

GRS Experience in Supporting Embarking Countries at NPP Construction Stage

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Introduction to GRS – Overview

- Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) gGmbH is a non-profit, non-governmental, impartial and independent research and expert organization
- We have been Germany's leading expert organization in reactor safety, radiation and environmental protection and nuclear waste management since 1977
- We are the central Technical Support Organization (TSO) in nuclear safety for the German Federal Government
- Our special strength is the consistent linkage of research and development with safety assessments by authorized experts



Introduction to GRS – Overview

- **About 320 technical-scientific** experts work at 4 locations with expertise in engineering, physics, chemistry, geology, hydrology, meteorology, etc.
- GRS technical staff is well mixed in terms of age and nuclear experience
- Expertise about the whole fuel cycle and lifetime of nuclear installations



Training for new staff

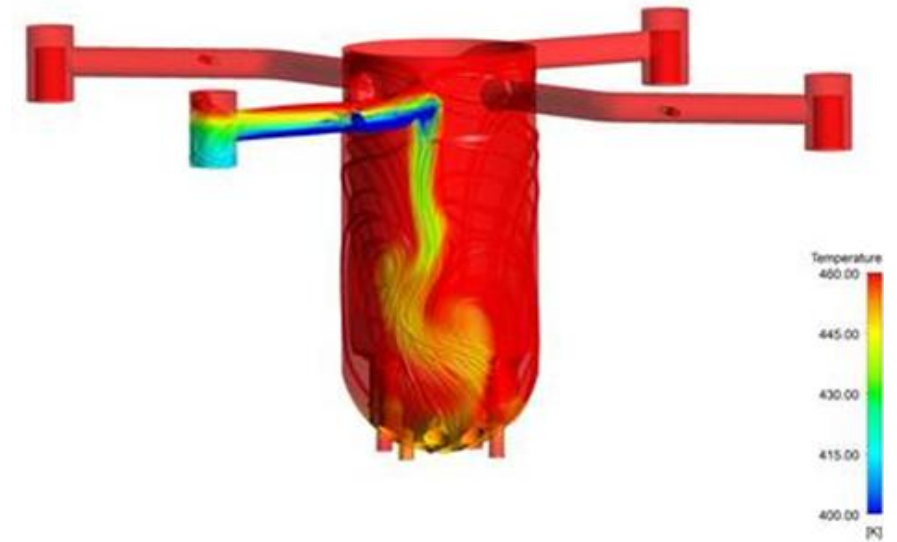


GRS offices in Germany
(Cologne, Garching, Berlin and Brunswick)

Work as a Technical Support Organisation

Tasks as an Expert Organization

- Support of the federal ministries on all questions of nuclear safety
- Operation of the emergency center
- Development of assessment methods
- Further development of the nuclear safety regulation
- Support of international cooperation and participation in expert groups



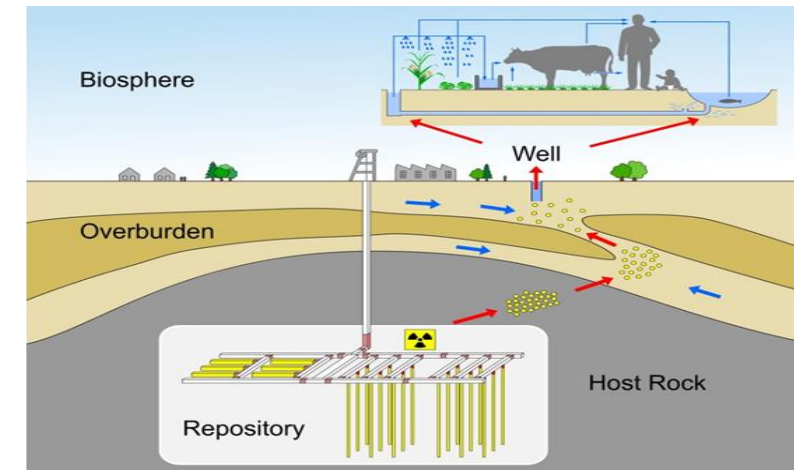
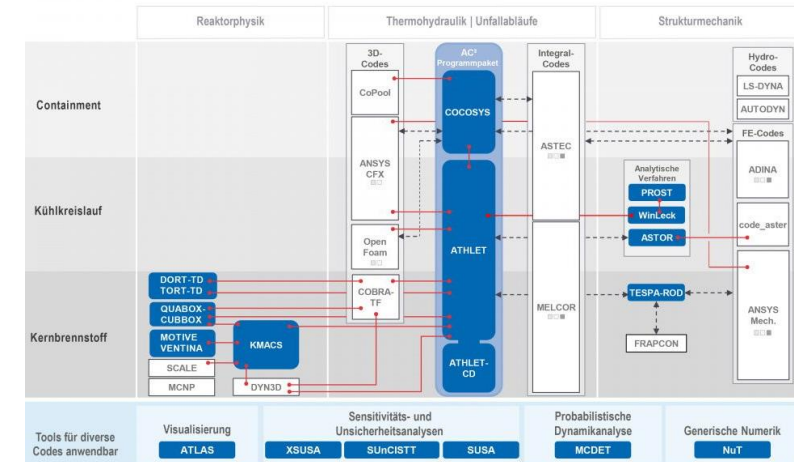
Tasks as a Research Organization

Plant safety

- Providing independent and state-of-the-art analysis tools for safety assessments (Thermohydraulic / Neutron transport / Structural integrity / Fission product behaviour / Nuclide inventory etc.)
- Enhancing simulation codes specifically for advanced reactor technologies
- Development of probabilistic assessment tools and plant simulators
- Development of tools for uncertainty and sensitivity analyses

Repository Safety

- Radionuclide transport modelling in repositories
- In-situ investigations / laboratory experiments
- Modelling of THMC processes in repositories
- Safety case issues



Repository safety: Exposure pathways

Capacity Building through GRS - Basic Facts

- Long history of contributing to capacity building in nuclear safety in:
 - Latin-America, Central and Eastern Europe, Southeast Asia, Middle East
 - Some of these activities started as early as 1980^s (Brazil)
- Beneficiary: Nuclear Regulatory Authorities and their TSOs
- Based on the GRS' expertise on German designed NNP's and German licensing procedure
- After 1990 GRS' expertise on VVER presents a significant contributor to capacity building
 - Russian speaking experts with degree in VVER reactor technology
 - Extensive collaborations with regulators of VVER and their TSOs
 - Web-based documentation system for VVER related knowledge

Capacity building aims at **improving technical and managerial competences** of nuclear safety authorities and their TSOs

Capacity Building through GRS - Basic Facts

Four pillars of capacity building:

1) Projects of the European Commission

- 1990 - 2006: PHARE programme (Poland Hungary Aid for Reconstruction of the Economy, Central and East Europe)
- 1991 - 2006: TACIS programme (Technical Assistance to the Commonwealth of Independent States)
- since 2007: INSC programme (Instrument for Nuclear Safety Cooperation, no region limitations)

2) Bilateral projects

- Capacity building often in addition to regular contract work

3) IAEA projects

- e.g. through fellowship programme

4) EBRD projects (European Bank for Reconstruction and Development)

- Assistance to Regulatory Authorities (e.g. Bulgaria, Ukraine)

Capacity Building through GRS - Examples from 20+ Years

Central and Eastern European countries: Czech Republic, Slovakia, Poland, Hungary, Lithuania, Slovenia, Romania, Bulgaria

Projects: PHARE, EBRD

Selection of training / support topics:

- Development of a system to prevent uncontrolled dispersion of radioactive sources
- Radiation protection, radioactive waste management
- Decommissioning
- Assessment and Validation of computer codes
- Review of legal framework
- Organisation of the Nuclear Safety Authority
- Inspection and assessment practices
- Procurement of measuring instruments
- Ageing management
- Licensing aspects of modern I&C equipment
- Development of internal procedures to review safety documents
- On-site inspector training on NPP maintenance, repair and modification
- Emergency preparedness



Temelin NPP. Czech Republic

Capacity Building through GRS - Examples from 20+ Years

Eastern European countries: Russian Federation, Ukraine, Armenia, Belarus

Projects: TACIS, INSC, EBRD, bilateral

Selection of training / support topics:

- Safety assessment of modernisation programmes of NPPs with VVER reactors
- Development and harmonization of safety requirements
- Decommissioning activities
- Licensing procedures
- Review of Safety Analysis Reports
- Review of Severe Accident Management Guidelines
- Review of Probabilistic Safety Assessments
- Radioactive waste management
- Development of quality management systems
- Leak before break approach / concept
- Improvement of I&C systems
- Strengthening TSO capabilities
- Emergency Planning
- Improvement of NPP inspection practices and procedures



Kozluduy NPP in Bulgaria

Capacity Building through GRS - Examples from 20+ Years

Middle Eastern / Southeast Asian / Latin American countries: Jordan, Egypt, Philippines, Vietnam, Indonesia, Mexico, Brazil

Project: INSC

Selection of training / support topics:

- Preparation of new regulations
- Regulatory review of site and environmental assessments and safety analysis reports
- Nuclear safeguards
- Deterministic and probabilistic safety assessment
- Quality management for internal processes
- Knowledge management strategy / human resources development plan and training programme
- Development of inspections capabilities
- Assessment of (digital) I&C systems
- Performance of uncertainty and sensitivity analysis of LOCA-scenarios
- Ageing management and long term operation
- Atmospheric dispersion and dose calculation
- Emergency preparedness



Angra NPP, Brazil

Example: Support for Capacity Building of the Belarusian Supervisory Authority

Projects: INSC, since 2008 (4 phases)

Goal: Contribution to the capacity building of the Belarusian regulatory authority GAN and its associated TSOs by supporting the

- Establishment of regulatory competence for the development of a nuclear regulatory framework that takes into account requirements of IAEA and EU as laid down i.a. in WENRA documents
- Creation of competence for the safety assessment of descriptive documents for nuclear facilities
- Establishment of the technical and professional competence to perform safety analyses for the assessment of accident impacts using existing recognised and internationally applied computer codes
- Development of a strategy and the necessary measures for the establishment and application of a system of emergency protection measures in accordance with international standards
- Development of a strategy for handling radioactive waste and irradiated fuel elements



Example: Support for Capacity Building of the Belarusian Supervisory Authority

- **Transfer of methodologies, approaches and knowledge for regulatory and expert work, especially in the areas of:**
 - Methodological approach to supervision and regulatory control in the field of radiation protection and nuclear safety in early operational phase
 - Strategies and methodologies for emergency preparedness oversight and regulatory control
 - Methodology for evaluation of accumulated operational experience
 - Improving the regulatory technical capabilities of the Inspectorate in reviewing deterministic and probabilistic safety analyses and in conducting its own independent assessments
 - Methodology for the development of legislation for the operation of nuclear facilities
- **In 2021, support was additionally provided for content of implementation of the National Action Plan, which was prepared as a result of the peer review of the National Report for Ostrovets NPP**
 - Approaches to the approval of safety improvement measures implemented at the Belarusian NPP as a result of the EU stress tests

Example: Support for Capacity Building of the Belarusian Supervisory Authority

Belarus NPP Site
April 2009



Belarus NPP Site
May 2012



First Concrete for
Unit 1
November 2013



Unit 1
April 2017



Example: Support for Capacity Building of the Belarusian Supervisory Authority

April 2019



Hot tests
completed at Unit 1
April 2020



Start commercial
operation of Unit 1
June 2021



First Criticality at
Unit 2
April 2022



Conclusion

- **For more than 40 years, GRS has been supporting supervisory authorities and their TSO in capacity building.**
- **Capacity building must take place well before construction of a facility begins.**
- **The involvement of partners from several countries increases international trust in the respective authority.**
- **Knowledge of the approval process in the country of the plant manufacturer is very helpful. If possible, cooperation with the respective authority or TSO should be sought here as well.**

Thank You!