

# GRS

Ludwig Bahr 30.06. – 02.07.2010

Workshop for Round-Robin Analysis on Containment Performance

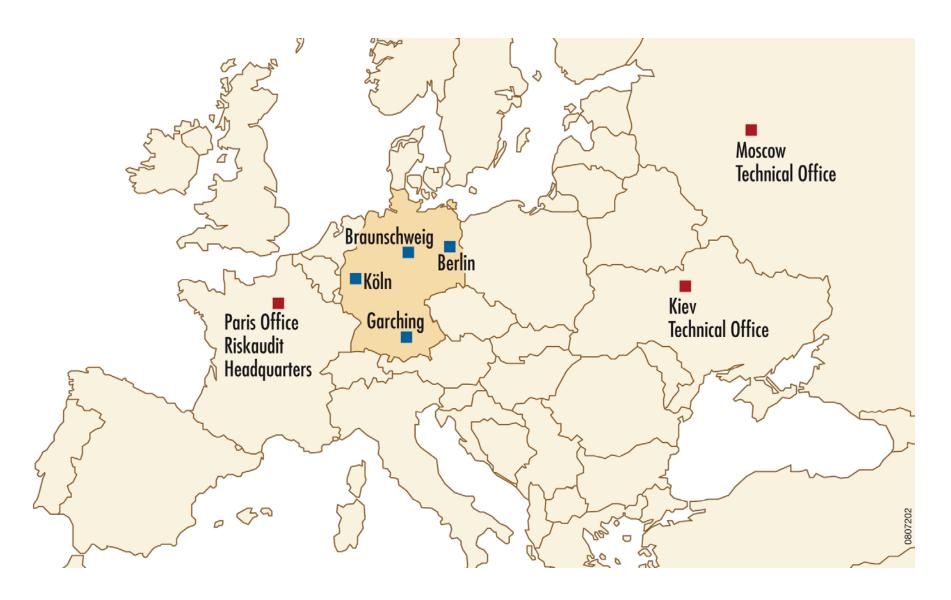


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- 2. Participation in ISP 48
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## **GRS – Company Locations and Technical Branch Offices**





#### GRS – Gesellschaft für Anlagen- und Reaktorsicherheit

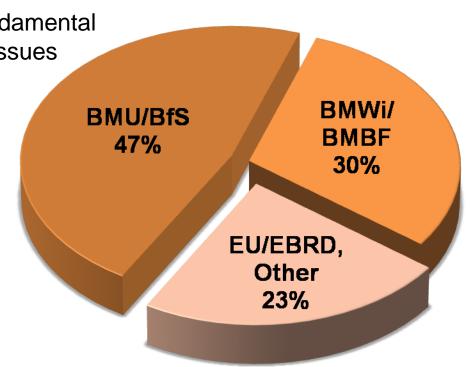
- independent, non-profit company
- main TSO in Germany on behalf of BMU (ministry of the environment), the federal regulatory authority for nuclear safety and waste management
- main nuclear research organization on behalf of BMWi (ministry of economics and technology), responsible ministry for nuclear research
- participates in international activities mainly by IAEA, OECD and EU on behalf of BMU and BMWi
- co-operates worldwide with its counterparts on bi-lateral basis



#### **GRS – Customers in 2008**

exclusively financed through projects turnover ~ €50 million p.a.

Analyses of fundamental nuclear safety issues and ad-hoc assessments of current issues of power plant operation.

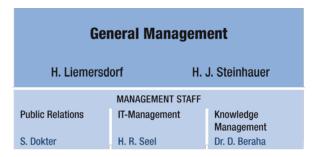


R & D in the field of nuclear facilities and waste management, including the final disposal of radioactive waste.

Safety analyses and assessments of nuclear facilities in Germany and abroad, providing expert advice to foreign supervisory and licensing authorities.



# **GRS – Organization Chart**



		Reactor Sat Analyses	Reactor Safety Analyses		pository Safety h	Radiation and Environmental Protection	Projects and International Affaires	<b>Central Services</b>	Project Mgmt. Agency/ Authority Support
Dr. A. Pautz		H. Liemersdorf		T. Rothfu	chs	Dr. G. Pretzsch	U. Erven	V. Watermeyer	R. Zipper
Barrier Effectiveness		Plant Engineering		Safety Ar	nalyses	Nuclear Fuel	National Project Management	Finance	
Dr. M. Sonnenkalb		Dr. R. Stück		Dr. J. Mö	nig	Dr. B. Gmal	Dr. H. Uhlenbruck	V. Watermeyer	
Cooling Circuit		Plant Reliability		Process /	Analyses	Radiation Protection	International Project Management	Human Resources and Legal Affairs	
Dr. H. Glaeser		C. Verstegen		Dr. HJ.	Herbert	H. Thielen	C. Eibl-Schwäger	M. Fillbrandt	
Core Behaviour		Plant Behaviour				Final Storage	International Programmes	Communication	
Dr. A. Pautz		W. Pointner				Dr. K. Fischer-Appelt	Dr. H. Teske	S. Dokter	
		Plant Concepts				Interdisciplinary Projects	Local Administration G. Diepolder J. Hanrieder		
		Dr. T. Schimpfke				Dr. M. Mertins	S. Krämer		
			Technical Of Kiev *)	Office					CRS
	K. Shas		tin M. Chouha		*) jointly with IRSN/RISKAUDIT				



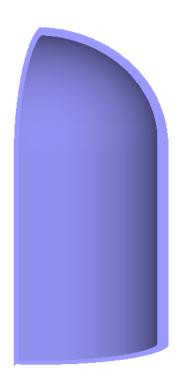
#### **ISP 48**

- GRS participated in ISP 48
   Phase 2: "Calculation of the Limit State Test (LST), i.e. static pressure loading" and
   Phase 3: "Calculation of response to both Thermal and Mechanical Loadings"
- posttest calculations
- work was conducted by H. Grebner and J. Sievers
- finite element simulations performed with ADINA (<u>www.adina.com</u>)
- penetrations were not included in the models

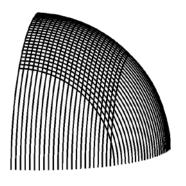


# ISP 48 – Analysis model

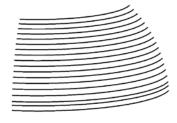
Finite element analysis: 90°-section model of PCCV



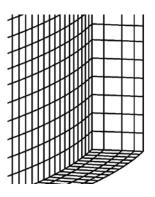
meridional tendons within dome



hoop tendons within dome



concrete modeling near base plate



meridional rebars within cylindrical part





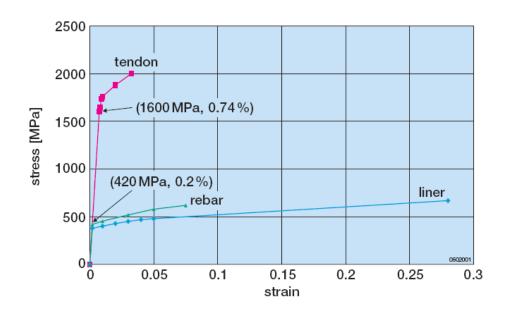
#### **ISP 48 – Material properties**

Stress-strain-curves of the PCCV materials used in simulations:

#### concrete

# stress (3.45 MPa, 0.01%) $\varepsilon_{u} \qquad \varepsilon_{c} \qquad \text{strain}$ $\varepsilon_{t} \qquad \xi \cdot \varepsilon_{t}$ $(-47.3 \, \text{MPa}, -0.2\%)$

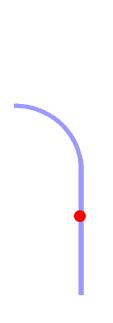
#### steel components

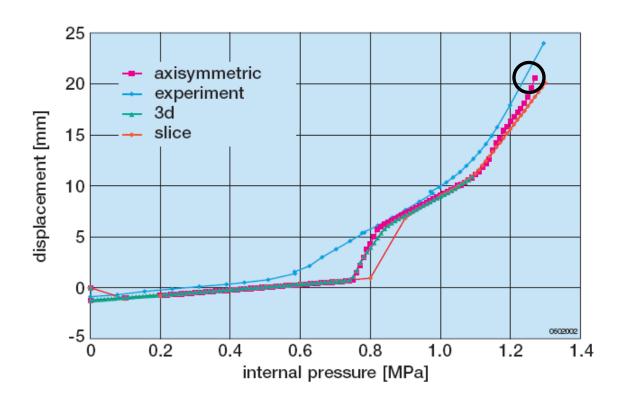




#### **ISP 48 – Selected analysis results**

Radial displacement at the inner surface of the model (cylindrical part at position 6.2 m above base plate), pressure only case

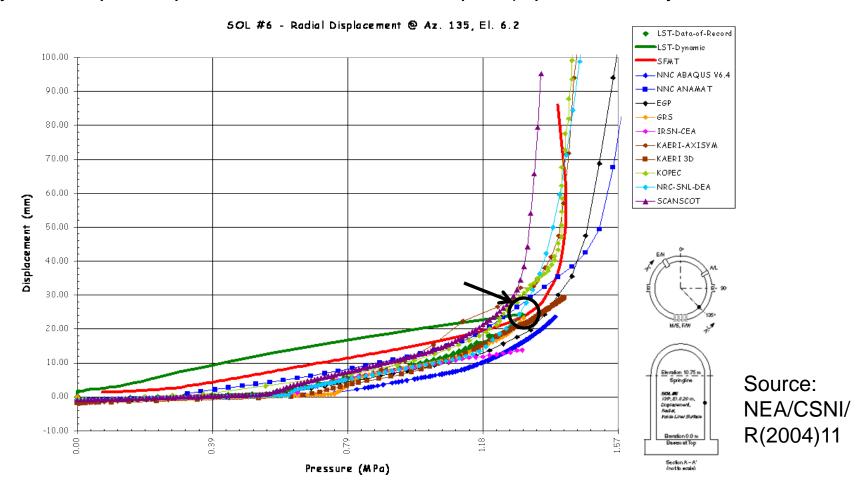






#### **ISP 48 – Selected analysis results**

Radial displacement at the inner surface of the model (cylindrical part at position 6.2 m above base plate), pressure only case





### **Special interests in framework of SPE**

- determination of leak rates through cracks
- failure mechanisms in liner
- steel-concrete interaction (bond model)
- influence of penetrations
- concrete behavior under temperature loads