way that is environmentally sound and, considered overall, has a positive impact on regional economy. For siting decisions to be accepted, it is however imperative that those affected by these decisions be fully informed and involved in the selection process.

The Sectoral Plan approach (see Figure 1 and page 12) takes this requirement for information and involvement into account. The authorities and the public in the siting regions can participate in the process, as can authorities from neighbouring countries and interested foreign and domestic organisations. The process comes to an end with a decision of the Federal Council and Parliament on the general licences for the repositories. Their decision is subject to an optional national referendum.
Waste management programme as specified in the Nuclear Energy Act

Article 32 of the Nuclear Energy Act calls for a waste management programme to be prepared by the waste producers for all types of waste. The programme is reviewed by the federal authorities and approved by the Federal Council. Together with the Sectoral Plan, the programme provides the basis for deciding on the way forward in Swiss waste management strategy. In line with instructions from the Federal Council, Nagra submitted the waste management programme to the authorities in October 2008, together with the siting proposals. The review of the programme by ENSI began in 2010 following completion of the review of the siting proposals and the results are expected in spring 2011.

Inventory of radioactive materials

Radioactive wastes with a broad spectrum of radiological and chemical inventories arise from the production of nuclear energy and from the use of radioactive materials in medicine, industry and research. Characterising and inventorying these wastes is provided as a service to the Members of the Nagra Cooperative, activities which also result in a compilation of complete material and nuclide inventories as input for safety analysis and planning of the geological repositories. An overview of waste types and volumes can be found on pages 54/55.

Nagra maintains a centralised inventory of existing radioactive waste comprising waste packages stored at the power plants, in the ZWILAG centralised interim storage facility and in the Federal Government’s interim storage facility. The inventory is updated annually. In 2010, it was expanded to include wastes from the reactor pressure vessels, which were inventoried using a newly developed program for activation calculations.

Nagra also maintains a Model Inventory of Radioactive Materials (MIRAM) that contains information on future waste arisings. This is currently under revision, with the first phase involving updating of the material inventories of the wastes.

Nagra is also working on projects on the mineralisation and solidification of wastes containing organic materials and on methods for reducing the volumes of metallic wastes that arise mainly from the decommissioning of nuclear power plants and research facilities. The results will be integrated into MIRAM.

For the inventorying of activated reactor components, Nagra first developed detailed three-dimensional models of all the power plants. Radiological inventories were then calculated in preparation for the 2010/2011 decommissioning studies. The methods and results were validated using comprehensive measurement programmes. This approach allows more accurate inventorying of activated reactor components than previously.

The contract with the Paul Scherrer Institute (PSI) for research and development on waste products has been extended for a further five years. During the year, the collaborative work focused on quality control of conditioned waste and development of solidification techniques for special wastes from the power plants. Waste disposability certification procedures were also carried out for the nuclear power plants, ZWILAG and PSI. These apply to operational waste and waste from reprocessing of fuel assemblies that will be stored in ZWILAG in the coming years.

The work described above was again carried out in close cooperation with the Members of the Nagra Cooperative and in accordance with the guidelines set out by ENSI. Participation in international working groups also ensured that the inventorying and characterisation of the waste is in line with internationally recognised standards.
Clear rules for site selection
With the approval of the conceptual part of the Sectoral Plan for Geological Repositories by the Federal Council on 2nd April 2008, the criteria, procedure and roles of those involved in the site selection process were clearly defined. The siting question will be clarified in three stages, working together with the Cantons and local communities. Safety has highest priority throughout the entire process, although spatial planning and socio-economic aspects are also taken into consideration.

From how to where
In June 2004, the Federal Council approved the demonstration of disposal feasibility (Entsorgungsnachweis) for high-level waste (HLW). The corresponding demonstration for low- and intermediate-level waste (LILW) had already been approved in 1988, meaning that the fundamental question of how all types of radioactive waste can be safely disposed of in Switzerland has been answered from a technical and scientific viewpoint. The question of where the required repositories should be constructed is being clarified as part of the Sectoral Plan process. In the coming years, sites will be evaluated in a stepwise narrowing-down process, with safety taking precedence over all other considerations during the entire process. Because of its transparent, systematic approach and the extensive rights of participation of a wide range of stakeholders, the Swiss site selection process is also considered by neighbouring countries to be exemplary.

Federal Government lead – independent supervision
The lead in the Sectoral Plan process lies with the Swiss Federal Office of Energy (SFOE; see Figure 2). Following the consultation and participatory phases, the authorities and the Federal Council conduct an overall evaluation of Nagra’s siting proposals based on scientific-technical criteria. Cantons and local communities, neighbouring countries, interested organisations and associations, political parties and the public are brought into the process by the SFOE. Nagra’s responsibility is to prepare the scientific and technical background. Based on the safety criteria set out in the Sectoral Plan, Nagra submitted proposals for suitable geological siting regions to the SFOE at the beginning of Stage 1. In the second stage, Nagra’s work in site selection is to construct the surface facilities. In the third stage, applications are submitted for the necessary general licences. Supported by independent experts, ENSI reviews Nagra’s proposals.

Cantons
Communities
Neighbouring countries
Waste producers Nagra
ENSIN KNE
Siting regions
Organisations
Public
Parliament
Federal
Council
DETEC
Working Group on Spatial Planning
Under the lead of the Federal Office for Spatial Development (FÖSd), the ‘Working Group on Spatial Planning’ provides support and advice in the following areas: preparing the spatial planning evaluation methodology for comparing sites in Stage 2, compilation of spatial planning data, defining the provisional planning parameters, ensuring information exchange and discussing draft object sheets (maps and text) that describe the individual projects. The Working Group is made up of federal experts (FÖSd, SFOE and Federal Office for the Environment) and representatives from the siting Cantons, Germany and Nagra.

Proposals for geological siting regions
The first stage of the Sectoral Plan process started in 2008. Beginning with the whole of Switzerland, Nagra applied a systematic site selection process based on the safety criteria and the narrowing-down steps specified in the Sectoral Plan, which led to three proposals for geological siting regions for high-level waste and six for low- and intermediate-level waste. These proposals are based solely on scientific and technical criteria.

Cantonal Commission
The ‘Cantonal Commission’ ensures cooperation between the government representatives of the siting Cantons and the affected neighbouring Cantons and countries and supports the Federal Government in implementing the site selection process. The siting Cantons coordinate their activities within the Commission. Operational tasks relating to safety, spatial planning, communication and regional participation are planned and coordinated by the ‘Technical Coordination Group of the Siting Cantons’, while safety-related evaluations are entrusted to the ‘Cantonal Working Group on Safety’. The latter also supports the ‘Cantonal Expert Group on Safety’, which has the task of advising the Cantons in reviewing safety-related documentation.

Detailed review of safety – high marks for Nagra
ENSI and its specialists conducted an in-depth review of the siting proposals in 2009. The resulting expert opinion, to which the Commission for Nuclear Waste Disposal (KNE), the Federal Office of Topography (swisstopo) and other experts contributed, was presented to the public on 26th February 2010. ENSI came to the conclusion that the analyses carried out by Nagra were correct and transparent and that the geological background had been documented comprehensively. Nagra was found to have taken into consideration all the information that is relevant for the selection of the siting regions and the criteria specified in the Sectoral Plan had been applied appropriately and correctly.

KNE also credited Nagra with a high degree of transparency, technical competence in compiling the project documentation and a clear willingness to cooperate in the case of questions and requests for additional information from the safety authorities. However, it also drew attention to areas that required further attention in the upcoming stages, in particular construction technology.

Based on the review, ENSI and KNE have confirmed all the sites proposed by Nagra: Südranden, Zürich Nordost (formerly Zürcher Weinland), North of Lägern, Jura Ost (formerly Bözberg), Jura-Südfluss and Wellenberg.

The Nuclear Safety Commission (NSC) published its independent review of ENSI’s conclusions on 6th May 2010. NSC is of the opinion that ENSI evaluated Nagra’s work in the second stage, Nagra’s work in site selection is to construct the surface facilities. In the third stage, applications are submitted for the necessary general licences. Supported by independent experts, ENSI reviews Nagra’s proposals.

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NSC also attaches considerable significance to gas production caused by metal corrosion and the degradation of organic materials. This should not present any risk to the barrier function of the host rock and therefore has to be avoided or reduced to an acceptable level. For the future, NSC recommends giving preference to homogeneous, tight host rocks, supplementing the understanding of the proposed siting regions at an early stage and looking at the technical implementation of the EKRA concept with respect to repository-induced influences, minimum perturbation of the host rock and possibly locating the HLW repository at greater depth.

Given the proximity of some of the siting regions to the national border, the German expert group on Swiss repositories (ESchT) also had the opportunity to review Nagra’s proposals with a critical eye. In its report published on 3rd March 2010, ESchT comes to the conclusion that, from the viewpoint of geology and safety, Nagra had proceeded according to the current status of science and technology and that its site proposals are well founded. No implicit prior commitment to a particular site could be identified. Several criticisms were made in relation to more detailed aspects that have no influence on the overall result of the narrowing-down process.
As part of the consultation phase for Stage 1, the SFOE organised information events in the siting regions; Nagra was also present at these.

Technical Forum on Safety
The ‘Technical Forum on Safety’ is made up of technical experts from the authorities, the commissions of the Federal Government and the waste producers. Also represented are the siting regions, the siting Cantons, the Cantonal Working Group on Safety, German authorities and environmental organisations. Under the guidance of ENSI, the Forum answers questions submitted by the public, Cantons, neighbouring countries and the siting regions. The questions directed to the Forum and the responses to these are published on the SFOE website (www.radioaktiveabfaelle.ch).

As part of the consultation phase for Stage 1, the SFOE organised information events in the siting regions; Nagra was also present at these.

Position of the Cantonal Commission
The Cantonal Commission also reviewed the results and processes of Stage 1, publishing its conclusions on 16th August 2010. The Commission, which also has German representatives, found that requirements relating to fairness, transparency and participation had been met and viewed the processes in Stage 1 as being expedient. The Commission noted that six regions for low- and intermediate-level waste and three for high-level waste had been proposed for further consideration. Uncertainties remaining in the geological siting regions should be eliminated by carrying out the necessary investigations before the end of Stage 2.

Consultation phase and completion of Stage 1
Based on the results of the safety reviews and the spatial planning investigations, the SFOE officially requested the Federal Council to confirm the proposed siting regions, the spatial planning evaluation method for Stage 2 and the planning perimeters and to initiate Stage 2 of the Sectoral Plan process. The draft of the results report was presented in public at a media conference on 23rd August 2010. This was followed by a three-month consultation phase from September to November, during which all interested parties had the opportunity to express their views on the results of Stage 1. By way of an introduction, the SFOE held information events in all the siting regions, as well as in the German communities of Jestetten and Blumberg. By the end of the year, more than 300 individual responses and around 3350 joint responses had been received.

Once the responses have been evaluated and the results report revised accordingly, the Cantons are expected to have the opportunity to once again express their views in mid-2011. The decision of the Federal Council on Stage 1 is expected for autumn 2011.

Preparation for Stage 2: participation of 202 local communities
In 2010, participation began in all the regions in the form of so-called start-up teams who are responsible for preparing the way for regional participation in Stage 2; this will integrate the siting regions further into the ongoing process. As a basis for this participation, the SFOE defined the provisional siting regions on 28th May 2010 (see Figure 3 and the associated text-box). These cover a total of 202 local communities (12 in Germany) and were defined with the cooperation of the siting Cantons, the start-up teams and the neighbouring German administrative districts.

In Stage 2, the SFOE will conduct a study in all the siting regions on the impact of a repository on the economy, environment and social structures. The method that will be used was presented by the authorities in 2010. These studies will form the basis for comparing the regions in terms of aspects not related to safety.
Besides expanding the geological knowledge base, Nagra’s activities during the year included reviewing and assessing the recommendations made by the authorities and their experts based on Stage 1 and starting work based on these recommendations.

**Siting proposals for surface facilities under discussion**

In Stage 2, possible layouts and designs for the surface facilities will be drawn up together with the siting regions. Nagra has the task of making corresponding proposals in all regions at the beginning of the Stage and these are then discussed with the bodies involved in regional participation. Based on the outcome, Nagra will designate at least one site in each region for the subsequent comparative assessment. To prepare for this collaborative exercise, Nagra has further developed the modules for the surface facilities and evaluated potential locations for the reception facilities and access routes (see page 22).

**The final step: decision via the ballot box**

Stage 2 ends with a decision by the Federal Council on at least two sites each for the HLW and the L/ILW repository. These sites are then investigated in more detail in Stage 3, compared with one another and any necessary field investigations carried out (e.g. boreholes). Based on the results of the investigations, Nagra proposes the final repository sites and prepares the licence applications. The Federal Council and Parliament decide on the licence applications, but their decision is also subject to an optional national referendum. The final say in the Sectoral Plan process thus lies with the Swiss voters.

**Strengthening the knowledge base for Stage 2**

In Stage 2, Nagra may not propose any sites that are clearly less suitable than the others in terms of safety. It may also not exclude sites for which the level of understanding is insufficient to allow suitability to be properly assessed. Evaluating safety is done by conducting provisional safety analyses and comparing sites based on safety criteria. The requirements are set out in the Sectoral Plan and are defined in more detail in a special report prepared by ENSI. The level of knowledge must be sufficient to allow a conclusive comparison to be made, but is not the same as the degree of detail required for the general licence applications in Stage 3.

Nagra began at an early stage to expand the database on the properties of the potential host rocks and the geological situation in the siting regions. The next target is to achieve a level of understanding that is sufficient for the safety-based comparison in Stage 2. Based on specified requirements, Nagra was required during the year to evaluate the level of knowledge expected to be achieved once the investigations have been completed. The corresponding report – NTB 10-01 – was submitted to the SFOE in November. Nagra comes to the conclusion that the expected knowledge base will be sufficient for all regions for Stage 2.

ENSI will review Nagra’s analysis and document the result in an expert opinion. The NSC and the cantonal experts will have the opportunity to comment.
Scientific and technical background

Since the approval by the Federal Council of the demonstrations of disposal feasibility (Entsorgungsnachweis) for all types of waste, the focus of research and development has been directed towards ensuring that the level of understanding is sufficient for the upcoming general licence applications. This should allow the conservative assumptions made to date in the safety analyses in order to take account of uncertainties to be replaced by more accurate information, thus improving the reliability of findings on the detailed behaviour of the repository barriers. ENSI is currently reviewing Nagra’s R&D plan (NTB 09-06) that was completed in 2009. The results of the review will provide new impetus for future work.

Geology

Nagra is carrying out a range of studies that will provide more detailed information on the proposed geological siting regions for Stages 2 and 3 of the Sectoral Plan process. These include systematic measurements of structural geology on outcrops, analysis of remote sensing data and reprocessing of the reflection seismic data from earlier campaigns. Gravity data for Northern Switzerland were integrated with data for Southern Germany and control and compaction measurements carried out. Nagra is also working on retrodeformation (kinematic balancing) of geological profile sections.

Two large-scale projects were initiated to look at the long-term geological evolution of Northern Switzerland: a more dense network of seismic stations and a permanent network of GNSS (Global Navigation Satellite System) receivers should lead to improved monitoring of recent crustal movements. At the end of the year, four Nagra GNSS stations were in operation and a construction permit had been granted for a further three. Nagra also supported university studies on investigation and age dating of Quaternary rock channels.

An important component of the work for Stage 2 is characterisation of the movement of deep groundwaters using regional and local hydrogeological models. The specification for this major project was drawn up at the end of the year. There was also a cross-border exchange of data with the Regional Department for Geology, Raw Materials and Mining of the State of Baden-Württemberg.

The Rock-Water Interaction Group at the University of Bern has brought together all available mineralogical, petrophysical and geochemical data on the proposed host rocks Opalinus Clay, “Brauner Dogger” and the Marl of the Helveticum and carried out additional measurements. This work provides key input for the sorption studies being carried out at the Paul Scherrer Institute (PSI).

In its Technical Report NTB 10-01, Nagra has evaluated the geological database for the provisional safety analyses in Stage 2 of the Sectoral Plan process (see page 16). The geological input data for further test calculations were defined and the conceptual models underlying the model calculations were developed; additional investigations foreseen for Stage 2 are also described.
Radionuclide retention
Radionuclide retention in the engineered barriers and surrounding geological barrier is one of the key safety-relevant features of a deep geological repository. Conclusions regarding long-term safety therefore require a well-founded understanding of the geochemical processes that are responsible for this retention.

The investigation and characterisation of these processes forms the focus of the long-standing collaboration between Nagra and the Laboratory for Waste Management (LES) at PSI. To understand the mechanisms involved in the key processes, classical radiochemical approaches are supplemented with modern spectroscopic techniques. Modelling studies aid process understanding and prepare the way for implementation in the safety analyses.

The compilations of geochemical data prepared by PSI, for example the updated Nagra/PSI thermodynamic database and the generic sorption database, provide input for solubility and sorption datasets that are used directly in the Nagra safety analyses.

Bentonite
Various projects are looking at the properties of the altered bentonite. The interaction of cement porewaters with bentonite is the subject of a dissertation, while other studies are analysing the properties and the thermodynamic stability of iron-rich bentonite and the safety-relevant properties of thermally treated bentonite. A further study is comparing different types of bentonite in terms of their potential use as alternatives to the bentonite considered up till now.

Gas pressure build-up and transport: The smaller the gas formation in a repository, the easier it is to show reliably that gas has no adverse effect on long-term safety. For this reason, Nagra is investigating possible measures for reducing gas formation, including selecting suitable materials for the engineered barriers (e.g. container, lining of disposal chambers) and an optimised waste management system.

Gas formation rates due to corrosion of metals in L/ILW and ILW repositories represent key input for safety analysis. Because resaturation of the disposal chambers takes several thousand years, the steel corrosion rate under un-
saturated conditions is of interest. A series of experiments addressing this is ongoing at the University of Toronto. Initial results indicate that the gas formation rate with 100 percent humidity is one to two orders of magnitude lower than for fully saturated conditions. A further important source of gas formation is degradation of organic components of the waste, but the rates of formation in this case are fairly uncertain. Nagra is carrying out a project aimed at reducing these uncertainties together with the Zurich University of Applied Sciences in Wädenswil.

Regarding the topic of gas transport, Nagra has begun developing three-dimensional models of the L/ILW and SF/HLW/ILW repositories. Preparations are currently underway for site-specific two-dimensional modelling of gas release (vertical sections through a series of disposal tunnels).

As part of the HLW programme, Nagra has performed a study on gas release taking into account the spatial variability of the hydraulic properties of the host rock. The investigation has shown that even a small variability in the gas permeability of the host rock can significantly delay gas pressure build-up. The maximum gas pressures are consistent with the results calculated for a homogeneous host rock. A further study evaluated the experience of the oil and gas industry with underground gas storage. In particular, this involved comparing national guidelines with the maximum operating pressure of natural underground gas storage facilities.

Further R&D related to gas issues includes the new large-scale experiment GAST (Gas-Permeable Seal Test) at the Grimsel Test Site, which is looking at the functioning of gas-permeable closure and sealing systems. Laboratory investigations on the gas transport capacity of engineered barrier systems (bentonite, sand-bentonite mixtures) and clay samples are being carried out at the EPFL Lausanne as part of the EU FORGE project (see page 31), at the ETH Zurich and at EMPA, as well as with various companies from the oil and gas industry.

Safety-relevant properties of radioactive waste
There is a trend in the nuclear power plants towards higher burnup of fuel assemblies. Together with PSI, Nagra has been investigating the safety-relevant properties of high-burnup fuel assemblies; the results show a correlation between the measured fission gas release rates and the release of safety-relevant radionuclides into the porewater. Fission gas release rates could thus be used to determine the release of these nuclides. The results are being documented in a joint report with SKB of Sweden.

Design of the geological repositories and the engineered barriers

a) Modules for the L/ILW and HLW repositories: Nagra has initiated two extensive projects on the planning of the surface reception facilities and their access infrastructure and on planning of underground installations and the associated construction technologies. Conceptual studies on generic facility modules have been developed taking into account the expected geological and spatial planning boundary conditions in the proposed siting regions. Proposals for locating the surface facilities will be prepared for all the siting regions.

b) Containers for spent fuel and high-level waste: Nagra has compiled and evaluated suitable methods for welding the containers for spent fuel and vitrified high-level waste. The results show that the required thicknesses of 60 to 150 millimetres can be achieved. A design study for the containers was also initiated.
Overview of current investigations: www.grimsel.com
www.mont-terri.ch

1 Grimsel Test Site
2 Mont Terri Rock Laboratory

2010 again saw many international research groups carrying out experiments and measurements at the GTS, for example in the Japanese C-FRS and JGP projects.

The exhibits for visitors to the facility were extended to include a HLW emplacement model on a 1:1 scale.

The focus of Phase VI is on projects aimed at providing a better understanding of engineered barrier systems and their practical implementation. One example is the FEBEXe experiment (see text-box for abbreviations) that has been running successfully since 1997. Another large-scale, long-term experiment in this area is the GAST experiment that was initiated in the year of reporting.

Projects looking at the transport of radionuclides under realistic boundary conditions continue to be a focal point of the research programme. As part of the LTD experiment, work in 2010 involved interpretation of the monopole (II) experiment (circulation of a radioactive tracer cocktail) and preparation for the monopole (II) experiment. The main activities in the CFM project included further tests and preparation for the field experiments scheduled for 2011.

Field experiments continued in the LCS project and the modelling and laboratory programmes for the coming years were defined.

As part of the IAEA initiative "Centres of Excellence – Training in and Demonstration of Waste Disposal Technologies in Underground Research Facilities", the GTS supported training courses and the associated fellowship programme. Students from Swiss universities also performed work at the GTS as part of PhD and Masters projects. They were supported in these efforts by the staff of the GTS and Nagra.

The radiation controlled zone (reserved for field experiments with radioactive tracers) was monitored regularly in accordance with the requirements of the Federal Office of Public Health (FOPH). All work in this zone was incident-free.

Developments in 2010

Projects at the Grimsel Test Site

CFM (Colloid Formation and Migration)
Formation and transport of colloids and their influence on radionuclide mobility under realistic conditions

C-FRS (Criepi Fractured Rock Studies)
Hydrogeological and geological characterisation of tectonic fracture systems

ESORED-plug experiment
(Engineering Studies and Demonstration of Repository Design)
Use of low-pH cements

FEBEXe (Full-scale HLW Engineered Barrier’s Experiment Extension)
1:1 demonstration of the emplacement concept for high-level waste

FORGE (Fate of Repository Gases)
Experiments on gas migration in engineered barriers (Bentonite/landfill)

FUNMIG (Fundamental Processes of Radionuclide Migration)
Fundamental aspects of radionuclide migration in crystalline rock

GAST (Gas-Permeable Seal Test)
Gas sealing experiment (initiation and first preliminary studies)

JGP (JAEA Grouting Project)
Cement injection experiment

LCS (Long-term Cement Studies)
Long-term interactions between cement solutions, porowaters and rock

LTD (Long-term Diffusion)
Long-term diffusion of radionuclides

TEM (Test and Evaluation of Monitoring Techniques)
Testing of monitoring methods

1 Sub-project of the EU project MoDeRn
2 Sub-project of the EU project MoDeRn
Key experiments in the Mont Terri Rock Laboratory

CI (Cement-Clay Interaction)
Mineralogical interaction between clay and cement

DR (Diffusion and Retention)
Diffusion and retention of radionuclides

DR-A (Disturbances, Diffusion and Retention Experiment)
Diffusion experiment with changing water chemistry

FE (Full-scale Emplacement Demonstration)
1:1 emplacement experiment for investigating the near-tunnel environment

GM-A (Geophysical Monitoring)
Monitoring using geophysical techniques

HE-E (Heater Experiment)
Behaviour of the engineered barriers under the influence of heat

HG-A (Gas Path Host Rock and Seals)
Gas flowpaths through Opalinus Clay and along sealing structures

HG-D (Reactive Gas Transport in Opalinus Clay)
Reactive gas transport in clay

HT (Hydrogen Transfer)
Transport of hydrogen gas

MB (Mine-by Test)
Deformation and hydromechanical effects during the excavation of tunnels and galleries

SE-H (Self-sealing in Combination with Heat)
Self-sealing of fissures in the excavation damaged zone, taking into account thermal influences

Mont Terri Rock Laboratory (FMT)
The international Mont Terri research project (St-Ursanne, Canton Jura) has been underway since 1996. The experiments are aimed at the geological, hydrogeological, geochemical and geotechnical characterisation of the Opalinus Clay. The project allows Nagra to further investigate, on a 1:1 scale, the properties of this potential host rock that are relevant for disposal of radioactive waste, with a view to upcoming licensing procedures and improving process understanding.

The Rock Laboratory is located in side tunnels of the security gallery of the Mont Terri motorway tunnel. 14 partner organisations from 8 countries are currently involved in the extensive research programme. The project is led by the Federal Office of Topography (Swisstopo) and is supported by a “Commission stratégique”. The interests of Canton Jura are represented by the “Commission de suivi”.

The first half of 2010 saw the completion of the 15th programme phase as planned, with Nagra being involved in 27 of a total of 37 experiments. Participation in phase 16 (July 2010 – June 2011) involves continuation of most of the experiments from the previous phase as well as initiation of new experiments in the areas of gas transport and hydrogeology. Projects from the 6th Framework Programme of the EU (GM-A and SE-H/TIMODAZ experiments) will also be continued (see page 31). Based on its own experience and on the recommendations made following the review by the authorities of the “Entsorgungsnachweis” project, the focus of Nagra’s activity has been on in-depth research on the development of the excavation damaged zone (MB, SE-H and HG-A experiments), radionuclide diffusion in the Opalinus Clay (DR and DR-A experiments), gas migration (HG-A, HG-D and HT experiments) and on continuation of a long-term experiment on the interaction between clay and cement (CI experiment). Cement is used in a repository (particularly for L/ILW and ILW) as a solidification, backfill and construction material. Implementation of the long-term large-scale FE experiment also began in 2010, with the main objective of investigating the behaviour of the tunnel vicinity (i.e. geological environment surrounding the tunnel) under the influence of a simulated section of a spent fuel disposal tunnel. Of main interest is the effect of temperature on hydraulic and mechanical processes in the host rock. Experience will also be gained in the technology to be used for excavating and securing the disposal tunnels and for emplacing the containers and backfill material.
Review of waste disposal costs (cost study)

The owners of the nuclear facilities are required to set aside financial reserves to secure the financing of waste management activities; the amount of these reserves is based on estimated waste management costs. The cost estimates are reviewed periodically; the last update was in 2006 and the results were approved by the authorities. In 2010, Nagra began preparing for the next update, which is to be submitted in 2011. Key input for this will be generated as part of preparations for the next stages of the Sectoral Plan, particularly in terms of planning facilities and exploration strategies.

International Services and Projects (ISP)

Nagra’s know-how and experience are recognised as valuable resources for other national waste management programmes as well as for technical applications outside the nuclear area. Our collective knowledge has accumulated over a period of more than three decades and covers a broad spectrum ranging from strategic programme planning, specification of waste inventories, site selection, characterisation and evaluation to repository design, safety case development, safely analyses and public communication. Since the founding of Nagra’s ISP Division in 1997, our involvement in more than 150 international projects has further enriched our experience with in-depth knowledge outside the Swiss national programme. We are strongly committed to providing timely, high quality and cost-effective solutions and engage motivated and dynamic staff who are also actively involved in the Swiss national programme. Of particular interest to us are joint projects that have synergies with the activities in our national programme.

Our projects in 2010 originated from partners in the Far East, Europe and North America. The strong collaboration with our Japanese partners CRIEPI, JAEA, JNFL, NUMO, RWM and Obayashi (see page 57 for abbreviations) was also reflected in our project portfolio for the year.

The project on injection techniques led by JAEA (with the support of Obayashi), which was initiated at the Grimsel Test Site in 2009, continued with various borehole drilling, field testing and characterisation activities. Nagra also continues to support JAEA’s research activities in the Japanese Mizunami and Horonobe rock laboratories. CRIEPI initiated a new phase in the long-term project on the characterisation of fractured rock at the Grimsel Test Site. NUMO and Nagra teams also collaborated in the areas of scenario development methodology, requirements management systems and demonstration and validation activities at the Yokosuka site in Japan, culminating in a series of papers being presented at the ICEM 2010 conference.

In May 2010, Nagra concluded a collaboration agreement with KRMC, the newly established Korean implementer, providing the framework for conducting joint projects. The first project has already been successfully implemented.

In the large-scale laboratory test on gas migration through bentonite materials being considered for Japan’s planned intermediate-depth repository, the emplacement of the bentonite and the instrumentation was completed in the first part of 2010 and saturation of the system was initiated. The test, which is being carried out by Obayashi on behalf of JNES of Japan, is perfor-
International collaboration

A regular exchange of information between Nagra and 17 foreign partner organisations takes place within the framework 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 generated a close network of personal relationships, which provide Nagra scientists with a wealth of opportunities to discuss technical issues with their peers. This network includes not only sister organisations but also the wider scientific community that is integrated into Nagra’s daily activities through review of its scientific work.

During the year, Nagra staff continued to be involved in work at Andra’s Bure rock laboratory in France. These projects were complemented by joint laboratory programmes run by various research institutes on model development and evaluation of databases. This includes projects on sorption and thermochromical databases under the auspices of the OECD/NEA.

Nagra’s participation in the EU Framework Research Programmes now represents an important component of its research and development activities. Collaboration with EU partners has been strengthened by Nagra’s involvement in the “Technology Platform for Implementation of Radioactive Waste Disposal” (IGD-TPI), which was set up in 2009. A strategic research programme was formulated with the target of starting operation of the first geological repositories in Europe by 2025.

Nagra staff continue to be represented in various advisory bodies and working groups (particularly in Belgium, Finland, France, Canada and Sweden) and are able to benefit directly from the experience of sister organisations worldwide. Over and above the various specific joint projects, Nagra is also represented in working groups of the OECD/NEA and works together with the IAEE on relevant projects. Nagra is also a member of EDRAM, an association of high-level staff from waste management organisations worldwide. Key results of international collaboration are presented in the project-specific sections of this report.

As in previous years, Nagra took part in international meetings on the topic of waste disposal, with frequent invitations to make presentations and be represented on the programme committee for some events. As part of what is now an annual event, Nagra attended the meeting of the German-Swiss Commission (DSK, working group 4). The Environment Minister for Lower Saxony Hans-Heinrich Sander also visited the Mont Terri Rock Laboratory in September.

Framework Research Programmes of the European Union (EU)

Since 1984, the Framework Research Programmes of the EU have acted 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 and 7th Framework Programmes are aimed specifically at creating a European Research Area. The idea 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 Framework Programmes. In return, Switzerland makes a direct contribution to the total budget of the Programmes.

The research projects in the area of deep geological disposal of radioactive waste allow Nagra to expand its technical knowledge base efficiently and continuously and to be instrumental in shaping important developments in Europe. The focus in 2010 was on completion of the MICADD, TIMODAZ and PAMINA projects (see text-box).

As part of the 7th Framework Programme, work was carried out on the projects MoDeNn, FORGE and PEBS. The application for the LUCOEX project was approved and work is expected to begin in 2011.

<table>
<thead>
<tr>
<th>Framework Research Programme</th>
<th>Description</th>
<th>Duration</th>
<th>Participants</th>
<th>Coordination</th>
</tr>
</thead>
<tbody>
<tr>
<td>LUCOEX (Large Underground Concept Experiments)</td>
<td>Demonstration of the emplacement and backfilling technologies for geological repositories</td>
<td>2006 – 2009</td>
<td>19 organisations from 7 countries</td>
<td>Armines Nantes (France)</td>
</tr>
<tr>
<td>TIMODAZ (Thermal Impact on the Damaged Zone Around a Radioactive Waste Repository in Clay Host Rocks)</td>
<td>Thermal impact on the excavation damaged zone around disposal tunnels in a clay host rock</td>
<td>2009 – 2013</td>
<td>10 organisations from 5 countries</td>
<td>BGS (United Kingdom)</td>
</tr>
<tr>
<td>FORGE (Fate of Repository Gases)</td>
<td>Influence of gas production and release on the long-term safety of a geological repository</td>
<td>2009 – 2013</td>
<td>24 organisations from 12 countries</td>
<td>BGS (United Kingdom)</td>
</tr>
<tr>
<td>PAMELA (PAMINA)</td>
<td>Monitoring Developments for Safe Repository Operation and Staged Closure</td>
<td>2006 – 2009</td>
<td>24 organisations from 12 countries</td>
<td>Armines Nantes (France)</td>
</tr>
<tr>
<td>PAMINA</td>
<td>Investigating the possibilities and limitations of monitoring in a geological repository</td>
<td>2006 – 2009</td>
<td>19 organisations from 7 countries</td>
<td>Armines Nantes (France)</td>
</tr>
<tr>
<td>MICADD (Model Uncertainty for the Mechanism of Dissolution of Spent Fuel in a Nuclear Waste Repository)</td>
<td>Uncertainties in the modelling of dissolution processes of spent fuel assemblies in deep geological repositories</td>
<td>2009 – 2013</td>
<td>17 organisations from 12 countries</td>
<td>Armines Nantes (France)</td>
</tr>
<tr>
<td>FORGE</td>
<td>Validation of thermo-hydro-mechanical models for simulating the HLW near-field in the early post-operational phase</td>
<td>2009 – 2013</td>
<td>24 organisations from 12 countries</td>
<td>BGS (United Kingdom)</td>
</tr>
<tr>
<td>PEBS</td>
<td>Long-term Performance of Engineered Barrier Systems – IES</td>
<td>Validation of thermo-hydro-mechanical models for simulating the HLW near-field in the early post-operational phase</td>
<td>2009 – 2013</td>
<td>BGS (United Kingdom)</td>
</tr>
<tr>
<td>DEM</td>
<td>Thermo-hydro-mechanical models for simulating the HLW near-field in the early post-operational phase</td>
<td>2009 – 2013</td>
<td>24 organisations from 12 countries</td>
<td>BGS (United Kingdom)</td>
</tr>
<tr>
<td>SIM</td>
<td>Long-term Performance of Engineered Barrier Systems – IES</td>
<td>Validation of thermo-hydro-mechanical models for simulating the HLW near-field in the early post-operational phase</td>
<td>2009 – 2013</td>
<td>BGS (United Kingdom)</td>
</tr>
<tr>
<td>7th EU Framework Research Programme</td>
<td>Long-term safety of a geological repository</td>
<td>2006 – 2010</td>
<td>19 organisations from 7 countries</td>
<td>Armines Nantes (France)</td>
</tr>
<tr>
<td>6th EU Framework Research Programme</td>
<td>Long-term safety of a geological repository</td>
<td>2009 – 2013</td>
<td>24 organisations from 12 countries</td>
<td>BGS (United Kingdom)</td>
</tr>
<tr>
<td>5th EU Framework Research Programme</td>
<td>Long-term safety of a geological repository</td>
<td>2006 – 2009</td>
<td>24 organisations from 12 countries</td>
<td>Armines Nantes (France)</td>
</tr>
</tbody>
</table>
Public outreach

The ongoing Sectoral Plan process, with its requirement for broadly based, effective regional participation, involves a large investment of time and effort. Nagra continued to be available as a point of contact for the affected siting communities and Cantons to answer questions and keep the public informed on Swiss waste management projects.

Communicating the facts
Providing factually correct information and conducting open dialogue form the basis for building trust. The public rightly expect answers to their questions on the topic of radioactive waste disposal and to be able to bring their concerns to the discussion table. Nagra’s public relations activities are aimed at maintaining contact with the public and providing them with comprehensive and understandable information. A wide range of communication tools and contact opportunities is used – the internet, brochures, films, media presence, guided tours of the rock laboratories, presentations and lectures, presence at regional trade fairs, road-shows, discussion platforms and so on.

Regular dialogue with the public
Nagra was present with its information stand at 16 regional trade fairs, mainly in towns and communities within the siting regions. For the first time, there was a presence at the BEA fair in Bern, where Nagra provided information on nuclear waste management as part of a special exhibit on energy and climate. Nagra staff had the opportunity to conduct interesting and sometimes quite emotional discussions with visitors to these events.

A total of around 3200 people visited the Grimsel Test Site and the Mont Terri Rock Laboratory. Besides the regular tours of the facilities, there were also two open days at the Grimsel Test Site for people living in the siting regions (25th June and 5th September). Nagra also took part in a special event on experiencing geology with tours of the GTS on 28th and 29th May.

Nagra also participated in four so-called TecDays at Swiss schools; these are organised by the Swiss Academy for Technical Sciences and have proved to be very popular with secondary school pupils.

Large information palette for interested readers
In 2010, Nagra produced two issues of "nagra info" that were sent to around 20,000 subscribers; 300,000 copies were also distributed to households in the siting regions. 14 issues of the electronic newsletter "e-info" (partly regional) were placed on line. Several other brochures were also produced on the topics of what the siting regions can expect, earthquakes and the evaluation of the database for the safety-based comparison of sites in Stage 2 of the Sectoral Plan. The brochures on activities in the two rock laboratories were also updated and materials for schools were expanded to include a new module.

www.nagra.ch
The Nagra website serves as a central dynamic information platform. It is continually updated, particularly with news, media releases and materials available for downloading. In December, a geology blog started with weekly
Developments in 2010

contributions. As a result of various measures such as optimisation of search engines and an adwords campaign, the number of visitors to the site increased by around 30%.

Nagra in the media spotlight

Nagra issued three media releases in 2010. There were also numerous media contributions, both in printed and audiovisual form. Key topics included the ongoing Sectoral Plan process and the build-up of regional participation, with representatives of Nagra having the opportunity to explain current activities during interviews. The interest of the German media and politicians in the Swiss waste management programme and the Sectoral Plan process continued to increase in 2010.
Management and Head Office

Head Office
At the end of 2010, 93 people were employed at Nagra’s headquarters (85 full-time employees and 8 part-time staffassistants), corresponding to 79.5 full-time positions.

On 1st September, Uwe Köhler took over as Head of the Engineering and Field Investigations Division.

Board of Directors and annual general meeting
The Board held four meetings to handle ongoing business, as well as two closed meetings. The focus was on the Sectoral Plan process, the database for the provisional safety analyses in Stage 2, budget planning for the period 2011 – 2015 and resource planning for 2010 – 2015. The Board took note of the planned research and development work for 2011 and approved the required outline credit.

The Technical Committee and the Commission for Communication and Information met five and three times respectively. The Finance Commission met to consider the closing of the annual accounts for 2009 and the budget for 2011, as well as the accumulated accounts.

The ordinary general meeting of the Members of the Nagra Cooperative took place on 22nd June 2010 in Bern. The Members approved the annual report and accounts for 2009, as well as the revision of the regulation on the procedure for handover of radioactive waste for disposal.

At the meeting, Mario Schönenberger stepped down from the Board for age reasons and Andreas Pfeiffer was elected as the new representative for NPP Leibstadt. Mr. Schönenberger’s successor as Chairman of the Technical Committee is Michael Plaschy (Alpiq Suisse SA).

Members of the Cooperative, Board of Directors, Commissions, Statutory Auditors

Members of the Cooperative
Swiss Confederation
Bern
Axpo AG
Baden
BKW FMB Energie AG
Bern
Kernkraftwerk Gossen-Däniken AG
Däniken
Kernkraftwerk Leibstadt AG
Leibstadt
Alpiq Suisse SA
Lausanne

Board of Directors
Pankraz Freitag
Hassian (Olarus)
President
Nagra
Dr. Stephan W. Dähler
Vice-President
Axpo AG
Peter Hirt
Kernkraftwerk Gossen-Däniken AG
Hermann Ineichen
BKW FMB Energie AG
Martin Jerjman
Paul Scherrer Institute
Dr. Michael Plaschy
Alpiq Suisse SA
Mario Schönberger
Kernkraftwerk Leibstadt AG
(till 22nd June 2010)
Dr. Andreas Pfeiffer
Kernkraftwerk Leibstadt AG
(from 22nd June 2010)
Peter Zbinden
Wallisellen (Zürich)
Former CEO of AlpTransit Gotthard AG

Technical Committee
Dr. Michael Plaschy
Chairman
Alpiq Suisse SA

Finance Commission
Michael Sieber
Chairman
Axpo AG

Commission for Legal Issues
Hansueli Sallenbach
Chairman
Axpo AG

Commission for Communication and Information
Peter Hirt
Chairman
Kernkraftwerk Gossen-Däniken AG

Statutory Auditors
PricewaterhouseCoopers AG
Zurich

Organigram Head Office

*P. Zuidema is responsible for the overall coordination and management of the Science & Technology programme.
*The Chefs of “Geology, Safety”, “Engineering, Field Investigations” and “Radioactive Materials” report directly to the person responsible for the overall coordination and management of the Science & Technology programme.
*Direct access to the Executive Board.
Annual accounts 2010
Comment on the annual accounts for 2010

Total expenditure rose compared to the previous year by around 6.2 million CHF. The reasons for this were increased fees (+ 1.1 million CHF), work on improving the generic database for Stage 2 of the Sectoral Plan process (+ 3.1 million CHF), higher expenditure for the Mont Terri Rock Laboratory (+ 1.5 million CHF) and increased personnel costs (+ 0.6 million CHF). Documented external expenditure rose by a total of 5.3 million CHF to 32.7 million CHF.

Similarly to total expenditure, total revenues also increased by 6.2 million CHF compared to the previous year to 49.0 million CHF. The contributions of the Members of the Cooperative rose by 6.2 million CHF to 43.7 million CHF.

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

Wettingen, 2nd April 2011

Dr. Thomas Ernst, Chief Executive Officer

Balance sheet

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Land and buildings</td>
<td>2 503 379</td>
<td>1 570 000</td>
</tr>
<tr>
<td>Other property, plant and equipment</td>
<td>382 650</td>
<td>243 453</td>
</tr>
<tr>
<td><strong>Total non-current assets</strong></td>
<td><strong>2 886 029</strong></td>
<td><strong>1 813 453</strong></td>
</tr>
<tr>
<td>Work in progress</td>
<td>3 757 250</td>
<td>2 978 330</td>
</tr>
<tr>
<td>Trade receivables</td>
<td>1 439 303</td>
<td>1 472 447</td>
</tr>
<tr>
<td>Other receivables</td>
<td>665 368</td>
<td>28 263</td>
</tr>
<tr>
<td>Accrued income and prepaid expenses</td>
<td>337 380</td>
<td>986 519</td>
</tr>
<tr>
<td>Cash and cash equivalents</td>
<td>16 174 042</td>
<td>12 809 905</td>
</tr>
<tr>
<td><strong>Current assets</strong></td>
<td><strong>22 373 343</strong></td>
<td><strong>17 375 484</strong></td>
</tr>
<tr>
<td><strong>Total assets</strong></td>
<td><strong>25 259 372</strong></td>
<td><strong>19 188 937</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Liabilities</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperative capital</td>
<td>120 000</td>
<td>120 000</td>
</tr>
<tr>
<td>Equity</td>
<td>120 000</td>
<td>120 000</td>
</tr>
<tr>
<td>Financial liabilities</td>
<td>650 000</td>
<td>– 1</td>
</tr>
<tr>
<td>Provisions</td>
<td>6 430 345</td>
<td>6 266 824</td>
</tr>
<tr>
<td>Trade payables</td>
<td>9 004 752</td>
<td>7 975 421</td>
</tr>
<tr>
<td>Advance payments</td>
<td>4 013 857</td>
<td>2 881 157</td>
</tr>
<tr>
<td>Other liabilities</td>
<td>1 573 834</td>
<td>777 695</td>
</tr>
<tr>
<td>Accrued expenses and deferred income</td>
<td>3 446 584</td>
<td>1 167 840</td>
</tr>
<tr>
<td><strong>Liabilities</strong></td>
<td><strong>25 139 372</strong></td>
<td><strong>19 068 937</strong></td>
</tr>
<tr>
<td><strong>Equity and liabilities</strong></td>
<td><strong>25 259 372</strong></td>
<td><strong>19 188 937</strong></td>
</tr>
</tbody>
</table>

Explanations in appendix page 44
Operating accounts

Total revenues

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributions to administration costs</td>
<td>600 000</td>
<td>600 000</td>
</tr>
<tr>
<td>Contributions for project expenditure</td>
<td>36 860 697</td>
<td>43 146 838</td>
</tr>
<tr>
<td>Contributions of Members of the Cooperative</td>
<td>37 460 697</td>
<td>43 746 838</td>
</tr>
<tr>
<td>Research contributions</td>
<td>323 223</td>
<td>427 053</td>
</tr>
<tr>
<td>Income from other services for Cooperative Members</td>
<td>940 549</td>
<td>965 169</td>
</tr>
<tr>
<td>Income from services for third parties</td>
<td>4 024 026</td>
<td>3 418 062</td>
</tr>
<tr>
<td>Income from deliveries and services</td>
<td>5 287 818</td>
<td>4 810 284</td>
</tr>
<tr>
<td>Income from disposal of fixed assets</td>
<td>–</td>
<td>405 291</td>
</tr>
<tr>
<td>Other operating income</td>
<td>70 666</td>
<td>69 187</td>
</tr>
<tr>
<td>Total revenues</td>
<td>42 819 181</td>
<td>49 031 600</td>
</tr>
</tbody>
</table>

Total expenditure

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third party supplies</td>
<td>27 378 486</td>
<td>32 665 509</td>
</tr>
<tr>
<td>Personnel costs</td>
<td>12 671 180</td>
<td>13 302 388</td>
</tr>
<tr>
<td>Depreciation</td>
<td>114 483</td>
<td>169 197</td>
</tr>
<tr>
<td>Other operating expenses</td>
<td>2 534 017</td>
<td>2 724 254</td>
</tr>
<tr>
<td>Operating expenses</td>
<td>42 698 166</td>
<td>48 860 348</td>
</tr>
<tr>
<td>Financial income</td>
<td>–45 341</td>
<td>–191 991</td>
</tr>
<tr>
<td>Financial expenses</td>
<td>65 488</td>
<td>160 025</td>
</tr>
<tr>
<td>Taxes</td>
<td>100 868</td>
<td>200 218</td>
</tr>
<tr>
<td>Financial result and taxes</td>
<td>121 015</td>
<td>168 252</td>
</tr>
<tr>
<td>Total expenditure</td>
<td>42 819 181</td>
<td>49 031 600</td>
</tr>
</tbody>
</table>

Change in cash and cash equivalents

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual result</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Depreciation</td>
<td>114 483</td>
<td>169 197</td>
</tr>
<tr>
<td>Formation of provisions</td>
<td>4 283</td>
<td>9 221</td>
</tr>
<tr>
<td>Application of provisions</td>
<td>–257 319</td>
<td>–172 742</td>
</tr>
<tr>
<td>Change in net current assets [without cash and cash equivalents]</td>
<td>5 394 693</td>
<td>–3 623 193</td>
</tr>
<tr>
<td>Cash flow from operating activities</td>
<td>5 256 140</td>
<td>–3 617 516</td>
</tr>
<tr>
<td>Investments</td>
<td>–320 533</td>
<td>–</td>
</tr>
<tr>
<td>Disinvestments</td>
<td>–</td>
<td>903 379</td>
</tr>
<tr>
<td>Cash flow from investment activities</td>
<td>–320 533</td>
<td>903 379</td>
</tr>
<tr>
<td>Repayment of loans</td>
<td>–</td>
<td>–650 000</td>
</tr>
<tr>
<td>Cash flow from financing activities</td>
<td>–</td>
<td>–650 000</td>
</tr>
<tr>
<td>Change in cash and cash equivalents</td>
<td>4 935 607</td>
<td>–3 364 137</td>
</tr>
</tbody>
</table>

Cash flow statement

Statement

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash and cash equivalents per 1.1.</td>
<td>11 238 435</td>
<td>16 174 042</td>
</tr>
<tr>
<td>Cash and cash equivalents per 31.12.</td>
<td>16 174 042</td>
<td>12 809 905</td>
</tr>
<tr>
<td>Change in cash and cash equivalents</td>
<td>4 935 607</td>
<td>–3 364 137</td>
</tr>
</tbody>
</table>

Explanations in appendix page 44
Accounting principles
The annual accounts for 2010 comply with the accounting principles set out in the Swiss Code of Obligations.

Valuation principles
Impairment in value of assets
The waste producers identical with the Members of the Nagra Cooperative are obliged in terms of the Nuclear Energy Act to finance the costs of waste management. The Members of the Cooperative have undertaken contractually to meet all expenditure incurred by Nagra. The intrinsic value of the assets is thus assured.

Capital (non-current) assets
Property, plant and equipment
Property, plant and equipment are carried at purchase cost less accumulated depreciation. The depreciation is made as planned over the expected useful lifetime of the asset category. The lifetimes for depreciation fall within the following bandwidths for the individual categories that are relevant for Nagra:
- Land: Depreciation only in the case of value impairment
- Buildings: 20 to 50 years
- Operating and business equipment: 5 to 10 years
- IT hard- and software: 2 to 3 years

Current assets
Work in progress
Under this position, the expenses associated with all ongoing commercial projects are capitalised at the balance sheet date at acquisition or production costs.

Receivables
Receivables are shown at nominal value less any appropriate provisions for bad and doubtful receivables.

Cash and cash equivalents
Cash and cash equivalents comprise petty cash, credit balances with bank and postal giro accounts and bank deposits with an original term of not more than 90 days. They are carried at nominal value.

Liabilities
Provisions
Provisions are carried at the actual nominal value as of the balance sheet date.

Payables
This position contains short-term obligations that are carried as of the repayment amount.

Advance payments
This position includes advance payments for ongoing commercial projects.

Notes on the balance sheet, operating accounts and cash flow statement

1 Fixed (non-current) assets

<table>
<thead>
<tr>
<th></th>
<th>Land and buildings</th>
<th>Office equipment</th>
<th>Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TCHF</td>
<td>TCHF</td>
<td>TCHF</td>
</tr>
<tr>
<td>Acquisition value per 01.01.2009</td>
<td>2 728</td>
<td>198</td>
<td>598</td>
</tr>
<tr>
<td>Additions</td>
<td>-</td>
<td>127</td>
<td>194</td>
</tr>
<tr>
<td>Disposals</td>
<td>-</td>
<td>-114</td>
<td>-114</td>
</tr>
<tr>
<td>Reclassifications</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Acquisition value per 31.12.2009</td>
<td>2 728</td>
<td>325</td>
<td>678</td>
</tr>
<tr>
<td>Additions</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Disposals</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Reclassifications</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Acquisition value per 31.12.2010</td>
<td>1 825</td>
<td>325</td>
<td>678</td>
</tr>
<tr>
<td>Accumulated depreciations per 01.01.2009</td>
<td>195</td>
<td>142</td>
<td>507</td>
</tr>
<tr>
<td>Additions</td>
<td>30</td>
<td>53</td>
<td>31</td>
</tr>
<tr>
<td>Disposals</td>
<td>-</td>
<td>-114</td>
<td>-114</td>
</tr>
<tr>
<td>Reclassifications</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Accumulated depreciations per 31.12.2009</td>
<td>225</td>
<td>195</td>
<td>425</td>
</tr>
<tr>
<td>Additions</td>
<td>30</td>
<td>55</td>
<td>84</td>
</tr>
<tr>
<td>Disposals</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Reclassifications</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Accumulated depreciations per 31.12.2010</td>
<td>255</td>
<td>251</td>
<td>509</td>
</tr>
<tr>
<td>Carrying amount per 01.01.2009</td>
<td>2 533</td>
<td>56</td>
<td>91</td>
</tr>
<tr>
<td>Carrying amount per 31.12.2009</td>
<td>2 503</td>
<td>130</td>
<td>253</td>
</tr>
<tr>
<td>Carrying amount per 31.12.2010</td>
<td>1 570</td>
<td>74</td>
<td>169</td>
</tr>
</tbody>
</table>

The maximum fire insurance payments for property, plant and equipment amounted to 11,522 TCHF as of 31st December 2010 (2009: 10,680 TCHF) for each case of damage.

2 Work in progress and advance payments
The capitalised work in progress/advance payments result exclusively from contracts for third parties. Of the ongoing projects, all costs are capitalised under work in progress and all customer invoices capitalised under advance payments.

3 Trade receivables

<table>
<thead>
<tr>
<th></th>
<th>31.12.2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TCHF</td>
</tr>
<tr>
<td>Receivables from Cooperative Members</td>
<td>18</td>
</tr>
<tr>
<td>Receivables from third parties</td>
<td>1 421</td>
</tr>
<tr>
<td>Total</td>
<td>1 439</td>
</tr>
</tbody>
</table>

The largest open position relates to the cost contribution by JAEA of around 450 TCHF to various Grimsel projects. Also outstanding are receivables from ZWILAG of around 220 TCHF.

4 Pre-paid expenses
The pre-paid expenses contain outstanding project cost contributions from the Members of the Cooperative (831 TCHF) to balance the annual accounts.

5 Cash and cash equivalents
Cash and cash equivalents decreased during the year of reporting by 3364 TCHF. There were no fixed term deposits as of 31st December 2010.

The parcel of land in Hägendorf was finally sold in 2010 and the associated long-term financial liability dissolved.

The parcel of land in Hägendorf was finally sold in 2010 and the associated long-term financial liability dissolved.
6 Provisions
The provisions contain credit balances for vacation time and overtime of employees and an obligation for restructuring costs since December 2007. In total, the provisions have decreased by 164 TCHF. In 2003, Nagra took over possible obligations for the Wellenberg site from the now liquidated company GNW for a one-off payment of around 4800 TCHF. The provision created with this payment will be used over a period of ten years for recultivation work, preparing project documentation and the final report and paying various fees. In the current business year there was no expenditure of this nature. The provision therefore remains unchanged. It will be dissolved in 2014.

7 Trade payables
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Payables</td>
<td>TCHF</td>
<td>TCHF</td>
</tr>
<tr>
<td>Cooperative Members</td>
<td>263</td>
<td>172</td>
</tr>
<tr>
<td>Payables third parties</td>
<td>7 766</td>
<td>6 803</td>
</tr>
<tr>
<td>Total payables</td>
<td>9 007</td>
<td>7 975</td>
</tr>
</tbody>
</table>

The largest creditors as of the balance sheet date are ENSI, PSI and the SFDE with a total of around 3500 TCHF

8 Accrued expenses and deferred income
Accrued expenses and deferred income decreased in the year of reporting by around 2300 TCHF; this is due mainly to project cost contributions for 2009 of around 2100 TCHF. As of 31.12.2010 there is a prepaid expenses item (see note 4) for outstanding project cost contributions for 2010.

9 Income from third party services
The reduced income from services for third parties is offset by reduced costs of an adequate amount for the relevant contracts. These are contained in external services (note 11).

10 Income from disposal of fixed assets
Income from disposal of fixed assets is shown separately due to the sale of the parcel of land in Hägendorf. In the previous year, this was contained in other operating income.

11 External services
<table>
<thead>
<tr>
<th></th>
<th>2009 TCHF</th>
<th>2010 TCHF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projects</td>
<td>17 493</td>
<td>21 268</td>
</tr>
<tr>
<td>Communication</td>
<td>2 350</td>
<td>2 531</td>
</tr>
<tr>
<td>Fees (ENSI, SFDE)</td>
<td>6 907</td>
<td>8 164</td>
</tr>
<tr>
<td>Travel costs</td>
<td>628</td>
<td>703</td>
</tr>
<tr>
<td>Total</td>
<td>27 378</td>
<td>32 666</td>
</tr>
</tbody>
</table>

12 Personnel costs
Personnel costs increased compared to the previous year by 5% to 13,302 TCHF. At the end of the year, staff consisted of 79.5 full-time positions, an increase of 3.4 compared to the previous year.

13 Other operating expenses
This position contains rents of around 950 TCHF, IT costs of around 800 TCHF and miscellaneous operating expenses of around 950 TCHF.

Further information
Off balance sheet transactions
In order to secure large project income from Japan, two currency futures transactions were made as of payment dates 31.05.2011 for 16 million JPY and 30.09.2011 for 8 million JPY. The value as of 31.12.2010 is 276 TCHF; the non-realised profit of 20 TCHF is not booked. Two further currency futures transactions were also made to secure contract work in the UK as of payment dates 15.06.2011 for 250 TGBP and 15.06.2012 for 100 TGBP. The value as of the balance sheet date is around 911 TCHF and the non-realised loss of around 66 TCHF was booked under accrued expenses and deferred income.

Contingent obligations
There are two bank guarantees in the amount of around 74 TEUR up to 10.02.2011 for an ongoing support contract for the Lithuanian state agency for radioactive waste management (RATA). There is also a guarantee in the amount of around 27 TEUR up to 31.12.2013 for a support contract for Ondraf/Niras in Belgium. All bank guarantees are non-balanced.

Transactions with associated persons
Transactions with associated persons are understood to mean transactions with the Members of the Cooperative according to page 37. There are no further transactions with associated persons.

Events subsequent to the balance sheet date
After the balance sheet date of 31st December 2010, no events occurred that are worthy of mention. Events after the balance sheet were taken into consideration up to 1st April 2011. On this date, the annual accounts were approved by Nagra’s Board of Directors.
## Accumulated accounts including allocations

<table>
<thead>
<tr>
<th>Revenues</th>
<th>Increase</th>
<th>Status</th>
<th>Increase</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swiss Confederation</td>
<td>1'065'019</td>
<td>27'799'497</td>
<td>1'246'582</td>
<td>29'226'079</td>
</tr>
<tr>
<td>Aare AG</td>
<td>8'123'720</td>
<td>210'797'982</td>
<td>9'069'034</td>
<td>220'307'016</td>
</tr>
<tr>
<td>BKW FMB Energie AG</td>
<td>3'942'154</td>
<td>96'761'760</td>
<td>4'614'583</td>
<td>101'376'343</td>
</tr>
<tr>
<td>Kernkraftwerk Gügen-Däniken AG</td>
<td>10'790'958</td>
<td>272'393'479</td>
<td>12'631'100</td>
<td>285'024'579</td>
</tr>
<tr>
<td>Kernkraftwerk Leibstadt AG</td>
<td>12'938'846</td>
<td>301'375'053</td>
<td>15'145'539</td>
<td>316'520'592</td>
</tr>
<tr>
<td>Contributions for project expenditure</td>
<td>36'860'697</td>
<td>909'307'771</td>
<td>43'146'838</td>
<td>952'454'609</td>
</tr>
<tr>
<td>Contributions to administration costs</td>
<td>600'000</td>
<td>84'920'000</td>
<td>600'000</td>
<td>85'520'000</td>
</tr>
<tr>
<td>Contributions of Cooperative Members to Nagra</td>
<td>37'460'697</td>
<td>994'227'771</td>
<td>43'746'838</td>
<td>1'037'974'609</td>
</tr>
<tr>
<td>Contributions of GNW</td>
<td>–</td>
<td>65'265'321</td>
<td>–</td>
<td>65'265'321</td>
</tr>
<tr>
<td>Contributions of Members of the Cooperative</td>
<td>37'460'697</td>
<td>1'059'493'102</td>
<td>43'746'838</td>
<td>1'103'239'940</td>
</tr>
</tbody>
</table>

### Total expenditure

<table>
<thead>
<tr>
<th>Increase</th>
<th>Status</th>
<th>Increase</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geoscientific studies</td>
<td>3'120'016</td>
<td>162'164'307</td>
<td>3'328'474</td>
</tr>
<tr>
<td>Nuclear technology and safety</td>
<td>1'394'828</td>
<td>37'287'576</td>
<td>2'133'938</td>
</tr>
<tr>
<td>Radioactive materials</td>
<td>1'220'781</td>
<td>31'799'242</td>
<td>1'531'762</td>
</tr>
<tr>
<td>Facility planning</td>
<td>941'993</td>
<td>19'615'151</td>
<td>2'398'006</td>
</tr>
<tr>
<td>Generic (non-site-specific) work</td>
<td>2'931'496</td>
<td>81'106'980</td>
<td>3'420'204</td>
</tr>
<tr>
<td>General programme costs</td>
<td>4'251'531</td>
<td>63'262'747</td>
<td>3'517'833</td>
</tr>
<tr>
<td>Fees and compensation</td>
<td>4'316'644</td>
<td>25'508'589</td>
<td>4'597'431</td>
</tr>
<tr>
<td>L/ILW programme</td>
<td>18'177'289</td>
<td>420'735'792</td>
<td>20'927'648</td>
</tr>
<tr>
<td>Geoscientific studies</td>
<td>3'612'401</td>
<td>299'536'235</td>
<td>3'357'201</td>
</tr>
<tr>
<td>Nuclear technology and safety</td>
<td>2'124'970</td>
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<td>3'570'749</td>
</tr>
<tr>
<td>Radioactive materials</td>
<td>754'429</td>
<td>21'830'262</td>
<td>864'210</td>
</tr>
<tr>
<td>Facility planning</td>
<td>880'955</td>
<td>15'653'374</td>
<td>2'126'154</td>
</tr>
<tr>
<td>Generic (non-site-specific) work</td>
<td>4'482'436</td>
<td>81'952'256</td>
<td>5'284'992</td>
</tr>
<tr>
<td>General programme costs</td>
<td>4'251'665</td>
<td>49'357'891</td>
<td>3'447'552</td>
</tr>
<tr>
<td>Fees and compensation</td>
<td>2'576'351</td>
<td>35'145'014</td>
<td>3'566'332</td>
</tr>
<tr>
<td>HLW programme</td>
<td>18'683'408</td>
<td>553'837'310</td>
<td>22'219'190</td>
</tr>
<tr>
<td>Project expenditure for repository programmes</td>
<td>36'860'697</td>
<td>974'573'102</td>
<td>43'146'838</td>
</tr>
<tr>
<td>Administration and general project expenditure</td>
<td>600'000</td>
<td>84'920'000</td>
<td>600'000</td>
</tr>
<tr>
<td>Total expenditure for L/ILW and HLW programmes and administration and general project expenditure</td>
<td>37'460'697</td>
<td>1'059'493'102</td>
<td>43'746'838</td>
</tr>
</tbody>
</table>
Notes on the accumulated accounts

The accumulated treatment of the contributions of the Members of the Cooperative and the application of these contributions forms the basis, at the time of waste emplacement, for any adjustments in payments between the Members. It also indicates what work has resulted in project-related expenditure.

The structure of the total revenues is oriented primarily to the operating accounts. The total expenditure and the total revenues are presented including allocations.

14. Contributions of Members of the Cooperative

The contributions of the Members of the Nagra Cooperative towards covering project costs are calculated based on the thermal output of the individual nuclear power plants. The contributions of the Members in the total amount of 43.7 million CHF (37.5 million CHF in the previous year) correspond to those in the operating accounts. Included is a contribution to administration costs in the total amount of 0.6 million CHF.

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

15. Project-specific expenditure for the repository programmes

The two repository programmes basically have the same structure in the presentation of the accumulated accounts and are oriented towards the most important technical tasks to be performed up to the completion of waste management activities. If there is no explicit reference to a specific programme, the following explanations of the individual positions apply to both projects.

a) Geoscientific investigations

Geological investigations for identifying potential siting regions comprise geological studies in the investigation area of Northern Switzerland relating to HLW disposal as well as processing of geological information on the L/ILW repository.

b) Nuclear technology and safety

The work comprises a safety-based evaluation of potential siting regions, laboratory studies on the near-field and on various backfill materials.

c) Radioactive materials

Expenditure on assessing the disposability of waste packages and on ongoing documentation and inventorying of radioactive waste.

d) Facility planning

This position includes expenditure on developing the concepts for surface and underground facilities of the repositories for HLW and L/ILW.

e) Generic investigations

This includes work on developing methodologies, modelling and validation of the models used in safety analyses; laboratory work, participation in the work at the rock laboratories (Brünnel and Mont Terri) and research programmes of the EU.

f) General programme costs

This expenditure results from programme management, expenditure on cost studies and public relations activities.

g) Fees and compensation

This includes the fees passed on to Nagra from the regulatory and safety authorities.

16. Total expenditure for the HLW and L/ILW programmes and management and general project costs

Total sum of the accumulated accounts taking into account the described allocations. The amount has to agree with note 14, contributions of Members of the Cooperative.
Berichterstattung aufgrund weiterer gesetzlicher Vorschriften

Wir bestätigen, dass wir die gesetzlichen Anforderungen an die Zulassung gemäss Revisionsaufsichtsgesetz (RAG) und die Unabhängigkeit (Art. 906 OR in Verbindung mit Art. 728 OR) erfüllen und keine mit unserer Unabhängigkeit nicht vereinbare Sachverhalte vorliegen.

In Übereinstimmung mit Art. 906 OR in Verbindung mit Art. 728a Abs. 1 Ziff. 3 OR und dem Schweizer Prüfungsstandard 890 bestätigen wir, dass ein gemäss den Vorgaben der Verwaltung ausgestaltetes internes Kontrollsystem für die Aufstellung der Jahresrechnung existiert.

Wir empfehlen, die vorliegende Jahresrechnung zu genehmigen.

PricewaterhouseCoopers AG
Willy Wenger
Revisionsexperte
Leitender Revisor

Daniela Keller
Betriebsökonomin FH

Aarau, 13. April 2011
## Waste inventories and volumes

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

### Waste volumes at the end of 2010

As a service to the waste producers, Nagra maintains a centralised databank of all waste packages. The following table shows the volumes and activities of waste that has been prepared for geological disposal as of the end of 2010. Not contained in the table are pre-conditioned raw wastes and waste packages, for example waste packaged for processing in the ZWILAG plasma furnace.

<table>
<thead>
<tr>
<th>Conditioned waste</th>
<th>Volume (m³)</th>
<th>Activity (Bq)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nuclear power plants</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZWILAG</td>
<td>3 439</td>
<td>1.2·10¹⁵</td>
</tr>
<tr>
<td><strong>Federal Govt. interim storage facility</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[waste from medicine, industry and research]</td>
<td>1 415</td>
<td>3.0·10¹⁴</td>
</tr>
<tr>
<td><strong>Federal Govt. interim storage facility</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[waste from medicine, industry and research]</td>
<td>1 491</td>
<td>6.6·10¹⁴</td>
</tr>
</tbody>
</table>

The ZWILAG waste consists of waste delivered to the interim storage facility from the power plants, waste packages from the plasma furnace and containers with strified high-level waste from reprocessing.

### Predicted waste volumes and inventories for deep geological disposal

Planning the geological repositories requires input in the form of information on expected waste volumes. The total volume of waste for disposal will be around 99,000 m³ 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 is based on the operational planning of the repositories.

<table>
<thead>
<tr>
<th>Predicted waste volumes (50-year NPP operation)</th>
<th>L/ILW (m³)</th>
<th>ATW (m³)</th>
<th>HLW/SF (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>conditioned</strong></td>
<td><strong>packaged</strong></td>
<td><strong>conditioned</strong></td>
<td><strong>packaged</strong></td>
</tr>
<tr>
<td><strong>BA-KKW</strong></td>
<td></td>
<td>7 260</td>
<td>24 400</td>
</tr>
<tr>
<td><strong>RA-KKW</strong></td>
<td></td>
<td>360</td>
<td>1 560</td>
</tr>
<tr>
<td><strong>SA-KKW</strong></td>
<td></td>
<td>28 265</td>
<td>28 265</td>
</tr>
<tr>
<td><strong>WA-KKW</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BA-ZWI</strong></td>
<td></td>
<td>45</td>
<td>140</td>
</tr>
<tr>
<td><strong>SA-ZWI</strong></td>
<td></td>
<td>620</td>
<td>655</td>
</tr>
<tr>
<td><strong>BA-MIF</strong></td>
<td></td>
<td>4 270</td>
<td>9 170</td>
</tr>
<tr>
<td><strong>SA-MIF</strong></td>
<td></td>
<td>23 000</td>
<td>23 000</td>
</tr>
<tr>
<td><strong>BEVA</strong></td>
<td></td>
<td>2 220</td>
<td>2 220</td>
</tr>
<tr>
<td><strong>HLW</strong></td>
<td>Canisters from reprocessing (completion of existing contracts, with substitution BNFL)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BE</strong></td>
<td>Spent fuel assemblies</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total volumes</strong></td>
<td>(rounded)</td>
<td>66 020</td>
<td>89 410</td>
</tr>
<tr>
<td><strong>Percentage</strong></td>
<td>(rounded)</td>
<td>97.3 %</td>
<td>90.3 %</td>
</tr>
<tr>
<td><strong>Activity¹</strong></td>
<td></td>
<td>4.7·10¹⁷ Bq</td>
<td>3.4·10¹⁰ Bq</td>
</tr>
<tr>
<td><strong>Percentage</strong></td>
<td></td>
<td>1.6 %</td>
<td>0.1 %</td>
</tr>
</tbody>
</table>

¹ This contains a reserve of 12,000 m³ for the as yet unspecified L/ILW from large-scale research facilities.

² Activity inventory for reference year 2050.
Publications 2010

Nagra Technical Reports (NTBs)

All the NTBs listed here are available in printed form or can be downloaded free of charge from the Nagra website. A complete list of all reports published to date (including prices) can also be downloaded from the internet.

NTB 10-01
“Beurteilung der geologischen Unterlagen für die provisorischen Sicherheitsanalysen in SGT Etappe 2 - Klärung der Notwendigkeit ergänzender geologischer Untersuchungen”; October 2010.

NTB 09-07
Comparison of the Reference Opalinus Clay and MX-80 Bantoniia Sorption Data Bases Used in the Entsorgungsnachweis with Sorption Data Bases Predicted From Sorption Measurements on Illite and Montmorillonite”; September 2010.

NTB 09-05

NTB 09-03
Sorption Data Bases for Generic Swiss Argillaceous Rock Systems”; September 2010.

Information for the general public

The website www.nagra.ch is continually updated with new content, images, animations and short films. The site is available in three languages (German, French and English).

Several print products were published in 2010 (not available in English). These can be downloaded from the internet or ordered from Nagra free of charge.

• Two issues of ‘nagra info’ – current news on waste management (German, French, Italian).
• Topical brochure on earthquakes (German, French).
• Brochure on what the site regions can expect (German).
• Brochure on evaluating the database for the safety-based site comparison in Stage 2 of the Sectoral Plan process (German).
• School lesson on geology (German).

Updated versions of various printed materials were also produced.

Nagra National Cooperative for the Disposal of Radioactive Waste www.nagra.ch (available in English)

Decommissioning and waste management funds (SFDOE) www.bfe.admin.ch/entsorgungs­fonds

ENSI Swiss Federal Nuclear Safety Inspectorate www.envsi.ch (available in English)

EcSht German expert group on Swiss repositories www.ecsht.de

FMT Mont Terri Rock Laboratory www.mont-terri.ch (available in English)

Forum VERA www.forumvera.ch (available in English)

GTS Grimsel Test Site www.grimsel.com (available in English)

IAEA International Atomic Energy Agency www.iaea.org

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

KNE Commission for Nuclear Waste Disposal www.kne-schweiz.ch (available in English)

LES Waste Management Laboratory (PSI) les.web.psi.ch (available in English)

NSC Federal Nuclear Safety Commission www.bfe.admin.ch/kns (available in English)

Nuclear energy internet portal www.kernenergie.ch

Nuklearforum www.nuklearforum.ch

PSI Paul Scherrer Institute www.psi.ch (available in English)

Radioactive waste (SFDOE) www.radioaktivwaste.ch (available in English)

SFDOE Swiss Federal Office of Energy www.bfe.admin.ch (available in English)

Swissnuclear Nuclear energy technical division of Swisslectric www.swissnuclear.ch (available in English)

Technisches Forum Sicherheit / Technical Forum on Safety www.technischesforum.ch (partly available in English)

ZWILAG Zwischenlager Würenlingen AG www.zwilag.ch (available in English)

Glossary

Andra Agence nationale pour la gestion des déchets radioactifs, France.

ATW Alpha-toxic waste.

BGR Bundesanstalt für Geowissenschaften und Rohstoffe, Germany.

BOS British Geological Survey.

BKW FMB BKW FMB Energie AG, Bern.

BNFL British Nuclear Fuels.

Criqi Central Research Institute of Electric Power Industry, Japan.


EDRAM International Association for Environmental Safe Disposal of Radioactive Material.


ENSI Swiss Federal Nuclear Safety Inspectorate.

EPRI Electric Power Research Institute, United States.

Escht Expert Group on Swiss Repositories, Germany.


EU European Union.

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

FOEN Federal Office for the Environment.

FOPH Federal Office for Spatial Development.


GNSS Global Navigation Satellite System.

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.

IAEA International Atomic Energy Agency, Vienna.

ILW Long-lived intermediate-level waste.

JAEA Japan Atomic Energy Agency.

JNES Japan Nuclear Energy Safety Organization.

JNFL Japan Nuclear Fuel Limited.


KRMC Korea Radioactive Waste Management Corporation.

L/I LW Low- and intermediate-level waste.

MIR Radioactive waste from medicine, industry and research.

MIRAM Model Inventory of Radioactive Materials.

NaGNet Nagra’s permanent GNSS measurement network.

NDA Nuclear Decommissioning Authority, UK.

NEA Nuclear Energy Agency of the OECD, Paris.

NPP Nuclear power plant.


Nume Nuclear Waste Management Organization of Japan.

NWMO Nuclear Waste Management Organization, Canada.

Obayashi Obayashi Corporation, Japan.

OECD Organisation for Economic Cooperation and Development.

Onдраf/Niras Organisme national des déchets radioactifs et des matières fissiles enrichies / Nationale instelling voor radioactief afval en verrijkte spilstoffen, Belgium.

PSI Paul Scherrer Institute, Villigen, Canton Aargau.


RWMC Radioactive Waste Management Funding and Research Center, Japan.

SF Spent fuel.

SFDOE Swiss Federal Office of Energy.

SKB Svensk Kärnbränslehantering, Sweden.

Swisstopo Federal Office for Topography. Mont Terri project manager from 2006.

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