The first 40 years.

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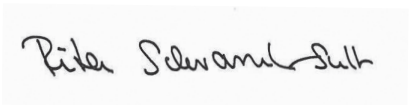
Content

GREETINGS



- Rita Schwarzelühr-Sutter -
Chairwoman of the Supervisory Board of GRS and Parliamentary State Secretary at the Federal Ministry for the Environment, Nature Conservation, Building, and Nuclear Safety

As chairwoman of the GRS supervisory council, I would like to offer my heartfelt congratulations to the organisation on its 40th anniversary.

As an independent scientific and research institution that is committed to objectivity, GRS has, over the past four decades, been significantly involved in shaping the development of nuclear safety. The sound scientific expertise and recommendations provided by GRS reflect the high level of interdisciplinary competence of the GRS staff, which is widely recognised and greatly benefits the work of policy-makers and informs the interested public. Through its work, GRS makes an important contribution to the advancement of science and technology in expert discussions with a view to enhancing the safety of installations not only in Germany but worldwide.

Political and legal frameworks have changed considerably in recent years with the energy transition. Renewable energies will play a key role in energy supply in the future. The phase-out of nuclear energy by 2022 and the restructuring of responsibilities in nuclear waste disposal also pose a great challenge to GRS. Here, the task will be to undergo a transformative process in an ever-changing market environment.

In light of this, it remains clear that the safety of German nuclear power plants must be ensured for the duration of their operating lives and also, throughout the post-operational, decommissioning and dismantling phases. Following the phase-out of the use of nuclear power in energy supply, Germany will continue to maintain a strong interest in safety issues at national and international level which require broad and interdisciplinary expertise beyond the year 2022.

GRS is a globally connected company, which for many years now has successfully been bringing German safety culture into international discussions. GRS thus fulfills all the preconditions to successfully master the challenge of becoming a broadly-positioned scientific institution that is geared towards the future and that will remain a sought-after and reliable partner.

I wish GRS every success in the work that lies ahead. I would like to offer my thanks and commend the management as well as all colleagues at GRS for their continuous competent and reliable work. I strongly believe that with your tireless commitment and engagement, you will lead GRS to a secure future.

INTRODUCTION

- Hans J. Steinhauer -
Commercial and Legal Director

- Uwe Stoll –
Technical and Scientific Director

Dear Readers

With the establishment of GRS 40 years ago, the founders provided the organisation with ambitious tasks for its journey ahead. It was said that the company shall position itself as an ›independent, scientific and expert organisation, one that obliges itself to objectivity and expands its knowledge on nuclear safety (…) as well as promotes the discourse between scientific progress and public interest both in Germany and across the world.‹ Furthermore, as already stated back then in our company charter, ›particular questions about environmental protection and security research shall be addressed.‹ When we use this brochure today to look back on what our colleagues have achieved since 1977, then we find that GRS has more than fulfilled its duties.

That applies above all to our traditional field of work. Here GRS can proudly claim to have furthered the safety and security of nuclear technology and waste management and with that, the continual protection of humankind and the environment. For example, many safety-enhancing upgrades are based on recommendations made by GRS in what has so far amounted to roughly 440 Information Notices. Amongst other things, the computer codes developed by GRS as a result of its own research satisfy the highest scientific standards and are used for safety assessments in Germany and also in many other countries, thus being a major contribution to nuclear safety.

Aside from nuclear technology, GRS has increasingly provided important contributions towards the improvement of the safety of technologies, and has been doing so since the mid- 1980s. Some of you may be surprised at the diversity of the issues our specialists have worked upon, which spans from research on safe disposal of chemically-toxic waste to geothermal energy, sustainable water management and all the way on to space travel.

As important to us as the positive technical outcomes, is that for over 40 years, the team at GRS have been one organization with collective goals and shared values. More than a few of our specialists have developed their entire careers at GRS. Particularly pleasing results come from the previous employee surveys, which showed definitively that the attractiveness of GRS as an employer can be in no small part attributed to the open, collegial atmosphere and the career development opportunities available to its staff.

As you may have gathered from the title of this booklet, we are convinced that the ›first forty years‹ of GRS have paved the way for many more years to come. We would therefore like to offer not only a look back on four eventful decades but also to take a glance into the future. To find out more, turn to page 38.

We wish you an enjoyable read!

THE FIRST DECADE FROM THE GERMAN RISK STUDY TO CHERNOBYL

On 26 May 1976, federal and Land representatives along with the Technical Inspectorates (TÜVe) approved the merging of the ›Laboratory for Reactor Control and Plant Safety‹ (Laboratorium für Reaktorregelung und Anlagensicherung – LRA) with the ›Institute for Reactor Safety of the Technical Inspectorates e. V.‹ (IRS). This produced the newly founded Gesellschaft für Reaktorsicherheit (GRS) mbH‹. Through joining the scientifically-orientated work of the LRA with the expert opinions prepared by IRS, GRS exhibited from the outset a character that until today remains one of its strengths: the interlocking of the work of an expert organization with application-orientated research and development.

German society around GRS is shaped in its first decade by two opposing developments. On one hand, there is the expansion of nuclear energy in the country, which reaches its peak with the commissioning of 12 power reactors. On the other hand, there is the anti-nuclear power movement, which is gaining considerable attention, manifested in large demonstrations at Brokdorf or Wyhl. On a technical level, two particular events stand out: the ›German Risk Study (Phase A)‹, by which GRS introduced the probabilistic safety analysis in Germany, and the accident at Chernobyl. The latter event poses great challenges to GRS, influencing both its professional work as well as by the development of nuclear technology in Germany in the decades to come.

1977

In January 1977, GRS officially begins operating. At its location in downtown Cologne and at the research facilities in Garching near Munich, around 400 employees begin their work, 300 of whom are Technical-Scientific Experts.

The focus of the work is on the development and validation of analytical methods for incidents and accidents as well as the assessment of nuclear power plants and other nuclear facilities. In February, GRS publishes the first final report in the company's history, titled ›Progress Report on Safety and Relief Valves‹ (GRS-A-1).

In addition to that, specialists in Garching and Cologne focus from an early stage on topics that will still be relevant 40 years later and continue to be the subjects of intense research and development. This includes e.g. the preparation of a ›Dynamic Analysis for Aircraft Crash Load Case‹, the first ›Study into Hardware Safety and Reliability of Computer Systems‹, and investigations of a variety of new reactor concepts, such as gas-cooled and sodium-cooled reactors.

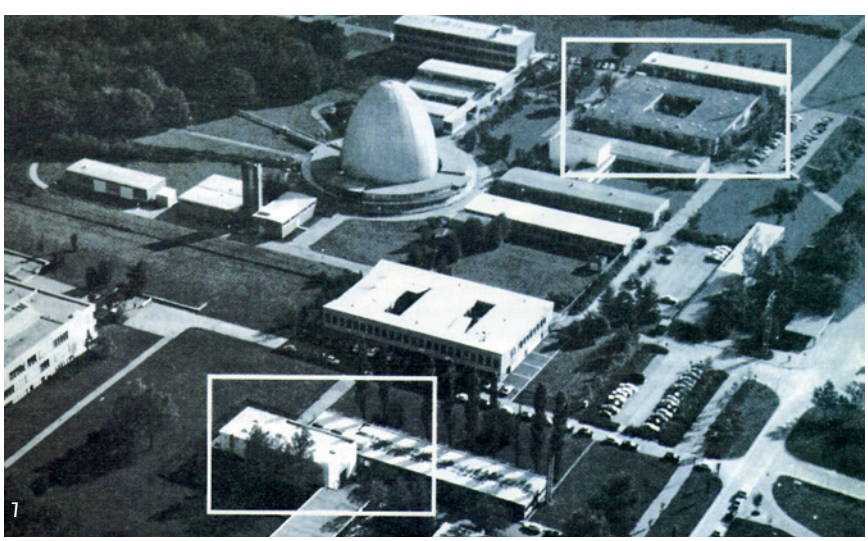
Furthermore, GRS is also tasked with running the secretariats of the Reactor Safety Commission (RSK), the ›Commission on Radiological Protection‹ (SSK) and the ›Nuclear Safety Standards Committee‹ (KTA).

Alongside the organization of conferences and the editorial and organizational support of publications, technical assistance forms a large part of operational activity, namely via the reappraisal of current technical knowledge as well as detail analyses of technical issues.

With its ›Central Research Support Division‹, GRS assists the Federal Research Ministry and the Federal Ministry of the Interior with the implementation of state-funded research programmes in the field of reactor safety. Tasks range from the professional support of programme content development to the administrative assistance of corresponding projects in various institutions as well as the collection and distribution of research results and the coordination of international collaboration in this field.

From 1977, GRS develops the ›German Risk Study of Nuclear Power Plants (Phase A)‹.

(1) The GRS offices in Garching (white boxes) are located within the vicinity of the research reactor in Munich known as the ›Atomic Egg‹.
(2) In Cologne, the offices have until this point been located in three different buildings. The expansion and development of the building in the Schwertnergasse begins in 1980.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THE FIRST DECADE

1978

One of the technical focal points of this year is the ›German Risk Study of Nuclear Power Plants (Phase A)‹. Already in 1977, the Federal Research Ministry had commissioned GRS with the task of conducting the probability-based study into risks to the population that arise from the use of nuclear power plants. The project is a starting point that leads to the development of methods for so-called ›probabilistic safety analyses‹ (in brief: PSA) – a specialist area where GRS goes on to set standards in nuclear safety and become a leading institution in this field. The methodology adopted for the ›Risk Study‹ was based upon the 1975 US-published ›Rasmussen Report‹, which was the first probabilistic risk analysis worldwide in the field of nuclear technology.

At the Garching location, a mainframe computer financed by the BMFT begins operation. The central unit (of type AMDAHL 470 V/5) has a (back then impressive) memory of 4 MB, earning it a place among the highest-performing machines on the market.

Alongside reactor safety, the topic of plant security gains importance at GRS: the organisation is commissioned to assess the protection standards against ›malicious acts‹ for all nuclear facilities.

The Federal Research Ministry makes GRS the project management agency for reactor safety research, thereby expanding the scope of tasks beyond the scope of research support. GRS continues to carry out the function of project management on behalf of German federal ministries up until today.

1979

The accident at the Three Mile Island nuclear power plant on in the USA largely impacts the work of GRS in 1979. On 28 March, a partial meltdown occurs in Unit 2. While the molten mass remains completely inside the reactor pressure vessel, radioactive material is released into the environment. On the INES scale introduced in 1990, the event would have to be classified as a Level 5 ›accident with off-site risk‹.

Immediately after the accident, GRS begins to research the safety of the facility's technical design and to analyse the accident sequence. Based on the results, GRS formulates recommendations for safety-enhancing retrofitting and measures in German nuclear power plants as well as suggestions to refocus research projects in order to address new questions that have arisen as a result of the accident. Subsequently, particular investigations are carried out, including those that delve into specific incident and accident phenomena and into the efficacy of ›accident management‹ measures, and an accident analysis calculator is developed.

At a press conference on 14 August, the Federal Minister for Research and Technology, Volker Hauff, presents the ›German Risk Study (Phase A)‹. During Phase B, which will be completed in 1989, the methodology will be further developed and new findings from reactor safety research will be taken into consideration.

On 28 March 1979, a partial meltdown occurs at the US Three Mile Island nuclear power plant . The salvage of the nuclear fuel and the dismantling of the reactor reached completion in 1993.

1980

Work associated with the evaluation of operating experience is further extended at GRS. Particular attention is given to the so-called ›in-service inspections‹. For the newer nuclear power plants, GRS carries out comprehensive accident analyses, whereby the effectiveness of the emergency cooling system is of particular interest.

In the field of radioecology, GRS – in conjunction with the Philippsburg, Emsland, Grohnde and Krümmel nuclear power plants – prepares expert opinions on the effects of the discharge of radioactive materials during normal operation and on their atmospheric release following accidents. The characterisation of radioactive aerosols that are emitted by nuclear power plants during normal operation forms the subject matter of a research project.

View of the office floor, completed in 1982, on top of the ›OpernPassagen‹, where 250 staff of GRS work today.

1981

GRS prepares its first ›Information Notice‹ (in German: Weiterleitungsnachricht – WLN). By the end of 2016, GRS will have prepared around 400 of such WLNs, informing authorities, experts and operators of the results of its evaluation of safety-relevant events in nuclear facilities as well as providing recommendations toward the improvement of safety.

The employee number at GRS has grown to almost 500 staff members. For the first time, the team in Garching move into their own office building.

In addition, GRS performs extensive preliminary work for the third edition of the ›Guidelines for Pressurized Water Reactors‹, which is approved by the RSK on 14 October. These guidelines formulate safety-related basic requirements for the reactors of the planned Konvoi type, which are to be constructed in the coming years.

1982

On recommendation from the Enquête Commission of the Bundestag ›Future Nuclear Energy Policy‹, the Research Minister appoints GRS to carry out the ›Risk-Orientated Analysis of the Fast-Breeder Reactor at Kalkar (SNR-300)‹. With the SNR-300, the first sodium-cooled breeder reactor in Germany is set to be constructed. Multiple institutions and specialists in subcontract and/or together with GRS take part in conducting the study. Among them is the Nuclear Research Centre at Karlsruhe and the seismological station of the University of Cologne. The study concludes that within the scope of its analytical accuracy, the risk of the SNR-300 corresponds to that of a pressurized water reactor. The nuclear power plant Kalkar is completed in 1985. It does not however begin operation. In March 1991 the then Federal Research Minister Heinz Riesenhuber announces the definitive end to the project.

Following the construction of an additional floor atop the building complex ›Kölner Ladenstadt‹, the colleagues in Cologne are able to move from three separate offices into one shared location.

The Bavarian government finalises the regional planning procedure for the reprocessing plant at Wackersdorf (WAA) and commences the nuclear licensing procedure. For the purpose of safety-related assessment, the TÜV (Technical Inspectorate) in Bavaria, the ›Organisation for Radiation and Environmental Research‹ (Gesellschaft für Strahlen- und Umweltforschung – GSF) and GRS form the ›Reprocessing Plant Bavaria Working Group‹. In the years to come, the WAA will become a topic of intense protest and its location will become the scene of large rallies with at times violent riots. In May 1989, construction is discontinued.

THE FIRST DECADE

1983

The activities of GRS continue to grow in the field of nuclear waste disposal. Alongside the work for the WAA, the organisation develops expert opinions for the interim storage facilities at Gorleben and Ahaus. On behalf of the German National Metrology Institute (Physikalisch-Technische Bundesanstalt – PTB), GRS begins with safety-related investigations of the former iron-ore mine ›Konrad‹, which is intended as a final repository for low and intermediate-level radioactive waste. Amongst other things, the target of the analyses is to determine potential radiation exposure to the public in the event of an accidental release of radioactive materials. In addition to that, GRS evaluates dispersion experiments that were conducted in the Konrad mine by the Institute for Toxicology and Aerosol Research at the Fraunhofer Institute.

Furthermore, GRS broadens its international collaboration, with employees being seconded to the International Nuclear Energy Agency (IAEA) and to research institutes in the US and Japan.

1984

GRS is intensively involved in the preparation of the experiment that is to be carried out from 1985 in the new large-scale UPTF (Upper Plenum Test Facility) test facility. This facility is constructed at the large power station in Mannheim by Germany, the USA and Japan as part of the international research project 2D/3D. The facility is a 1:1 scale model of a pressurized water reactor (of the 1,300 MW class), with the active components of the primary system such as the core, the pumps and the steam generators as well as the containment simulated by computer models. GRS provides extensive analytical support to the UPTF project.

The eighth GRS ›Fachgespräch‹ conference focuses for the first time on the safe disposal of radioactive waste. Central topics this year are safety analyses of the Konrad final repository and the development of safety requirements for repositories in near-surface and deep geological formations.

1985

GRS expands its international operations, taking part in a risk-orientated analysis for the Qinshan nuclear power plant under construction in China as well as carrying out transient analyses for the first pressurised water reactor in Britain (Sizewell B). Additionally, GRS prepares a safety assessment of the 1,000 MWe 3-Loop Concept of KWU (Kraftwerks-Union) for Turkey, and analyses the safety of small heating reactors produced by several manufacturers.

Furthermore, GRS expands its activities and takes a more international approach within the field of non-nuclear technologies: In the context of two research programmes from the European Community, GRS takes part in projects that target an improvement in the quality of production processes and the increase in reliability of software.

Otto Kellermann, who together with Prof. Adolf Birkhofer has led GRS as Managing Director since the founding of the organization, enters retirement. Dr. Walter Hohlefelder succeeds his position.


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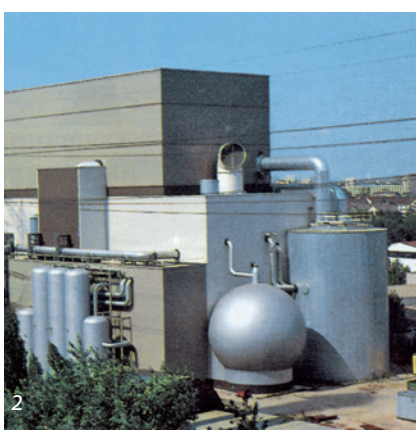
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(1) The headframe of the former iron-ore mine Konrad, which is converted into a final repository for low and intermediate radioactive waste.
(2) View of the large-scale UPTF (Upper Plenum Test Facility)test facility at the large nuclear plant in Mannheim. From 1986 and for about ten years afterwards, over 220 test runs are completed regarding accident phenomena in the primary system.

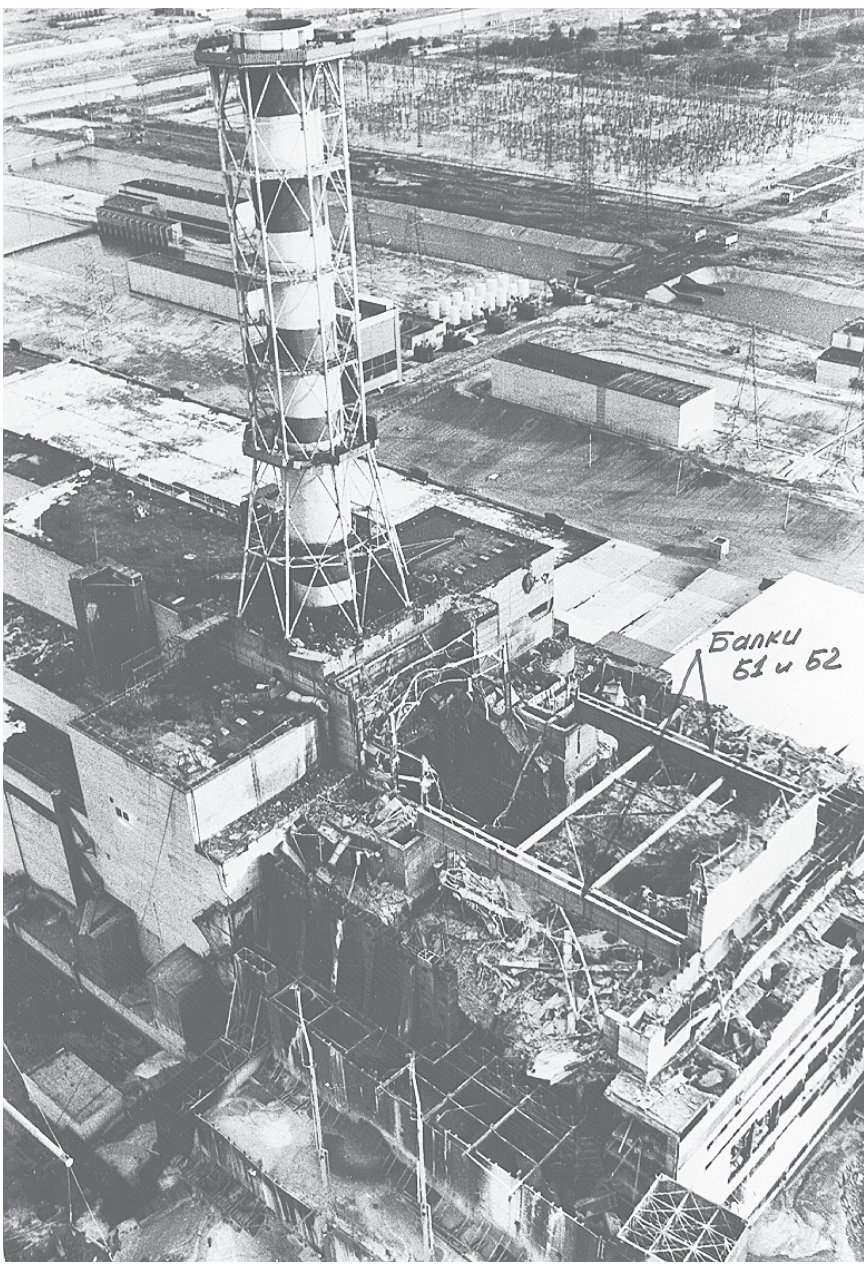
1986

On 26 April, the world is shocked by the reactor accident in Unit 4 of the Chernobyl nuclear power plant. As a result of the worst nuclear catastrophe in history to date, large areas of land in Ukraine, Russia and Belarus become heavily contaminated. The extent of the health hazards that arose from the accident remain to this day contentious: According to a study by the ›Chernobyl Forum‹, which comprises experts from the IAEA, World Health Organisation and further committees of the United Nations, around 4,000 fatalities in the aforementioned territories can be attributed over the long-term to the accident; in other estimates, this figure is several orders of magnitude higher.

The first expert assessment work by GRS begins just days after the accident. Even before the first official reports by Soviet agencies about the accident, and at the intercession of the German federal government, Soviet representatives arrive at GRS in order to discuss the possible measures available for containing a graphite fire. As one of the first institutions worldwide to do so, GRS presents a report in June about the probable accident sequence and its aftermath. The report reaches a peak circulation of over 50,000 copies. A revised edition appears in November.

Alongside the technical challenge to make sound scientific statements on an accident in a largely unknown reactor type, GRS is faced by an enormous public demand for information.

In the coming months and years, specialists of GRS are available for answers in numerous interviews and lectures and handle several thousand queries from the media and the general public.



The destroyed Unit 4 of the Chernobyl nuclear power plant shortly after the accident in April 1986.

The first GRS report on the accident at Chernobyl, issued in June 1986. It was not least because of the information regarding the radiological consequences for Germany that the report was widely circulated.

THE SECOND DECADE CHANGE AND GROWTH: NEW COLLEAGUES, LOCATIONS AND SUBSIDIARIES

The second decade in the history of GRS represents growth and technical diversification. Following the reunification of Germany, GRS takes on board numerous specialists from the GDR's State Office for Nuclear Safety and Radiation Protection (Staatliches Amt für Atomsicherheit und Strahlenschutz – SAAS). In 1990, these new team members begin their work at the newly established Berlin offices. Their expertise with Soviet reactors is the reason why GRS becomes one of the most competent western specialist organisations for nuclear power plant safety in Eastern Europe. With the takeover of the 'Institute for Deep Disposal‹ (Institut für Tieflagerung) in Braunschweig in 1995, GRS obtains yet another office location with around 70 highly qualified staff members. The combination of research and expertise position GRS as one of the leading German institutions in the field of repository safety.

Growth leads to further organisational changes: GRS becomes a corporation. At the beginning of 1992, the first subsidiary, ›The Institute for Safety Technology – ISTec‹ is established. Some months later, GRS and its French counterpart IPSN establish the joint subsidiary RISKAUDIT. From Paris, RISKAUDIT plays a central role in the advisory assistance and implementation of projects for the European Commission.

1987

At the Garching location, GRS sets up a test control room for the simulation of accidents and events at nuclear power plants. For the simulation, the self-developed ATHLET code system and a model of a 1300-MW pressurised water reactor are used. The first investigation focuses on the effectiveness of measures against beyond-design-basis accident sequences. Until today, the test control room has been continuously further developed.

In the area of waste disposal, GRS is largely involved in the plan approval procedure of the scheduled repository for low and medium-level radioactive waste in the former iron ore mine Konrad. On behalf of the licensing authorities, the newly formed ›Long Term Safety Group‹ at GRS begins working on the assessment of long-term safety.

On behalf of the German Federal Environment Agency, GRS investigates the applicability of probabilistic analysis methods for chemical plants. As a pilot project, its experts conduct a probabilistic safety analysis (PSA) for parts of an explosives-manufacturing facility. From this project, concrete indications can be derived regarding the improvement of safety. In order to create a better database for future PSAs of chemical plants, GRS develops a databank with corresponding reliability parameters on behalf of the Federal Research Ministry.

1988

GRS completes the ›German Precursor Study‹, whereby the methodology of precursor analyses has been first tested for a German reference plant. From 1992, the company will continually examine reportable events in Germany to see whether the probability of an event involving core damage beyond a certain degree has increased and can therefore be classified as a precursor event.

On behalf of the USSR, GRS carries out an analysis of accident sequences for the Russian VVER-1000/88reactor concept. In the context of the ›Agreement on Scientific and Technical Cooperation‹, GRS also begins a comprehensive exchange of information with the Soviet Union.

Work begins on the first ›Transport Study Konrad‹. The study is to identify and asses the radiological exposure and corresponding risks expected from the transportation of low and intermediate-level radioactive waste to a repository.

From July 1987, Gerald Hennenhöfer takes on his role as the new Commercial and Legal Director. He succeeds Dr. Walter Hohlefelder, who left GRS in September 1986 in order to take up a position leading the Reactor Safety and Radiation Protection Department at the newly formed Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety.

(1) In June 1989 the Federal Minister of Research Prof. H. Riesenhuber along with Prof. A. Birkhofer presents the ›German Risk Study, Phase B‹ at a press conference. (2) GRS analysis centre at Garching.

THE SECOND DECADE

Lift-off of an ARIANE 4 launch vehicle. An accident in May 1986 in which engine damage led to the self-destruction of the rocket was the trigger for the investigation by GRS of the engine flow processes for the third phase.

The Federal Office for Radiation Protection (Bundesamt für Strahlenschutz – BfS) is founded. The new authority takes over the support role that GRS provided to the secretariats RSK, SSK and KTA as well some of the employees at GRS that were tasked with this work.

1989

Through the completion of the ›German Risk Study Nuclear Power Plants (Phase B)‹ GRS concludes one of the largest and most complex projects in its company history. The study bundles together current research findings on reactor safety, the results of comprehensive evaluations from operating experience and more recent investigations into accident management to arrive at an integral safety assessment. At the end of July, Federal Research Minister Heinz Riesenhuber presents the study at press conference. Coinciding with this occasion, GRS publishes a summarised report. The overall study is published as a book in April 1990.

In July, GRS and its French partner, the Institut de Protection et de Sûreté Nucleaire (IPSN), enter into an agreement regarding the cooperation of nuclear and non-nuclear safety issues. Alongside the collective development of studies and evaluations, the agreement also provides for the exchange of personnel and the formation of joint working groups. This is the beginning of a permanent partnership.

The political turning point in the GDR and the fall of the Berlin wall directly impact what is expected of GRS: By the end of 1989, the initial groundwork for the envisaged cooperation with East Germany's State Office for Nuclear Safety and Radiation Protection (SAAS) has already begun.

GRS addresses various issues in the aerospace sector. On behalf of the German manufacturers of jet engines for the European ARIANE launch vehicle, they investigate the thermal hydraulic processes from the inflow of liquid hydrogen until ignition. In addition, GRS develops its own simulation program and demonstrates its suitability through recalculations of manufacturing trials. In a further project, they determine possible radiation exposure to the public that could be caused by satellite crashes with nuclear energy sources such as the so-called radioisotope batteries.

The Managing Directors of GRS, G. Hennenhöfer (left) and Prof. A. Birkhofer sign an agreement over future collaboration with the IPSN Director Cogné (right).

Berlin location: Since 1990, GRS has had its own offices at Kurfürstendamm 200.

Drums containing radioactive waste in the Morsleben (ERAM) repository

1990

GRS receives an order from the BMU requesting the safety analysis of Units 1 to 4 of the Greifswald nuclear power plant. As early as the beginning of the year and under the guidance of GRS, a committee of experts from Germany and the SAAS meet at the plant for a work seminar. In March, the BMU presents the first interim report from the committee at the federal press conference. In a further interim report, the shut-down of Units 2 and 3 is recommended. In the second half of the year, GRS together with the SAAS analyses Unit 5 at Greifswald. The safety analyses subsequently begin for the Stendal nuclear power plant (with VVER-1000 reactor type). The technical safety assessments prepared by GRS are discussed in depth with Russian specialists.

In autumn, GRS takes on board around 40 technical specialists from the SAAS. From this point on they begin working in the newly established office at Kurfürstendamm in Berlin. The new colleagues bring extensive knowledge about Soviet-built nuclear power plants as well as valuable contacts to Eastern European experts with them.

This lays the foundation for GRS's development over the coming years into one of the leading western specialised institutions for the safety of nuclear power plants in Central and Eastern Europe. Meanwhile, fundamental changes occur within the internal organisation at GRS. The steadily growing significance of the work concerning interim storage and disposal is reflected in the formation of the new technical ›Waste Management‹ division, comprising departments dealing with ›Nuclear Fuel Cycle‹, ›Radiation and Environmental Protection‹ and ›Disposal‹.

1991

The BMU commissions GRS to carry out a safety analysis of the former GDR's ›Repository for Radioactive Waste Morsleben‹ (ERAM). The aim of the investigation is two-fold: to assess the safety of the staff and environment during operational activities as well as the evaluation of long-term safety following the planned closure of the repository. In a further project, GRS begins to prepare the so-called ›Altlastenkataster‹ (register of contaminated sites). Through the project, data is collected about the radio-ecological conditions of Wismut AG uranium mining sites in the former GDR, while additional data is provided for the planned ecological rehabilitation.

The Federal Research Ministry initiates a multitude of research projects with the goal of adapting the western analysis codes to eastern European nuclear power plants. A further goal is to promote the exchange of information and knowledge with eastern European experts, from which a close working relationship develops with the Moscow Kurchatov Institute.

THE SECOND DECADE

Example of the ecological rehabilitation of legacies of Wismut AG uranium mining: the slag heaps known as the ›Pyramids of Ronneburg‹ in 1990 (left) and the so-called ›new Ronneburg landscape‹ in 2007 (above).

In the non-nuclear field, GRS takes on projects such as the safety analysis for a waste incineration plant, the formation of a data base for reportable environmentally relevant events, the fire analysis for a chlorine pipe as well as the establishment of secretariats for the two new advisory committees of the BMU: the Technical Committee on Plant Safety (TAA) and the Accident Commission (SFK).

On 6 July, the shareholders of GRS agree to an expansion of the activity scope as well as the name change to ›Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) mbH‹. With that, GRS signals its desire to expand and engage in non-nuclear areas as well.

1992

Within the scope of the evaluation of operating experience, GRS begins to develop its own system of ›Technical Documentation‹ (in brief: TECDO). In order to swiftly evaluate the incidents and events at nuclear facilities, GRS forma a database with collected texts, images and information. Through continued further development, TEDCO becomes one of the most important tools for the evaluation of events.

The public hearing on the planning documents begins as part of the plan approval process for the Konrad mine. Until 1993, GRS provides comprehensive technical support for the licensing authority, including the screening and technical evaluation of a total 290,000 objections that have been raised against the project.

At the beginning of the year, GRS founds its first subsidiary: the Institute for Safety Technology GmbH (also known from 1994 onwards in short form: ISTec). ISTec will focus on the application-orientated development of technical systems, such as the further development of diagnostic technologies stemming from nuclear technology for early fault detection in wind turbines. On 1 May, approximately 30 assigned specialists from GRS begin working for the new subsidiary.

The founding of the second subsidiary takes place in August: together with IPSN, GRS becomes co-proprietor of RISKAUDIT. With regard to technical advice and the preparation and implementation of projects in the field of nuclear safety, RISKAUDIT is one of the leading organisations in Europe. Together with its parent companies and on behalf of the European Commissions and other official clients, RISKAUDIT engages in numerous projects across the globe.

ISTec, founded in 1992, focuses in part on the development of Onboard Diagnostic Technology for the monitoring and diagnosis of bogies of high-speed trains such as the ›Intercity Express‹ (ICE). In addition to this, the workforce of approximately 35 employees addresses issues such as the development of documentation systems for the decommissioning of nuclear installations and radioactive waste management. At the Garching location, ISTec maintains a variety of test facilities (e.g. for valves, shown in the bottom picture).

1993

GRS together with other western safety organisations founds the ›Technical Safety Organisations Group‹ (TSOG), whose focus is on supporting eastern European authorities with the European Community's PHARE and TACIS programmes. Together with eastern European experts, safety assessments begin for the Temelin, Kozloduij, Rovno, Balakovo, Ignalina, Smolensk, Mochovce, Zaporoshje and Chernobyl nuclear power plants. Alongside the actual investigations, the projects aim to support the development of licensing authorities and the transfer of methods and knowledge. Furthermore, the transfer of computer codes necessary for the safety assessment of the VVER and RBMK reactors is intensified in various federal-government-sponsored and TACIS and PHARE programme projects.

GRS concludes its ›probabilistic safety analysis‹ for boiling water reactors. The study will long be regarded as a reference for studies relating to this reactor type.

On behalf of competent authorities in Saxony and Thuringia, GRS begins to evaluate the monitoring concept that has been set up by the Wismut AG company as part of its efforts towards the remediation of former uranium mining sites.

GRS together with IPSN establish technical offices in Moscow and Kiev to provide support to the local projects. Both offices are managed by RISKAUDIT.

1994

GRS together with experts from the Russian authority MINATOM develop a feasibility study for the German Foreign Office focusing on the manufacturing of mixed-oxide fuel elements by using nuclear weapons-derived plutonium.

Alongside the continued further development of the ATHLET simulation code, reactor safety research focuses on the development of the COCOSYS computer code. All relevant phenomena that occur during severe accidents in the containment of a light water reactor can be simulated with COCOSYS. Like ATHLET, COCOSYS is at present used in many technical organisations around the world.

On behalf of the IAEA and the Nuclear Energy Agency (NEA) of the OECD, GRS participates with an international expert group in a review of the ›International Nuclear Event Scale (INES)‹. Until today GRS provides the so-called ›INES Officer‹ for Germany, who is responsible for the review of the ranking of events at each nuclear facility and the forwarding of event reports from Level 2 onwards to the information system of the IAEA.

With funding from the Federal Research Ministry, GRS works on the development of assessment criteria regarding the safety of the disposal of conventional rest materials as backfill in disused mines.

On behalf of the German Environment Agency, GRS establishes at its Berlin location the secretariat of the Expert Commission that is to prepare the draft for an Environmental Code.

Commercial and Legal Director Gerald Hennenhöfer is appointed as the new Head of the 'Safety of Nuclear Facilities and Radiation Protection' department at the BMU. He leaves GRS on 30 September.

THE SECOND DECADE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From 1994 on, GRS together with other European safety organisations and technical experts from eastern European authorities and institutes prepare safety assessments for the nuclear power plants Balakovo (1,2), Ignalina, Kozloduij, Mochovce, Rovno (3), Zaporoshje, Smolensk, Temelin (4) and Chernobyl.


4

1995

GRS takes over the research section of the Institute for Deep Storage (›Institute für Tieflagerung‹ – IfT), which is a part of the Institute for Radiation and Environmental Research. As a result, GRS obtains not only a new location in Braunschweig, but also a new specialist field. The 70 new staff members that transfer from IfT to GRS bring with them strong expertise in the area of repository safety research. These competencies and the geotechnical and geochemical laboratories enable GRS, through its own research, to secure and further develop its applied methods. Through this work at the Braunschweig location (which is now the current Repository Research Centre of GRS), the organisation has been able to significantly further develop the state of the art in science and technology in the area of repository safety. The same applies to the safety of the underground disposal of hazardous chemical waste. The research work in this area has significantly contributed over the years toward a better understanding of the fundamental phenomena taking place in a repository and to the development of assessment methods.

1996

A focal point of reactor safety research is the joint development (with IPSN) of the so-called ASTEC integral code. On the basis of the ATHLET and COCOSYS simulation program, ASTEC allows the determination of the source term of core meltdown accidents. The code is used for example for studies in the field of probabilistic safety analyses (PSA Level 2), for support of experiments or for the investigation of the effectiveness of accident management measures.

At the same time, GRS also addresses the safety of future fusion reactors. The organisation creates a reference code for investigations into the thermo-chemical behaviour of the ITER test facility and provides an essential contribution to the first location-independent safety analysis report of this facility.

In a project financed by the Federal Research Ministry, GRS compares the relevant phenomena and processes related to the long-term safety of a repository in salt and granite host rock formations. In addition to this, GRS compares the currently available methods for long-term safety analyses. The results of the comparison is to contribute to the determination of the research needs as-yet existing from a German perspective in connection with the analysis of the long-term safety of a repository in a granite formation.

On 1 March, Dr. Walter Leder takes up the position of Commercial and Legal Director at GRS.

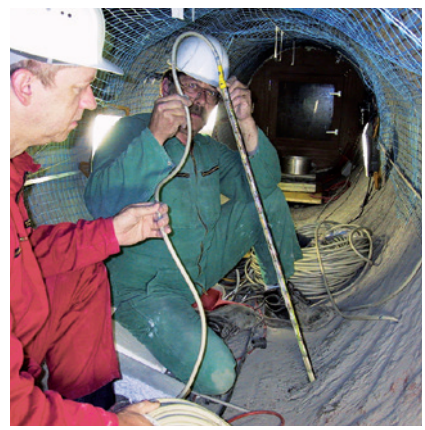
On the 10th anniversary of the Chernobyl accident, specialists at GRS together with the ›Wissenschafts-Presse-Konferenz (WPK)‹ present their findings at an organised press event.

In 1995, GRS prepares an expert report for the Bavarian regional government on the use of highly enriched nuclear fuel in the München II research reactor.

THE THIRD DECADE BETWEEN PHASING-OUT AND INTERNATIONAL NETWORKING

The most defining event for GRS in the third decade – and beyond – is the decision of the nuclear phase-out in Germany. Ever since the amendment of the German Atomic Energy Act of 2002, it is clear that GRS will have to be prepared for the fact that in the long term, its tasks will change, especially in the field of the expert support of federal supervision. Apart from the necessary adjustments to its fields of avidity, GRS is faced with the challenge of continuing to ensure a lasting supply of qualified junior scientists and to maintain competence.

In the light of these objectives, GRS participates in the foundation of the Alliance for Competence in Nuclear Technology in 2000. Research institutions, universities and companies from all areas of nuclear energy technology cooperate in this network to coordinate research and to promote the education of qualified specialists. Also internationally, GRS expands its co-operation. Besides initiatives like the ›Junior Staff Programme‹, founded together with IRSN in 2002, or the ›Severe Accident Research Network of Excellence‹ (SARNET), founded in 2004, GRS seeks to strengthen especially the international networking of Technical Safety Organizations. This starts in 1999 with the organisation of the EUROSAFE Forum and results in the foundation of the ›European Technical Safety Organisations Network‹, ETSON for short.



From the mid-1990s, GRS extends its research projects on clay stone and granite as potential host rock for nuclear waste repositories. The cooperation with the underground laboratories like the Grimsel (left) and Mont Terri (right) rock laboratories in Switzerland play an essential role. Here, numerous experiments are carried out by the experts of GRS.

1997

For the first time, following the completion of the German risk study, GRS again brings a probabilistic safety analysis to a conclusion – this time regarding severe accident sequences up to meltdown accidents in boiling water reactors. In the field of the evaluation of operating experience, the work focuses on the evaluation of the effects of long-term operation on the safety of German nuclear power plants.

In the field of repository research, studies into the determination of safety-relevant parameters for disposal of spent fuel in granite are further expanded. One example of this is the experiment on gas migration performed by GRS together with foreign partners in the GRIMSEL rock laboratory in Switzerland and in the Swedish ÄSPÖ hard rock laboratory.

Work on transferring the methods of long-term safety analyses for repositories of radioactive waste to underground waste disposal sites for conventional pollutants is completed. On the basis of the now available methods, safety assessments of underground waste disposal sites can be performed to determine the impacts of backfill or waste materials on the biosphere.

Chernobyl is increasingly becoming the subject of various activities of GRS. Together with IPSN, GRS forms the ›Franco-German Initiative for Chernobyl‹ which will deal intensively with the radiological and health consequences of the accident and the condition of the Sarcophagus at Chernobyl in the coming years. Experts of both organisations are providing support to the Ukrainian authority in the planning of the decommissioning and dismantling licensing procedures of Units 1-3 as well as of the construction of the various disposal facilities at the site. Moreover, GRS continues to support the German Federal Government concerning the adoption of the ›Shelter Implementation Plan‹ in the context of which the G7 states are funding the construction of a new protective structure over the old Sarcophagus – the ›New Safe Confinement‹.

The quality management of GRS is certified according to DIN EN ISO 9001 for the first time. In Garching near Munich, a further new building is completed and staff can move into new offices.


TÜV CERT

ZERTIFIKAT

Die TÜV CERT-Zertifizierungsstelle
der TÜV Rheinland
Sicherheit und Umweltschutz GmbH
bescheinigt gemäß
TÜV CERT-Verfahren, daß das Unternehmen

GRS

für den Geltungsbereich

Forschung und Entwicklung, Sicherheitsbewertung und Projektträgerschaften auf dem Gebiet der Anlagen- und Reaktorsicherheit, Entsorgung, Endlagerung und des Umweltschutzes

ein Qualitätsmanagementsystem eingeführt hat und anwendet.

Durch ein Audit, Bericht Nr. 70048
wurde der Nachweis erbracht, daß die Forderungen der

DIN EN ISO 9001

erfüllt sind.

Dieses Zertifikat ist gültig bis Juli 2000

Zertifikat-Registrier-Nr. 09 100 70048

TÜV Rheinland

THE THIRD DECADE

1998

A frequently discussed subject among the general public and in the media that GRS is dealing with is the transgression of the permissible contamination limit values found on transport casks during their transportation to and from reprocessing in France and England. On behalf of the German Federal Ministry for the Environment, GRS prepares an expert assessment analysing the potential causes of the contamination and identifying measures in order to prevent future incidents.

Work starts on the first Level 2 probabilistic safety analyses (PSA) of a Konvoi plant. The extent and the frequency of radionuclide releases into the environment during a core melt accident are also to be quantified by the study.

GRS' collaboration in the Mont Terri rock laboratory in Switzerland starts. Ever since, GRS has been gathering data in numerous experiments and with different project partners for a better understanding of the safety-relevant processes in a repository in Opalinus clay. These data are used to develop models which are able to depict these processes. The models, in turn, are the basis for computer codes allowing simulations of processes in repositories in clay stone formations.

1999

Against the background of the German Federal Government's plan of a gradual phasing-out of nuclear energy, GRS, in coordination with its supervisory bodies, develops a concept for its reorientation. The objective is that even in the long term, GRS is to remain in a position to produce reliable results in order to support the Federal Government on any significant issues concerning nuclear safety and to maintain qualified personnel despite the difficult recruitment situation in engineering and natural sciences. Furthermore, the range of GRS‹ activities is to be extended by also applying the methods and the knowhow to an even greater extent to the assessment and improvement of other technologies presenting potential risks to man and the environment.

The competent mining authority in Lower Saxony commissions GRS in co-operation with the Federal Institute for Geosciences and Natural Resources (BGR) with assessing the planning phase of the decommissioning of the Asse II mine regarding long-term safety. From 1965 to 1995, the now almost 100-year-old potash and salt mine was used by the Helmholz Zentrum Munich, on behalf of the German Ministry of Research and Education, for exploring the handling and storage of radioactive waste in a repository. Until the year 1978, more than 125,000 drums of low and medium-level waste were emplaced.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2

(1) Federal Minister for the Environment Dr. Angela Merkel presents the results of the GRS‹ expert opinion on contaminations of transport casks for spent fuel (see 2). (3) View into a so-called supply chamber in the Asse II mine.

In July 2000, the Federal Ministry for the Environment organized the 2nd Chornobyl Pledging Conference.

2000

On behalf of the Federal Ministry for the Environment, GRS carries out an inventory of the existing amounts of radioactive waste in Germany and determines the future disposal requirements. The results serve as a basis for the so-called National Disposal Plan of the German Federal Government.

In a consortium led by RISKAUDIT, GRS supports the Ukrainian licensing authority in co-operation with IPSN (France), AVN (Belgium) and ANPA (Italy) in the assessment of the licensing documents for the decommissioning of Units 1–3 at Chernobyl and the construction of interim storage facilities for spent fuel and waste treatment facilities as part of an EU-funded TACIS project. For the Federal Ministry for the Environment, GRS provides extensive organisational and technical support in the preparation of the 2nd Chornobyl Pledging Conference taking place in Berlin.

In Cologne, GRS hosts the 2nd ›EUROSAFE Forum‹. The opening event of the international specialist conference on nuclear safety launched by GRS and IPSN took place in Paris in the year before. The ›EUROSAFE Forum‹ replaces the former ›Fachgespräche‹ which had been annually organized by GRS since its foundation and since 1997 in co-operation with IPSN.

2001

The attacks of September 11 shake the world and spark a new debate on the protection of nuclear facilities against terrorist attacks. Against this background, GRS is charged by the Federal Ministry for the Environment with the preparation of an expert assessment of the potential consequences of a deliberate aircraft crash onto a German nuclear installation. Especially in the first few days after the attacks, GRS receives numerous media inquiries.

In the context of the ongoing development of methods for the probabilistic safety analyses for nuclear installations, great effort is focused on the better consideration of fire events. Here, a particular challenge is to identify fire scenarios relevant for the safety in the approx. 1,500 to 2,000 service compartments of a nuclear power plant.

In the field of radioactive waste disposal, GRS analyses the applicability of geostatic methods for the development of probabilistic statements on the long-term safety of repositories.

THE THIRD DECADE

In the wake of the September 11 terrorist attacks, the research on potential consequences of similar attacks on nuclear facilities has been intensified. GRS-projects focus on consequences of deliberate aircraft crashes.

At the end of the year, Prof. Adolf Birkhofer retires from GRS. As Head of the Laboratory for Reactor Control and Plant Safety (Laboratorium für Reaktorregelung und Anlagensicherung – LRA), he was instrumental in the foundation of GRS, leading it as Technical-Scientific Director for more than 25 years.

2002

After his appointment as the new Technical-Scientific Director in December 2001, Lothar Hahn takes up his duties for GRS on 1 January.

The expert assessment of the potential consequences of a deliberate aircraft crash onto a German nuclear installation that GRS was charged with the year before is completed.

Ten years following the start of the procedure, the plan approval decision for the construction and operation of a repository for low- and medium-level waste at the Konrad mine is enacted. From planning to the final decision, GRS has been intensively involved in all stages.

The ›Arbeitskreis Auswahlverfahren Endlagerstandorte‹ (AkEnd) (Committee on a Selection Procedure for Repository Sites) convened by Federal Environment Minister Jürgen Trittin at the beginning of 1999 completes its work. In its final report, the committee presents the general outline for a gradual selection process and criteria to select a potentially suitable site for a high-level waste repository. Two of the personally appointed members of the AkEnd are GRS experts.

An ICE chassis in the ISTec laboratory, presented at the open day in 2002.

2003

On behalf of the Federal Foreign Office, GRS starts work on initial projects within the ›Global Partnership‹. Due to the impact of the terrorist attacks of September 11 2001, the G8 states founded this programme in 2002. With a total investment volume of 20 billion US dollars, the programme aims at supporting projects, especially in the countries of the former Soviet Union, against the proliferation of weapons and materials of mass destruction over the next ten years. Germany invests about 1.5 billion US dollars to be used for the destruction of chemical weapons, the disposal of old nuclear submarines, and the physical protection of nuclear material and installations. Until the end of 2012, GRS leads numerous specific projects – e.g. on the modernisation of the security systems of the former Soviet nuclear facilities at Mayak and Tomsk – with a volume of approx. 170 million euros.

In cooperation with the Institut de Radioprotection et de Sûreté Nucléaire (IRSN) – IPSN until 2002 – GRS establishes the ›Junior Staff Programme‹. Junior employees of both organisations meet regularly several times a year in order to strengthen professional and personal exchange.

GRS launches new software tools for an even better coordination of the volume of contracts and the objective control of individual projects in the different fields of competence. GRS‹ quality management system is continually developed. At the end of 2003, GRS is certified according to ISO-9001/2000. On June 23, the GRS/IRSN/RISKAUDIT technical office in Moscow celebrates its tenth anniversary.

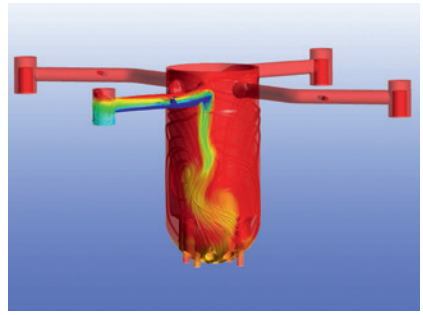
2004

In April 2004, the ›Severe Accident Research Network of Excellence‹ (SAR-NET) is launched with significant participation of GRS and with assistance of the EU within the 6th Research Framework Programme. The consortium, under the leadership of IRSN, involves 49 organisations from all over Europe wishing to contribute to the networking by sharing significant parts of their research on severe accidents and to better coordinate and to increasingly integrate their activities in this field in future. The core of the work is the integral code ASTEC jointly developed by GRS and its French partner IRSN.

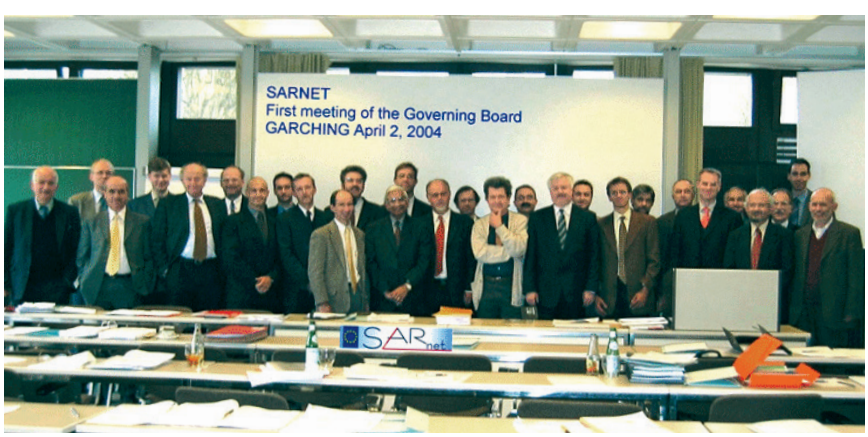
High-resolution, three-dimensional fluid flow calculations by means of the so-called CFD codes are increasingly used in the safety analyses, both for processes in the coolant system and in the containment. For the further development and the validation of these codes, GRS co-operates closely with research centres in Germany and numerous other countries.

Issues relating to impacts of extreme weather conditions on the safety of nuclear installations are gaining in importance. The flooding event at Blayais (France) and the high river temperatures in the exceptionally hot summer of 2003 trigger in-depth investigations by GRS.

The ›Franco-German Initiative for Chernobyl‹ comes to a conclusion. GRS and IRSN jointly issue three expert reports on the condition of the Sarcophagus and on the radiological consequences and health effects of the accident.



Visualisation of the flow conditions in a reactor pressure vessel, created by the CFD code ANSYS CFX.



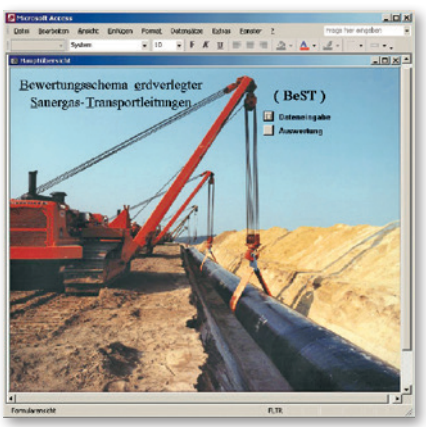
Participants of the first SARNET Governing Board Meetings convened at GRS Garching.

2005

Great importance is attached to the revision of the German nuclear non-mandatory guidance instruments. On behalf of the Federal Ministry for the Environment and with participation of the Institute for Applied Ecology (Öko-Institut) and the Physikerbüro Bremen, GRS revises the non-mandatory regulations ranking above the KTA nuclear safety standards. In order to facilitate the intense discussion, especially with the professional public, all draft modules of the new revised nuclear rules and regulations are published on a web-based platform for comments.

GRS again receives an order from the Trade Association for Natural Gas and Petroleum Extraction (WEG). As part of the work, GRS develops a method for gathering and assessing the data on the integrity of underground sour-gas pipelines – i.e. natural gas pipelines containing toxic hydrogen sulphide. For this purpose, GRS establishes the BeST Database Program for the Assessment of the Integrity of Buried Sour Gas Pipelines and tests is successfully.

On December 31, Dr. Walter Leder resigns as Managing Director of GRS.



Area of Europe's largest natural gas storage facility at ›Rehden‹ (top), and view of the home page of GRS's BeST Database Program (bottom)

On the 20th anniversary of the accident, GRS organises a trip by journalists to Chernobyl. Here, the head of communications of the plant site explains future activities by using a plant model.

2006

The incident at the Swedish Forsmark 1 nuclear power plant on July 25 receives widespread public response. After a short circuit outside the plant, reactor scram occurs, then parts of the electrical energy supply of the emergency core cooling and residual-heat removal system fail, as a result of which parts of the control system are not fully available. On behalf of the Federal Ministry for the Environment, GRS analyses the incident and the potential applicability to German plants.

As a result of the increased participation of further expert organisations and authorities in the programme committee over the past few years, the EUROSAFE Forum has evolved into an initiative for international specialists exchange.

In the light of these developments, the directors of IRSN and the Belgian AVN as well as Lothar Hahn, the managing director of GRS, sign a Memorandum of Understanding on the creation of ETSON (European Technical Safety Organisations Network). By the end of 2016, the number of members will have risen to 16.

Funded under the 6th Research Framework Programme of the EU, the project PAMINA starts in Brussels on 12 and 13 October. Coordinated by GRS, 24 institutions from ten European countries participate in the project. The aim of the project is to enhance and harmonise methods and computer codes in order to demonstrate the safe disposal of long-lived radioactive waste and spent fuel elements in deep geological formations.

Also at national level, another important step forward is made in repository research: THEREDA (Thermodynamic Reference Database) is launched, a joint project in which all relevant German research institutions work together to develop a consistent and quality-assured thermodynamic reference database for the description of solubilities of radionuclides and other toxic materials. By involving the Federal Office for Radiation Protection (BfS) as the supervisory authority at an early stage, THEREDA can serve as a reference for all future repository projects.

The 20th anniversary of the Chernobyl accident attracts once again considerable media interest. In the run-up to this anniversary, GRS – in cooperation with the GSF – National Research Center for Environment and Health – takes the initiative of sending a fact-finding mission of 15 science journalists to Belarus and Ukraine and hosts a German Science Journalists' Association (Wissenschafts-Pressekonferenz – WPK) conference in Bonn on 22 April.

On 1 August, Hans J. Steinhauer takes up his duties as the Commercial and Legal Director of GRS.

Units 1 and 2 of the Swedish Forsmark Nuclear Power Plant. Due to the incident in Unit 1 in July 2006, GRS started a comprehensive investigation.

THE FOURTH DECADE
GENERATION CHANGE, DIGITALISATION, FUKUSHIMA

One of the biggest successes of GRS in the years from 2007 goes largely unnoticed from outside: By the year 2012, the age-related retirement of almost an entire generation of experts has been compensated by the recruitment of around 250 new and often quite young colleagues, thereby keeping the quality of the work at a constantly high level. Many of the new staff also bring with them fresh ideas and new competences, from which GRS draws considerable benefit, not least because much of it is about the use of digital and web-based technologies, the application of which has in the meantime become normal practice. This encompasses activities from scientific developments such as the first ever virtual underground laboratory to the presence of GRS in social media and the release of the first mobile phone app.

From a technical point of view, it is above all one event that dominates the fourth decade: the accident at Fukushima. GRS is highly praised for the work of its Emergency Centre – where initially GRS staff are on duty around the clock – and its public relations work. The lessons learned are considered in the planning of the new Emergency Centre. In the months and years that follow, the accident is still the focal issue of numerous projects, e.g. in the analysis of the accident sequence or the collaboration in the so-called ›stress tests‹.

Participants of the first ETSON Summer School held at GRS Garching in the summer of 2008.

2007

The progressing digitalisation in nuclear technology is also reflected in the topics dealt with by GRS as an expert organisation. Here, the focus is on studies into IT security and relating to the effects of the application of IT-based systems on plant security. Within the framework of various projects commissioned by Land authorities, GRS assesses corresponding security concepts of the plant operators, formulates IT-specific objectives for nuclear security, and develops adversary profiles. The introduction of IT Security Officers in nuclear installations is i.a. also due to recommendations made by GRS.

Current developments of probabilistic safety analysis (PSA) methods are aimed at performing ›dynamic PSAs‹. The development of a so-called ›Crew Module‹ for the MCDET simulation code makes it possible to model the actions of a shift crew consisting of several individuals and thereby to simulate more realistically possible incident and accident sequences in a PSA.

The first GRS Fachforum conference takes place in Cologne. In this two-day event, GRS presents its latest working results in numerous presentations, covering the fields of reactor safety, waste management, and radiation protection. This format takes up the tradition of the GRS Fachgespräch, which served a similar purpose from the foundation of GRS until the EUROSAFE Forum came into being.

2008

Bidding for a tender with the British authority HSE (Health and Safety Executive), GRS wins several lots. In the years to come, it will assume a major role in connection with the so-called Generic Design Assessment. This will involve the generic safety assessment of the AP 1000 and EPR reactor types.

The development of the PROST simulation code is concluded. This software makes it possible for the first time to determine for certain damage mechanisms the probability of leaks and breaks in piping with complex geometries and in vessels. It also allows predictions of crack behaviour under operational loads and even the determination of leak rates. By quantifying probabilities, the code supplements the existing PSA methods.

The activities of GRS in support of training qualified junior scientists are extended. The ETSON Summer School is founded jointly with the ETSON partners. The first training course is held at GRS in Garching, with 44 young scientists from Belgium, Britain, France, Germany and the Netherlands taking part. Furthermore, the collaboration with German universities is extended through co-operation agreements with RWTH Aachen and TU Dresden; in 2009, a corresponding agreement with Brandenburg University of Applied Sciences is to follow.

THE FOURTH DECADE

2009

The simulation code COCOSYS is extended by a module for the simulation of the so-called direct containment heating – in short: DCH. DCH means the release of core melt and gases from the reactor pressure vessel (RPV) containment at the accidental failure of the RPV under increased inner pressure. With this extension to COCOSYS, it is now possible to simulate completely the processes starting from core destruction up to the behaviour of the core melt in the containment.

One focus of the expert work in the field of nuclear safety is on the ongoing support of the Dutch authority KfD (Kernfysischer Dienst). For example, GRS develops an analysis simulator for KfD to be used for investigating incidents and accidents in the Dutch Borssele power reactor.

One of the Information Notices of GRS in 2009 deals with results of the evaluation of the transformer fire at the Krümmel nuclear power plant.

For the ›Konrad Transport Study‹, GRS analyses and assesses the possible radiological consequences of transports of radioactive waste to the Konrad repository. The study concludes that the transports do not lead to any relevant risk to man and the environment, neither under normal conditions nor if one assumes an accident during shipment. GRS had performed a first Konrad Transport Study in 1991 already.

After more than 17 years, the GRS corporate design and logo get a new makeover. It is the fourth one in its history.

2010

The ›stuxnet‹ malware worries the general public and experts alike. GRS issues an Information Notice regarding this computer virus, which specifically targets industrial systems for process control, making specific recommendations for the protection of IT systems in nuclear installations in Germany.

In the field of disposal, several milestones are recorded in 2010. With VerSi, GRS concludes a project in which methods for a safety-analytical comparison of repository systems in different host rock types – in this case clay and rock salt – have been de-veloped for the first time.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(1) For the Dutch Borssele nuclear power plant, GRS has developed among other things an analysis simulator for incidents and accidents.
(2) MOSAIK® container for the interim storage and transport of medium-active waste with negligible heat generation, to be stored in the Konrad mine in the future.

GRS has contributed significantly to the preparation of the ›Safety Requirements for the Disposal of Heat-Generating Radioactive Waste‹, which are published by the Federal Environment Ministry. The ›Safety Requirements‹ are also applied in one of GRS's largest and most elaborate research projects, which starts this year: In the ›Preliminary Safety Analysis Gorleben‹, eight of the leading German institutions under the leadership of GRS will amongst other things develop prototypical storage and closure concepts for a repository for high-active waste by the year 2013 and identify the future research and development needs.

In the area of its non-nuclear activities, too, GRS has an eventful year in 2010: Together with the international IPEN network and the Czech environmental organisation ARNIKA, it publishes a study on the spreading of mercury-containing products in emerging and developing countries, thereby concluding a project funded by the Federal Environment Ministry.

As part of a research project sponsored by the Federal Research Ministry, GRS publishes the results of its ›Long-Term Safety Assessment of Underground CO2 Storage‹. It organises an international workshop in Braunschweig on the underground storage of hazardous chemical waste, attracting more than 100 experts from 15 countries.

On the fringe of the ETSON Summer School in Garching, the ETSON partners found the ETSON Association under French law. ETSON thereby becomes a legal entity.

The end of March sees the retirement of Scientific-Technical Director Lothar Hahn. Until the arrival of his designated successor Prof. Dr. Frank-Peter Weiß on 1 November, Heinz Liemersdorf becomes Acting Scientific-Technical Director of GRS.

View of part of the above-ground installations of the Gorleben exploratory mine. Between 1986 and 2000, the salt dome was explored underground for its possible suitability as a geological repository for high-active waste.

(1) Image of one of the tsunami waves, taken by a surveillance camera at the Fukushima Daiichi site.
(2) In the search for information on the situation inside the plant, the experts in the GRS Emergency Centre were supported by a Japanese translator.
(3) GRS Managing Director Prof. F.-P. Weiß being interviewed by a German news channel.

2011

On March 11, after a severe earthquake off the east coast of Japan and a subsequent tsunami, the most serious nuclear power plant accident since Chernobyl happens at the Fukushima Daiichi site. The reactor cores in three of the six power plant units melt down. Massive releases of radioactive substances lead to large-scale contamination of the surrounding area. Some 170,000 people are affected by evacuations.

After initial contact with Japanese colleagues about two hours after the start of the accident, the Emergency Centre of GRS starts work at around noon. In the first ten days, the emergency team is in operation around the clock. By the beginning of July, the experts have produced and published some 200 situation reports for the Federal Environment Ministry – initially on the GRS website and later on as part of a web portal set up especially for the accident. In addition to the technical challenge, enquiries made by the media, citizens and companies come in at an unprecedented level. In the first few days alone, around 250 press enquiries are dealt with and a large number of interviews are given. GRS achieves much acclaim for its professional work as well as for its commitment to the public communication of events.

The accident and its consequences also largely dominate the work in the following months and years. For example, in the very same year 2011, GRS supports the federal government and the Reactor Safety Commission in the so-called stress tests at national and EU level, analyses the causes and sequences of the accident in several research projects, and prepares an Information Notice with 22 recommendations to enhance safety in German nuclear power plants.

(1) Screenshot from one of the animated videos of GRS, explaining the various types of ionising radiation; by early 2017 this video had been viewed over 60,000 times on YouTube.
(2) On ›Türöffnertag‹, children are taking a stab at being junior scientists at the Repository Research Centre of GRS Braunschweig.

2012

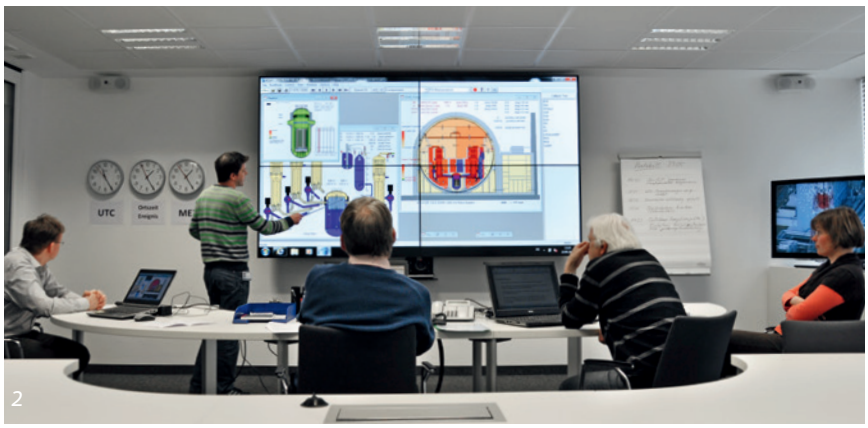
After almost 10 years, GRS successfully completes its work on the revision of the nuclear non-mandatory guidance instruments. The main committee of the Länder Committee for Nuclear Energy finally adopts the ›Safety Requirements for Nuclear Power Plants‹developed under the leadership of GRS on behalf of the Federal Environment Ministry; they are subsequently published in the Federal Law Gazette in 2013.

In the context of the factual survey in connection with the recovery of the waste from the Asse mine, the Federal Office for Radiation Protection commissions GRS as part of the EPROM project to analyse gaseous, solid and liquid samples from old em-placement chambers of the Asse mine. For this purpose, suitable sampling techniques must first be developed and tested. For the analysis of the samples, analysis methods are designed and co-ordinated between the geoscientific laboratory of GRS and other external special laboratories

The GeoSys project is the first of several projects getting underway in which GRS will intensively deal with electricity production in geothermal power plants over the coming years. Sponsored by the Federal Environment Ministry, GeoSys is first of all to analyse relevant ecological and technical aspects as well as the existing legal framework with the aim of identifying research needs and possible gaps in the regulations.

The Social Media activities of GRS are extended. Since 2011 already, it is present on the most important networks, such as Twitter and Facebook. In 2012, GRS starts producing videos and publishes them on YouTube and its own website. It is above all the short animated videos in which fundamental phenomena and technical terms are explained that prove popular over the next years: By the end of 2016, these videos have been viewed around 300,000 times.

In September, GRS Braunschweig participates in the so-called ›Türöffnertag‹ and invites children to its geoscientific laboratory. The door-opener is an initiative of German broadcaster WDR's children programme ›Die Sendung mit der Maus‹ and is intended to give children the opportunity to gain insights into companies and other areas of life.



2013

The new Emergency Centre of GRS is opened in Cologne. The concept of the new centre reflects the lessons learned from the emergency organisation of GRS during the accident at Fukushima. This includes the fact that the new centre does not only dispose of state-of-the-art communication technology and an uninterrupted power supply, with its own emergency power generator unit to be prepared for a grid failure, but also that it offers the necessary spatial infrastructure with about 300 square meters of space and a flexible layout of rooms to be able to cope with longer-lasting crisis situations. The optimisation of the emergency organisation of GRS as such is supplemented by the WINO project. Here, GRS – on behalf of the Federal Environment Ministry – is expanding its knowledge base on nuclear installations in Europe in order to further improve its ability to assess incidents and accidents abroad.

The kick-off meeting of the EU-sponsored CESAM project, which is managed by GRS, takes place In Cologne. The aim of this project is to improve the knowledge on emergency measures in the case of nuclear accidents. The focus of the work is on the further development of the simulation code ASTEC, which was jointly developed by IRSN and GRS, into a tool for rapid decision-making in emergencies. Participants in CESAM include a total of 18 institutions from 11 countries of the European Union as well as Switzerland and India.

The Federal Ministry of Education and Research commissions GRS to provide support to the project management relating to the decommissioning, dismantling and waste management of federal nuclear test facilities. The new task will be in addition to GRS's many years of work as project management agency in the area of reactor safety research.

In the field of repository safety, too, 2013 is again an eventful year for GRS. Together with the leading institutions dealing with final disposal research in Germany, it establishes the German Association for Repository Research (Deutsche Arbeitsgemeinschaft Endlagerforschung – DAEF). The aim of this Association is to contribute to the final disposal of radioactive waste and to make research more effective.

View into the antechamber (1) and the room of the emergency team leadership (2) in the new Emergency Centre of the GRS. The new Emergency Centre is equipped with an uninterrupted power supply with its own emergency power generator unit (shown in picture 3 during its installation in July 2013) as well as with a satellite-based communication system to ensure operability in the event of longer-lasting failures of the electricity supply grid.

Experts from GRS and other European project partners and their colleagues from eight African countries at the start of an EU-funded project to support the handling of CBRN substances

2014

The publication of a synthesis summary report concludes the ›Preliminary Safety Analysis Gorleben‹. Its results are made available to the public in 24 specialist volumes, totalling more than 5,000 pages and creating a reference for carrying out comprehensive safety analyses. Almost at the same time, GRS tackles the next major research project: ZIESEL, funded by the German Environment Ministry. The focus here is on the further development of methods for the investigation of radionuclide transport with water and gases in the geological subsoil – the so-called two-phase flow – and the testing of these methods, using data from the repository for radioactive waste at Morsleben (ERAM).

The non-nuclear activities of GRS see a thematic expansion. On behalf of the Federal Research Ministry, GRS becomes project leader in the NAWAK project, in which sustainable adaptation strategies for water management are to be developed by 2014 against the background of climatic and demographic change.

Co-operation with Chinese expert organisations is expanded. In a new project that starts in October, Chinese scientists are trained in the application of various simulation codes of GRS.

The international COSSAL benchmark project brings together organisations from Finland, Sweden, the Slovak Republic, Japan and Germany, performing calculations under the leadership of GRS relating to a large-scale experiment carried out by the materials testing institute at the University of Stuttgart.

Together with other international partners, GRS is awarded the contract for an EU project in which institutions and staff in various African countries are trained and made aware of the risks involved in dealing with hazardous chemical and biological waste.

The new ANEMONA project is the third project in which GRS deals with so-called deep geothermal energy. The aim of this project, which is financed by the Federal Ministry of Economics and Technology and is carried out by GRS together with power utility EnBW AG and the Geoscientific Centre of the University of Göttingen, is the development of a monitoring system for geothermal power plants.

GRS sells ISTec to TÜV Rheinland. All staff members of ISTec are taken over by the new owner.

Together with Fraunhofer IFF – here a view into the so-called ›Elbedom‹ with its 360° projection surface – DBE TEC and BGR, GRS has created VIRTUS, the first virtual underground laboratory worldwide.

2015

The development of a new calculation code for source term prediction is concluded. In the event of an accident in a nuclear power plant, this code allows the prediction of possible source terms practically at the push of a button and makes it possible to send the information very quickly via special forms to authorities or institutions such as the Federal Office for Radiation Protection. One option is e.g. to transmit the data directly to the RODOS decision aid system used by the Federal Office to make predictions.

Concluding a research project sponsored by the Federal Economics Ministry, GRS publishes the most comprehensive study so far on the concepts currently pursued internationally regarding the development of so-called Small Modular Reactors (SMR). Some of these reactor types are much smaller than customary nuclear power plants and are also based in part on reactor concepts other than the so-called light water reactors.

The federal government publishes the ›Interpretations of the Safety Requirements for Nuclear Power Plants‹, which were mainly developed by GRS.

Together with the Federal Institute for Geosciences and Natural Resources, DBE Technology GmbH and the Fraunhofer Institute for Factory Operation and Automation, GRS creates VIRTUS, the prototype of first virtual underground laboratory worldwide. With this code, which was developed for the Federal Economics Ministry, it is for the first time possible to visualise phenomena in 3D, like heat propagation in a repository. Besides serving for the further exploration of the processes and interactions taking place in a repository, the platform is also to contribute to the search for a repository as well as to a better understanding among the general public.

Taking effect on 1 January 2015, the form of company of GRS is changed to ›gemeinnützige Gesellschaft mit beschränkter Haftung‹, or in short: gGmbH, with the small ›g‹ reflecting the non-profit character of the company.

2016

The 30th anniversary of the Chernobyl accident gives rise to a large number of media enquiries to GRS. The same is true of the completion of the New Safe Confinement, the new protective cover which over a period of about two weeks at the end of the year is pushed over the old Sarcophagus that has enveloped the destroyed reactor for the past 30 years. GRS has been supporting the Ukrainian licensing authority for many years in the safety assessment of this structure and continues collaborating in many different projects dealing with the accident consequences and work at the site.

The portfolio of the simulation and analysis tools of GRS is extended by two further codes: Together with the Department of Nuclear Chemistry of the University of Cologne, GRS develops a software-based model that can be used to calculate the radiation exposure of the personnel during work on the primary system of a pressurised water reactor during maintenance or decommissioning. In another project, GRS develops a novel method for analysing the reliability of digital, software-based instrumentation and control systems in nuclear power plants.

GRS prepares an expert opinion for the Bundestag Commission on the Storage of High-Level Radioactive Waste on the disposal of radioactive waste in deep boreholes. On this topic, GRS also publishes a study entitled ›Deep boreholes‹ in February. In May, GRS prepares a further report for the Commission on the temperature compatibility of the host rock types salt, clay and crystalline.

In the ANEMONA project, experts develop a monitoring system which, among other things, allows for the first time the measuring of the naturally occurring radioactive noble gas radon-222 in the thermal water pumped up in geothermal power plants from several thousand meters below. This system, which is installed in a southern German geothermal power plant, is also unique because such radon measurements have so far not been able to produce reliable results under pressures above around 20 bar and temperatures above about 120 degrees Celsius.

As from May, the first GRS app is available for download from app stores. Anyone interested in using ›GRS Info‹ can access information about and from GRS. A further two apps are to follow in 2017.

In July, Uwe Stoll becomes the new Scientific-Technical Director of GRS. He succeeds Prof. Dr. Frank-Peter Weiß, who retired from GRS in 2015 after six years.

(1) Almost exactly 30 years after the erection of the ›Sarcophagus‹, the ›New Safe Confinement‹ was shifted into its final position in November 2016.
(2) ANEMONA project: GRS experts Sebastian Feige (left) and Henrich Meyering (right) in front of the first monitoring system for radon, installed in a southern German geothermal power plant.

LOOKING AHEAD

When we look at GRS today, we see in the truest sense a mature and robust organization, one that brings with it all that is necessary for a successful future. This includes a motivated team, by which the expertise of experienced colleagues is combined with the ideas, knowledge and enthusiasm of younger colleagues. In addition to that, GRS has acquired over the last 40 years an outstanding reputation. This not only holds true for the consistent, positive feedback we receive from our customers in Germany and overseas but also for our position as an esteemed member of the international scientific community. We are therefore convinced that GRS can and will play a continually important role in the years and decades to come.

This applies in particular to our traditional areas of work, namely nuclear safety and radiation protection. Herein lies one of our most important tasks, which is to maintain and develop our competencies over the long-term in order to achieve a higher level in nuclear safety worldwide. To this end GRS will continue to collaborate on the development of international guidelines as well as to provide technical-scientific support to foreign supervisory and licensing authorities. Especially in recent years the demand for GRS's expertise by overseas authorities has grown. Furthermore, GRS will continue to provide specialist support to the German Federal Government in the case of nuclear emergencies via the GRS Emergency Centre.

We also see a continued and growing demand for GRS's competencies with regards to nuclear waste management. The organisation's expertise and combination of research and assessment makes GRS one of the leading international institutions in this field today. With that in mind, we see GRS continuing to play a significant role in the search process for a final repository which has just started in Germany. With specific regard to research and the development of methods to assess and verify long-term safety, and for the comparison of various sites in differing host rock, GRS has already laid down important foundations. These will and can be built upon over time.

Last but definitely not least we also see GRS expanding into other, new subject areas. We have already, as one example, made significant contributions towards the safety of the underground disposal of toxic-chemical wastes and the safe and economically viable use of deep geothermal energy for electricity generation. In addition to that, we are working on the development of new projects in areas such as civil security and environmental protection. In the coming years, we will considerably expand our scientific efforts in such areas. This growth and movement is an integral part of our mission at GRS: to strive for progress in science and technology in order to contribute to the protection of humankind and the environment.

Yours, Uwe Stoll and Hans J. Steinhauer

40 YEARS IN NUMBERS

In 40 years ...

... 3.330 diverse staff members from 25 countries have worked for GRS.

... technical specialists at GRS have worked on over 4.300 projects and have produced roughly the same amount of reports.

... Via 439 GRS ›Information Notices‹ authorities, experts and operators have been informed of findings derived from the analyses of events as well as been provided with safety recommendations.

... GRS simulation programmes have been made available to 282 institutions in 39 countries.

... authorities and specialist organisations in 24 countries have established scientific cooperation with GRS.

... the GRS videos on YouTube have been viewed over 300.000 times.

... GRS has operated with 4 logos.

... around 3.210.000 times, net users visited the online Fukushima Information Portal set up by GRS.

global research for safety

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