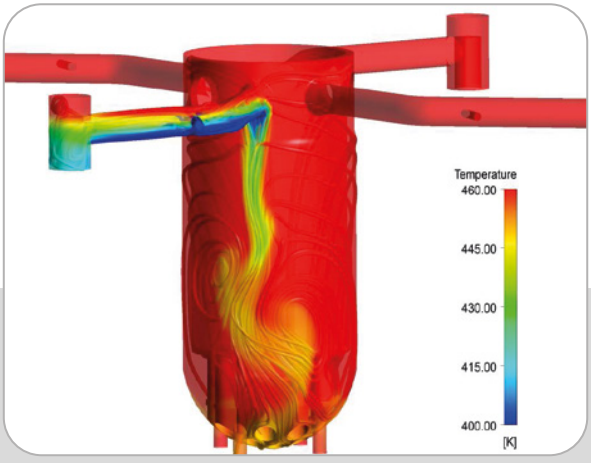
profile 2022



global research for safety

Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) gGmbH is a non-profit and independent research and expert organisation. The focus of our work is on nuclear safety – in this field, GRS has been Germany's leading expert organisation since 1977. Furthermore, we are increasingly engaged in issues relating to the safety of conventional plants and technologies.

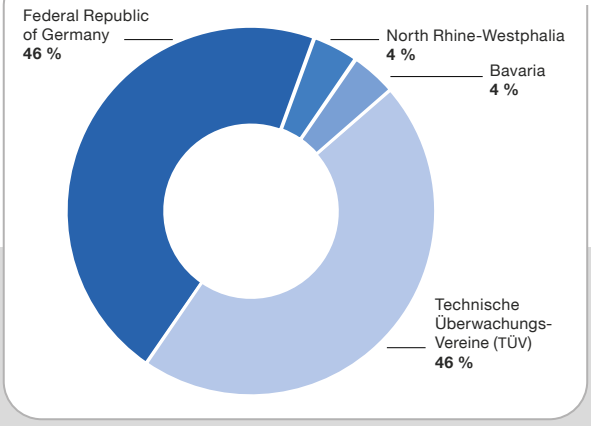
Common public interest. Our aim is to enhance the protection of man and the environment against the hazards involved in nuclear and conventional installations. Most of our work is funded by way of public-sector-financed research projects and expert opinions. Our main customers in Germany are the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV), the Federal Ministry for Economic Affairs and Climate Action (BMWK), the Federal Ministry of Education and Research (BMBF), the Federal Foreign Office (AA), and the Federal Office for Radiation Protection (BfS). Our main international customer is the European Commission. Being a non-profit organisation with its shareholders coming mostly from the public sector, our work is guided by the common public interest.

Interdisciplinary. This is the objective of the about 400 staff of GRS, among them about 350 experts from disciplines such as physics, engineering, geology, chemistry, meteorology, biology, computer science, mathematics, and jurisprudence. Our special strength is the consistent linkage of research and development with the work as authorised experts.

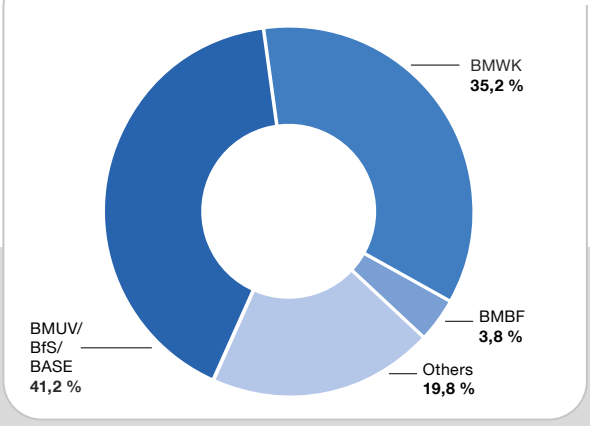
Global. In both areas, we are active on a worldwide stage – in international research projects, within the framework of bilateral co-operation projects and networks with foreign expert organisations or commissioned by foreign authorities. We contribute our know-how to continue developing the international state of the art in science and technology and to promote safety.

GRS works according to high quality standards. It is certified according to DIN ISO 9001:2015 and ISO/IEC 27001:2013.

Shareholders of GRS



Customers (turnover in 2021: 50,22m)



Locations

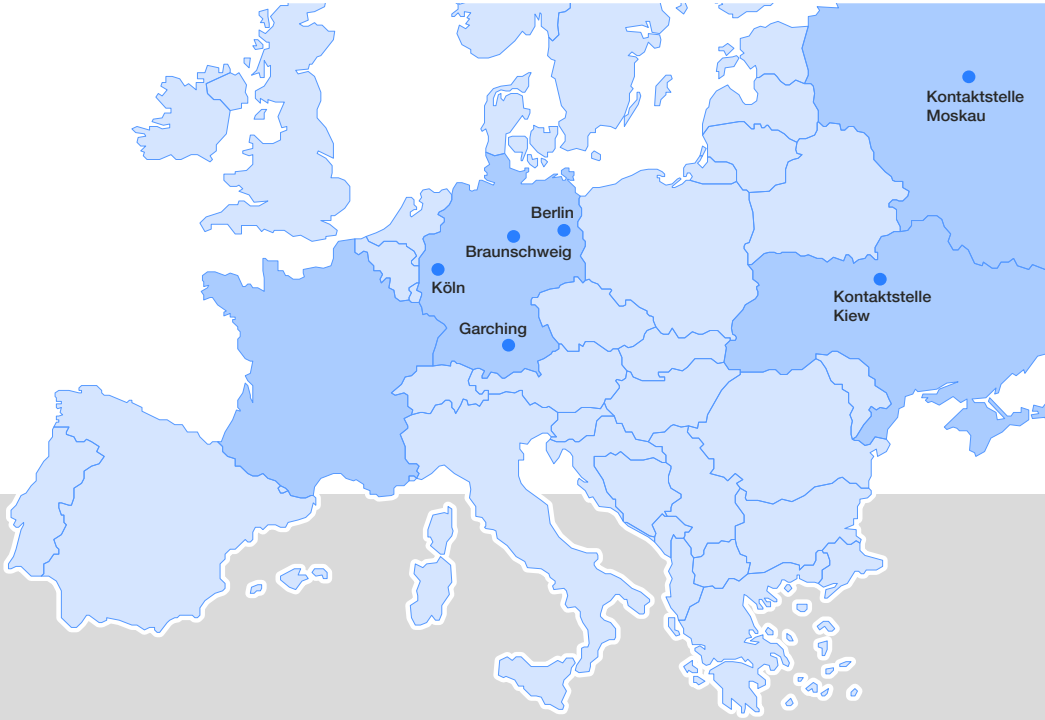
GRS has locations in Cologne, Garching, Braunschweig and Berlin.

Cologne. The Cologne offices are the headquarters of GRS. Our team in Cologne deals with the safety and the physical protection of nuclear installations, their decommissioning and with issues of radiation protection. Furthermore, Cologne is also home to the Project Management Agency, Project Management and Central Services Divisions. The Emergency Centre of GRS is also housed here. As part of the Radiological Situation Centre of the Federal Government, GRS experts provide support from here to the Federal Environment Ministry and other authorities in the event of a nuclear accident.

Berlin. The main focus of the tasks at the Berlin location of GRS is on international projects - especially in Central and Eastern Europe. Our experts work closely together with foreign nuclear authorities and their expert organisations.

Braunschweig. GRS's Repository Research Centre is located at Braunschweig. It is from here that the Disposal Division is managed. At Braunschweig, our researchers carry out application-oriented basic research and development required for the safe disposal of radioactive and hazardous chemical waste. In the geoscientific laboratory of GRS that is located on the premises, research is conducted on geochemical and geotechnical issues that arise in connection with the disposal of such waste.

Garching. Our Garching offices are located on the research campus of the Technical University of Munich in the immediate vicinity of the FRM II research reactor. The Safety Research Division is managed from Garching. Among other things, the scientists here develop simulation codes that can be used to calculate events and accidents in nuclear power plants. Garching is also home to GRS's ATLAS analysis simulator, which is used for this purpose.



In the field of reactor safety, we contribute by our research to the further development of the state of the art in science and technology. As authorised experts advising the federal authorities, we support the Federal Government in all issues related to nuclear safety.

Research and development

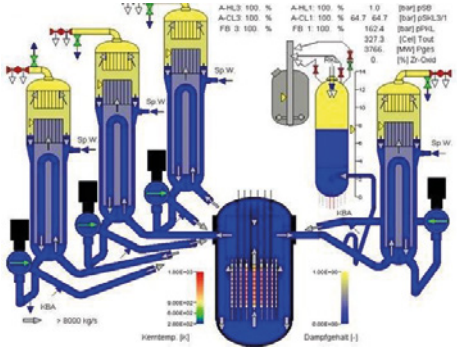
The focus of our research in the area of reactor safety is on the **development and validation of simulation codes.** With the help of these computer codes, it is possible to analyse the behaviour of a nuclear power plant (NPP) or individual components under the most varied conditions, from normal specified operation up to severe accidents.

The computer codes of GRS cover all relevant phenomena of reactor physics, thermal hydraulics and core destruction as well as structure mechanics. They allow the simulation of all essential safety-relevant processes, from the behaviour of the reactor core up to the effects of mechanical impacts on plant components and building structures. With the AC² code system, which is made up of the GRS codes ATHLET/ATHLET-CD and COCOSYS, it is for example possible to simulate essential phenomena of scenarios involving core destruction – starting from the initiating event and continuing with the failure of the reactor pressure vessel and the discharge of melt into the containment up to a release of radionuclides into the environment. Further information about the codes of GRS can be found in our brochure *"Scientific Codes Developed and Used at GRS – Reactor Safety".*

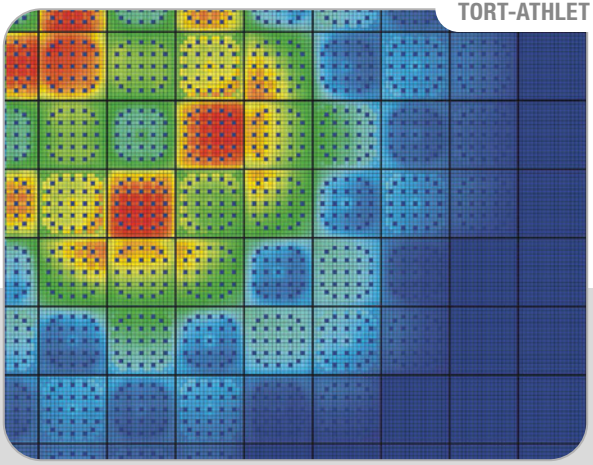
The simulation codes are applied in practice in connection with our work as authorised experts, e. g. in our expert support of authorities in licensing and supervisory procedures. Furthermore, more than 50 expert organisations and authorities worldwide use the simulation tools of GRS in their work.

A further focus of the work of GRS in the area of reactor safety is the further development of methods for **probabilistic safety analyses (PSA)** and their application. The fundamental PSA methodology was established in Germany by GRS at the end of the 1970s; today, PSAs have to be presented by the NPP operators as part of the periodic safety reviews that have to be performed every 10 years. Based on the determination of the probabilities of a large number of possible individual events – e. g. the loss of the electrical power supply – the PSA allows an integrated view of the safety of a plant. For instance, it can be used to identify components or

ASTEC



TORT-ATHLET



scenarios that contribute to a relatively large extent to the overall risk of the plant and which should therefore be the priority subject of safety-related improvements.

Expert work and consultation

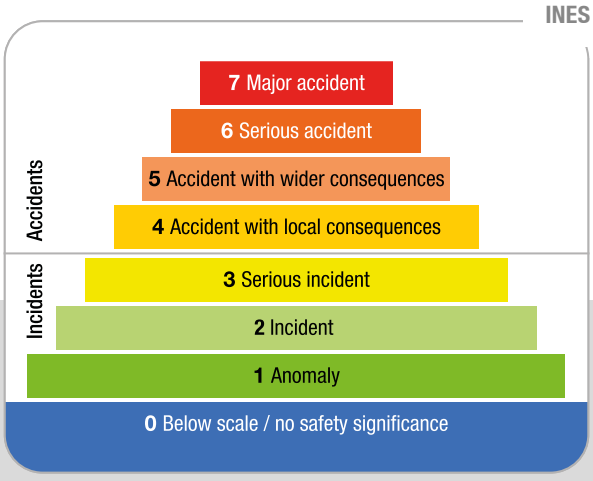
With our work as authorised experts, we assist and advise the German Federal Government (BMUV, BfS) and – above all in the area of physical protection – the nuclear regulatory authorities of the Länder.

One essential task is the **evaluation of operating experience** in NPPs at home and abroad. If the analysis of an event yields new insights that might potentially also apply to other NPPs, then GRS will prepare an Information Notice with recommendations for safety-enhancing measures for German NPPs.

Giving scientific advice to authorities in Germany and abroad also involves the **analysis of generic issues** as well as the technical support of the BMUV by providing **expert opinions in federal supervisory procedures**. The insights gained from the above-mentioned tasks eventually also form one of the bases for the further development of the nuclear regulations. At international level, we are engaged on behalf of the Federal Government in technical committees of international organisations such as the International Atomic Energy Agency (IAEA) and the Organisation for Economic Co-operation and Development (OECD) – for instance in the drafting of the contents of safety standards that are consulted worldwide as a reference for national regulations. On behalf of the BMUV, GRS also provides the so-called **"INES Officer"** for Germany, who, among other things, is in charge of reviewing the provisional event classifications that have to be submitted by the operators and are made according to the internationally applied scale of nuclear and radiological events (INES).

Emergency centre

A further task of GRS in connection with emergency preparedness is the technical and expert support of the BMUV's emergency organisation in the case of an event or accident in a German or foreign nuclear installation. For this purpose, GRS operates its own emergency centre. If required, a team of experts of different disciplines such as systems engineering, thermal hydraulics, radiation protection etc. will be ready for action to gather and assess information on the situation. For example, when the Fukushima accident happened, the crisis team of GRS prepared more than 200 situation reports to keep the Federal Government up to date and also informed the public at large.



GRS emergency centre

In the field of radioactive waste management, the competences of GRS cover the entire waste management path. The focus of our work in this area is on disposal. Here, we are active on two levels: on the one hand in repository safety research and on the other hand in providing expert advice to authorities.

Research and development

At its **Repository Research Centre**, GRS carries out comprehensive research and development that covers all essential scientific aspects of the disposal of radioactive waste.

This begins with the research of the physical and chemical **properties of different types of host rock,** such as salt or clay, that are fundamental in connection with the safety of disposal. In view of the disposal of high-active waste, this is e. g. about the behaviour of host rock types under the impact of heat. Part of this research is carried out at the Geosciences Laboratory at our Braunschweig location, which has been accredited as a test laboratory for the sampling and selected chemical analysis of aqueous saline solutions. Furthermore, GRS scientists also take part in "in situ" experiments in so-called **underground laboratories** as part of co-operation projects with partners in France, Sweden and Switzerland. The subject of this research is i. a. the understanding of the interaction of the so-called geotechnical barriers with the surrounding rock.

The findings obtained from these activities are a major prerequisite for understanding the complex **geochemical and geophysical processes** developing in a repository. As the leading organisation in this field, GRS develops software and databases with which such processes can be modelled in simulations over very long periods of time.

In order to visualise the results of such simulations in the form of three-dimensional animations and thereby make them easier to grasp and comprehend for laypeople and experts alike, GRS is furthermore developing the **VIRTUS** code together with other partners. Being the first "virtual underground laboratory" worldwide, VIRTUS will be able – on the basis of real geological data – to model repositories and their evolution under the most varied conditions over hundreds of thousands of years.

Repository Research Centre

Geoscientific laboratory of GRS

A further focus is on the work is related to what is known as the **long-term safety case.** Before a repository gets permission to be built, it has to be demonstrated in an official procedure that over a period of one million years, the radionuclides contained in the waste will not or only in insignificantly low amounts be released from a defined area around the repository – the so-called “containment-providing rock zone” – within the host rock. GRS develops computer codes and methods for the preparation or assessment of such verifications. This includes e. g. the identification and description of possible influences, such as ice ages or the failure of geotechnical barriers.

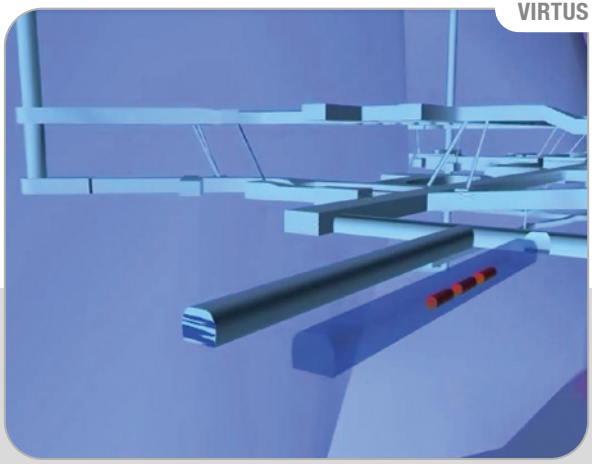
Finally, our research and development also extends to scientific issues in connection with the **search for a repository site.** Here, GRS has developed methods for the comparison of repository concepts for sites in different host rock types.

Our tasks as authorised experts

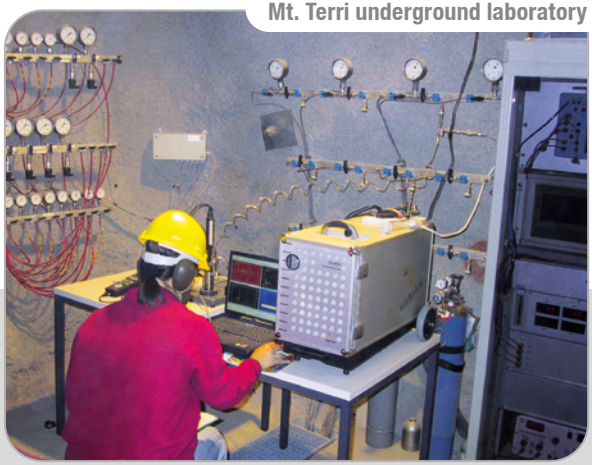
Our long-standing experience and the results of our research and development activities influence our work as authorised experts. For example, GRS is consulted by federal and Länder authorities whenever an expert opinion needs to be given on scientific-technical issues within the framework of licensing or supervision. An example are the current activities in connection with the decommissioning of the Asse mine: here, GRS is developing a system with which gaseous, solid and liquid samples can be taken from emplacement chambers of the Asse and analysed.

We additionally support the BMUV in the preparation of regulatory fundamentals with regard to safety requirements and guidelines as well as in the development of assessment criteria. This is done at national level and also on technical committees of international organisations, such as the IAEA.

VIRTUS



Mt. Terri underground laboratory



We have been competent in the field of radiation protection for more than 40 years. The objective of our work is the protection of the population and the personnel from ionising radiation. This comprises the performance of safety analyses, the preparation of expert opinions for federal and Länder authorities, and research and development.

Applied radiation protection

At the centre of applied radiation protection is the registration and assessment of the radiation exposure of occupationally exposed personnel and the optimisation of measures for its protection. This personnel includes not only nuclear power plant workers but also medical practitioners and pilots. This classical field of radiation protection is closely linked with many different questions of radiation protection technology, such as dosimetry.

Decommissioning of nuclear installations

After their operational lifetimes, nuclear installations have to be decommissioned. During dismantling, aspects of radiation protection have to be considered so that the decommissioning process can develop in a way that leaves man and the environment unharmed. Hence our work in this specialist field comprises amongst other things questions relating to the radiation exposure of the personnel as well as to waste management and the clearance of radioactive materials, i.e. their release from the scope of the Atomic Energy Act. You can find out more about the topic in our brochure “Decommissioning of Nuclear Installations”.

Emergency preparedness

The specialist area of emergency preparedness comprises the emergency preparedness in the area outside nuclear installations to protect the population. This concerns measures by the authorities, the interfaces between plant-internal accident management and external emergency protection as well as special aspects of defence against nuclear hazards, which means protection against so-called nuclear crimes. As regards emergency preparedness, for example, GRS supports the BMUV amongst other things in the planning, execution and evaluation of realistic exercises.

Local dose rate measurment

Decommissioning

Transport safety analyses

Safety analyses of the transport of spent fuel assemblies and other radioactive materials as well as of medical drugs and other commodities containing radioactive materials are another important specialist field of GRS. In our “Transport Study Konrad 2009”, we analysed and assessed the possible radiological effects of radioactive waste shipments to the Konrad repository. As part of studies commissioned by the BMUV, we provide regular information about the radiological effects that CASTOR transports to central interim storage facilities have on the population and on the transport and accompanying personnel.

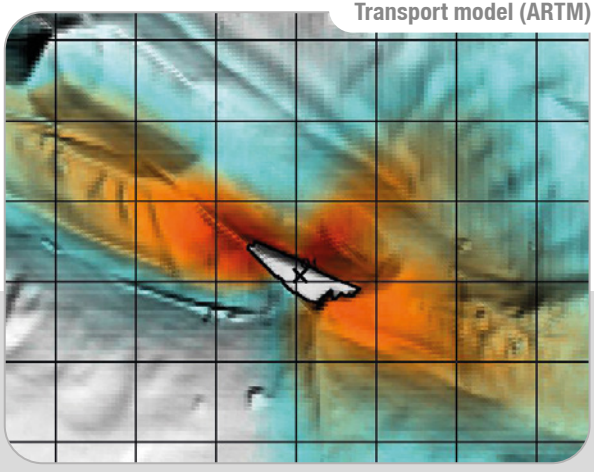
Radiological consequence analysis

Radiological consequence analyses of normal operation as well as of events and accidents in nuclear installations or in connection with the handling of radioactive materials are a further field of work of GRS. This is about the identification and analysis of possible scenarios in which radioactive materials are released into the environment. After determining in a first step the conditions of the release – for example the kind and amount of the radioactive materials released – the dispersion of these materials in the atmosphere is then calculated with the help of computer models. Here, simulation codes are employed that also take complex meteorological and topographical conditions into account. One example is the Atmospheric Radionuclide Transport Model (ARTM) that was co-developed by GRS.

Radioecology

Radiological consequence analyses in turn provide important basic data for the specialist field of radioecology. Here, the potential radiation exposure of the population is calculated by means of modelling the behaviour of the radioactive materials in the environment. The radioecological studies of GRS also deal with the assessment of radioactive legacies and so-called NORM residues (NORM: naturally occurring radioactive material).

CASTOR® cask



Transport model (ARTM)

GRS deals with non-nuclear topics in areas such as environmental protection, geothermal energy, energy storage, and network infrastructure. Here, the researchers apply their knowledge and experience from classic GRS fields such as plant safety, radiation and environmental protection, and repository safety research.

Deep geothermal energy. One focus of GRS's work in the field of geothermal energy is research to further the availability and safety of geothermal plants. For example, within the scope of the interdisciplinary system analysis in the GeoSys project, GRS investigated plant conditions and their possible effects on objects of protection in the environment. The aim of the GeoDat project was to create a thermodynamic database that could be used to calculate complex geochemical processes in deep geothermal strata.

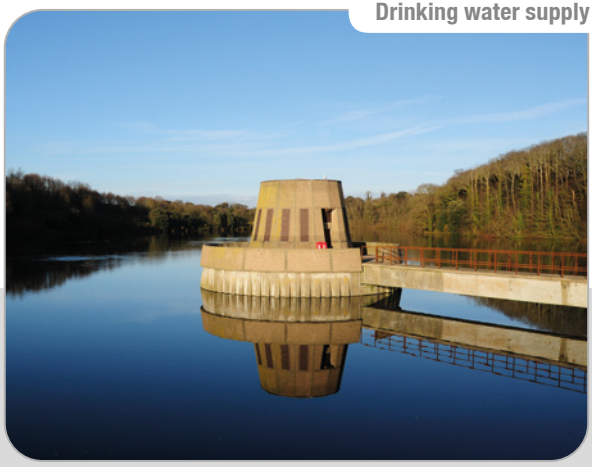
The ANEMONA joint project focused on the aspects of environmental protection, occupational health and safety, and economic efficiency. Among other things, new technologies for monitoring geothermal power plants were developed and tested.

Power-to-gas. In the PORTAL GREEN joint project, GRS – together with partners from research, industry and representatives of associations – is developing a guideline on the technical and licensing requirements for the construction and operation of power-to-gas plants and adjacent branches of use. With this technology, excess green electricity is converted by electrolysis into hydrogen gas or methane in an electrochemical process. Both can be fed into the natural gas grid and stored there.

Drinking water supply. The NAWAK project, coordinated by GRS on behalf of the BMBF, dealt with future challenges of water management. Together with water utilities as well as representatives from research organisations and authorities, sustainable adaptation strategies for the infrastructures
of water management were developed, taking into account climatic and demographic change.

Network infrastructures. GRS researchers are working in several fields on the safety and reliability of network infrastructures.

Geothermal plant



Drinking water supply

For example, experts in electrical engineering and instrumentation and control have investigated the effects of grid and power outages on nuclear power plants. Our colleagues were able to apply their knowledge in the field of structural mechanics in a project to test pipeline systems for natural gas. In order to facilitate pipeline maintenance, GRS has developed a probabilistic methodology for registering and assessing pipelines. However, not only the supply of electricity and natural gas but also the availability of drinking water must be ensured. Scientists at GRS have therefore looked at the extent to which the findings from the studies relating to so-called leak-before-break detection in nuclear engineering may be applied to the maintenance of the drinking water network.

CBRNInitiative. In many African countries, supposed everyday activities, such as the excessive use of pesticides, take place under conditions that are harmful to the environment and human health. In order to raise awareness among institutions and specialists and provide training in the handling of such waste, the EU initiative “Centres of Excellence” launched the “Management of Hazardous Chemical and Biological Waste in the African Atlantic Facade Region” project. Besides eight African partner countries, GRS (for Germany), Spain and Italy were involved. GRS’s task was to register the waste deposits and quantities of each country locally.

Hazardous chemical waste. When investigating the safety of the storage of hazardous chemical waste in underground waste disposal sites, a wide range of influencing factors must be taken into account. In addition to the waste composition, possible geochemical and geotechnical processes also play a role, as does the effectiveness of technical and geotechnical barriers. Based on its decades of experience in repository safety research and in particular in the long-term safety analysis of repositories for radioactive waste, GRS has made a variety of contributions.

Network infrastructures

Underground disposal

The constant enhancement of the protection of man and the environment against the possible hazards involved in nuclear and conventional technologies is a global challenge. This is why for more than two decades we have continuously been expanding our international commitment – in transnational networks, co-operation with foreign partners, and international projects.

Networks and initiatives

ETSON. In 2006, GRS, IRSN and the Belgian TSO Bel V founded the **European Technical Safety Organisations Network (ETSON)**. TSOs from Belgium, Germany, Finland, France, Great Britain, Lithuania, Italy, Romania, Switzerland, Slovakia, Slovenia, the Czech Republic and Hungary have joined forces in the network.
Regarding technical exchange, the objective of ETSON is above all the harmonisation of safety assessment methods, but the network furthermore promotes the co-operation of its members in dedicated international projects.

ETSON | EUROPEAN TECHNICAL SAFETY ORGANISATIONS NETWORK

To share and exchange on the activities of ETSON as well as of its members with other stakeholders, the network organises the annual EUROSAFE conference. The organisation on behalf of the network is currently provided by Bel V (Belgium), GRS (Germany) and IRSN (France) which host the event alternately in their respective countries.

EUROSAFE | PROMOTING NUCLEAR SAFETY IN EUROPE

Bilateral co-operation

Cross-border co-operation has long been self-evident in research. Thus, our experts also collaborate on a regular basis with experts from foreign institutions within the framework of international ranges projects. Furthermore, since the beginning of the 1990s, GRS has concluded bilateral co-operation agreements with a considerable number of expert organisations in America, Asia and Europe.
This co-operation reaches from regular technical exchanges and joint research and development to consultation on concrete scientific-technical issues.

EUROSAFE

International projects and research projects

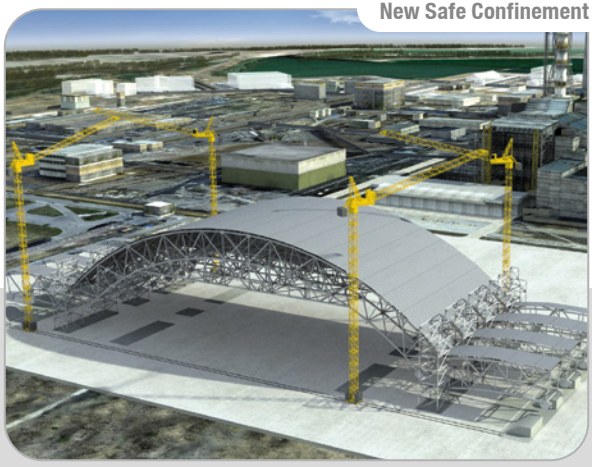
Around one third of our turnover stems from international projects. These are on the one hand projects that are financed from German government funds. Here, since the early 1990s, one of the emphases has been on projects to enhance nuclear safety in Central and Eastern Europe. In these projects, we support foreign regulatory authorities by providing advisory assistance, by know-how transfer or by dealing with specific problems as experts in the respective fields.

Apart from that, we also take part in numerous projects within the framework of international programmes and projects that are financed by the EU and international institutions, such as the European Bank for Reconstruction and Development (EBRD).

Exemplary for this commitment are our diverse activities in connection with the management of the consequences of the Chernobyl accident, which is financed by the Federal Government as well as by the EBRD. For example, together with Ukrainian scientists, GRS experts are developing the “Shelter Safety Status Database” for Chernobyl in which systematic data on radiological exposure and contamination at the site are registered. In another project, we supported the Ukrainian authority in the safety-related assessment of the “New Safe Confinement” (NSC), which has been enclosing the accident reactor and the Sarcophagus since November 2016.

Finally, we also work directly for foreign authorities. As an example, in the Netherlands, GRS fulfils the functions of a TSO for the Dutch economics ministry and the Kernfysischer Dienst (KFD), supporting them i. a. in the safety-related assessment of the Borssele nuclear power plant as well as in the drafting of safety requirements for nuclear power plants and research reactors. The British Office for Nuclear Regulation (ONR), too, draws on the expertise of GRS when it comes to the assessment of new reactor concepts.

New Safe Confinement



Borssele NPP

Law

The application and further development of legal regulations in the area of environmental protection raise complex questions from time to time that require interdisciplinary knowledge for an answer – knowledge of the underlying technical and scientific facts as well as of the relevant legal aspects. In the specialist **field of Technology and Law,** GRS therefore employs a team of fully-trained legal experts and lawyers that deal primarily with questions of environmental law.

In dedicated legal projects for our shareholders, but also in supplement to our technical projects, the team work on issues of national and international law. The main legal areas concerned reach from general immission control, soil protection and water law as well as waste, chemical and mining law up to atomic and radiation protection law. Apart from classical environmental law, aspects of planning and constitutional law also play an important role in many projects, as e. g. in connection with environmental impact assessments.

Project management agency

As Project Management Agency GRS (PT GRS), we assist German authorities in devising and implementing funding measures as well as in the management of projects in the fields of nuclear safety, decommissioning, and waste management.

The focus of our tasks is on the technical and administrative implementation of sponsorship programmes, including the fiduciary administration of federal funds within the framework of so-called project sponsorships. For example, we implement the reactor safety research programme for the BMWK. In addition, PT GRS is responsible for the implementation of the research and development area “Effects of extended interim storage periods on waste and containers”. In addition to project management, GRS also carries out independent controlling for the BMBF on technical and financial aspects of the decommissioning of state-owned nuclear test facilities.

On behalf of the BMWK, GRS also co-ordinates the Federal Government’s National Contact Points (NCPs) for the EURATOM Horizon 2020 programme and acts itself as NCP for the Nuclear Technology and Reactor Safety Division. In the various steering committees of the OECD’s Nuclear Energy Agency, GRS represents German interests in multilateral research projects.

GRS Organigram

General Management			
U. Stoll		H. J. Steinhauer	
Press Officer S. Dokter	**CSR / QM** C. Vieten	**International Relations** C. Eibl-Schwäger	**Internal Auditing** N. Frais

Project Management Agency Dr. K. Stummeyer	**Safety Research** Dr. A. Schaffrath	**Geological Disposal** Dr. J. Mönig	**Project Management** Dr. S. Kus	**Plant Safety** Dr. M. Kund	**Decommissioning and Waste Management** H. Thielen	**Central Services** V. Watermeyer
	Containment S. Beck	**Site Selection** Dr. J. Flügge	**National Project Management** Dr. F. Jansen	**Reactor Safety** Dr. F. Michel	**Decommissioning and Storage** Dr. F.-N. Sentuc	**Finance** V. Watermeyer (act.)
	Cooling Circuit Dr. A. Wielenberg	**Repository Research** Dr. O. Czaikowski	**International Project Management** J. Walter	**Plant Operation** Dr. B. Becker	**Radiation and Environmental Protection** Dr. T. Stahl	**Human Resources** Dr. H. Johann
	Nuclear Fuel Dr. R. Kilger	**Repository Safety** Dr. J. Wolf	**Law and Compliance** Dr. S. Kus (act.)	**Electrical and I&C Systems** Dr. D. Sommer	**Security** Dr. M. Pelzer	**Communication** S. Dokter
			International Projects S. Stransky	**Safety Analyses** Dr. A. Kerner		**IT** E. Kardes

GRS *As at: April 2022*

Executive bodies

– Shareholders' meeting — Chair: Parliamentary State Secretary Christian Kühn
– Supervisory board (11 members) — Deputy chair: Dr. Astrid Petersen

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April 2022