



SAR_{net}

IRSN

ERMSAR 2005

Overview of SARNET deployment and progress

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Région



Provence-Alpes-Côte d'Azur

SUMMARY

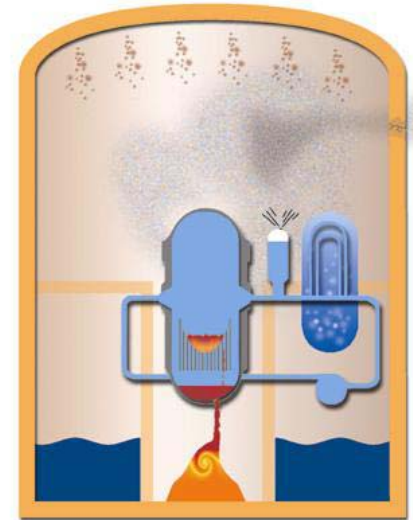
- General frame
 - FWP of the European Commission
 - Reactor severe accidents, progress needs
- SARNET project
 - Objectives
 - Structure and activities
- Status and achievements 18 months after
 - Deployment, first results
- ERMSAR 2005
 - Expected outputs

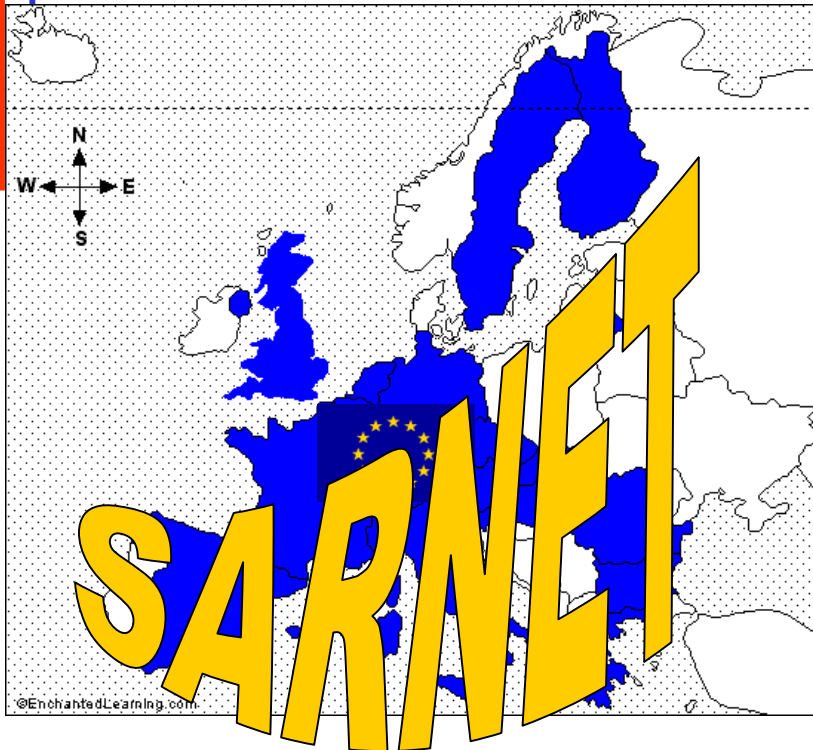
GENERAL FRAME

- EURATOM 6th Framework Programme (FP-6) 2002-2006
- Main objective
 - Contribute to the creation of the European Research Area (ERA) in the field of nuclear energy by improving integration and co-ordination on nuclear research in EU
 - Close partnership with the EU Member states and different European organizations
 - Networking the excellence
 - Overcoming the fragmentation of European research

REACTOR SEVERE ACCIDENTS

- Hypothetical scenario (very low probability)
 - Accidental event (Ex: break in the cooling system)
 - And failure of Safety Systems
- Might have serious consequences
 - Release of radioactive elements out of the containment
- Large R&D efforts for more than 20 years (TMI2 : 1979)
- Large progress has been made and (logically) allocated budgets are decreasing
- Risk
 - To leave unsolved some issues still open and important in terms of reactor safety (i.e.: Ruthenium release, corium retention, ...);
 - To lose competence and knowledge





Severe Accident Research NETwork of excellence



- 18 Countries
- 49 organizations
 - 18 Research Organizations
 - 10 Universities
 - 11 Industry Organizations
 - 4 Utilities
 - 6 Safety Authorities or Technical Supports

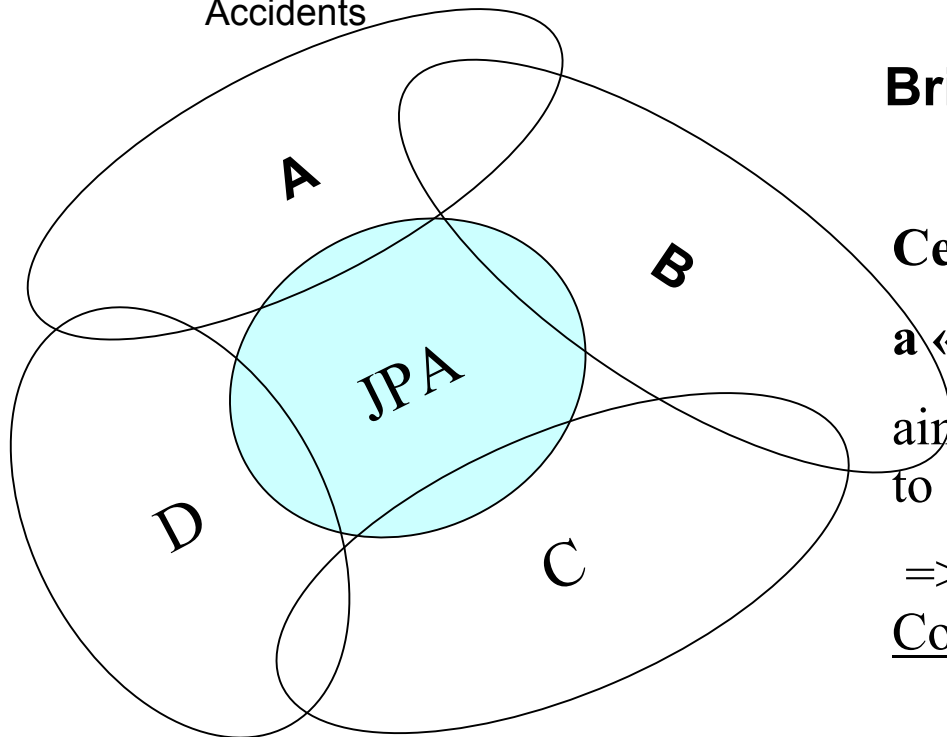
SARNET MAIN OBJECTIVES

- Resolution of still pending questions that are important for reactor safety
- Optimised use of available resources and competences throughout Europe
- Knowledge transfer for safety application
- Perpetuate the competence (capitalize the knowledge)

Structure of the network

- Go beyond the existing collaborative frames that are generally:
 - limited to a small number of organisations (Ex: bi or trilateral collaboration agreements)
 - or limited to a small scientific domain (Ex: multiparty share cost action on a given experimental programme)

- Integrate in a common structure all the European Research and Development devoted to Severe Accidents



Bricks = National R&D Programmes

Cement =

a « Joint Programme of Activities » (JPA)







aiming at making the best use of available resources to create, capitalize and disseminate knowledge

=> base of the contract with the European Commission (2004-2008)

SARNET « joint programme of activities »

- Development of 4 common references: basement of the network
 - A common Information System :
 - Advanced Communication Tool for networking
 - Experimental data base system
 - Common Research axes:
 - A reference plan defining research priorities (periodically updated)
 - A common computation tool:
 - **ASTEC**, a scientific software dedicated to the numerical simulation of Severe Accident transients and that will continuously capitalize the knowledge produced within SARNET and become the European reference tool for SA reactor safety studies
 - A common reference in terms of PSA methodology
- Joint research activities (strongly linked to national programmes)
 - Recommendations/proposals for underway/future experimental programmes
 - Common interpretation of experimental results, and model development
- Education, training and mobility programme (knowledge dissemination)

SARNET Status and Achievements

- Partnership 
- Research Priorities (Klaus Trambauer) 
- Information system (David Beraha & Alessandro Annunziato) 
- Knowledge dissemination (Raj Sehgal) 
- Joint research activities (Jean-Michel Bonnet, Leonhard Meyer, Tim Haste) 
- Assessment tools, simulation and PSA (Jean-Pierre Van Dorselaere, Bernard Chaumont) 

Encouraging progress indicators

- Larger and larger use of common tools (ACT, DATANET, ASTEC)
- Collaboration fostering:
 - Several examples of Knowledge Transfer
 - Experimental data
 - Tools and methods
 - Know-how
 - Interactions with national programmes
 - Programme modifications
 - Common recommendations
- Large success of the mobility programme
- High motivation of young researchers

ERMSAR 2005

Main objectives, expected outputs

- Information transfer
 - Transverse exchange beyond interpretation circles and WPs borders
 - With end users not directly involved in SARNET
 - With other R&D partners (OECD projects, ISTC,...)
- Discussion and definition of orientations for SARNET future activities
 - R&D priorities
 - Improvement of the general process

PARTNERS

IRSN	FRANCE	INR	ROMANIA
AEA-T	UNITED KINGDOM	INRNE	BULGARIA
AEKI	HUNGARY	IVS	SLOVAKIA
ARC-S	AUSTRIA	JRC (Ispra, ITU, Petten)	EEC
AVN	BELGIUM	JSI	SLOVENIA
B Tech	GERMANY	KTH	SWEDEN
BUTE	HUNGARY	LEI	LITHUANIA
CEA	FRANCE	NNC	UNITED KINGDOM
CESI	ITALY	NRG	NETHERLANDS
Chalmers	SWEDEN	PSI	SWITZERLAND
CIEMAT	SPAIN	RUB	GERMANY
CSN	SPAIN	SWEDPOWER	SWEDEN
DEMOKRITOS	GREECE	TECHNICATOME	FRANCE
DIMNP (Pisa U)	ITALY	THERMODATA	FRANCE
EA	SPAIN	TRACTEBEL	BELGIUM
EDF	FRANCE	TUS	BULGARIA
ENEA	ITALY	UCL	BELGIUM
FORTUM	FINLAND	UJD	SLOVAKIA
FRA ANP SAS	FRANCE	UJV	CZECH REPUBLIC
FRA ANP Gmbh	GERMANY	ULB	BELGIUM
FZJ	GERMANY	UPM	SPAIN
FZK	GERMANY	VEIKI	HUNGARY
FZR	GERMANY	VTT	FINLAND
GRS	GERMANY	VUJE	SLOVAKIA
IKE	GERMANY		

18 countries

49 organisations

around 200 researchers

around 20 PhD students

Other links:

ISTP

ISTC projects

GAMA, WGRISK (OECD)

.....

2 candidate organisations

Research priorities

- To day based on EURSAFE conclusions,
- Some difficulties to initiate the process of periodic revision,
- Now, in position to elaborate research priorities and recommendations in terms of future programmes.
- Topics of major importance for SARNET: it is expected from SARNET clear indications on what should be done.
- Recommendations expected by the EC that foresees to reserve some funds for SA topics in FP7.



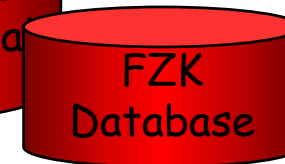
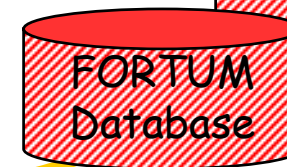
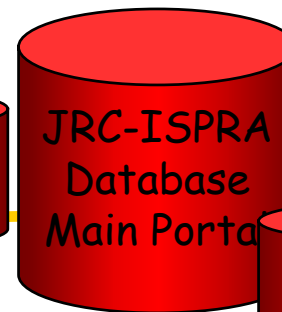
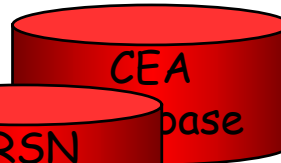
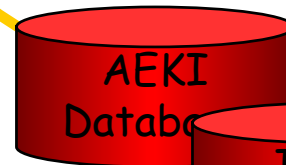
A WEB portal supplies SARNET partners with an access (reading and or writing) to:

- **networking tool** (document management, meeting org., forum, questionnaire, ...)
- **experimental data bases**
- ASTEC code,
- links
- ...



ACT Status

- 200 users
- around 500 accesses / month
- More than 200 major documents
- 10 Topical sites



DATANET Status

- 5 nodes are open (JRC, FzK, IRSN, CEA, AEKI)
- 2 are under works (FORTUM, KTH)
- 2 are foreseen (CIEMAT, VTT)

- Implementation of 10 experimental programmes is underway
- More than 60 tests results already implemented

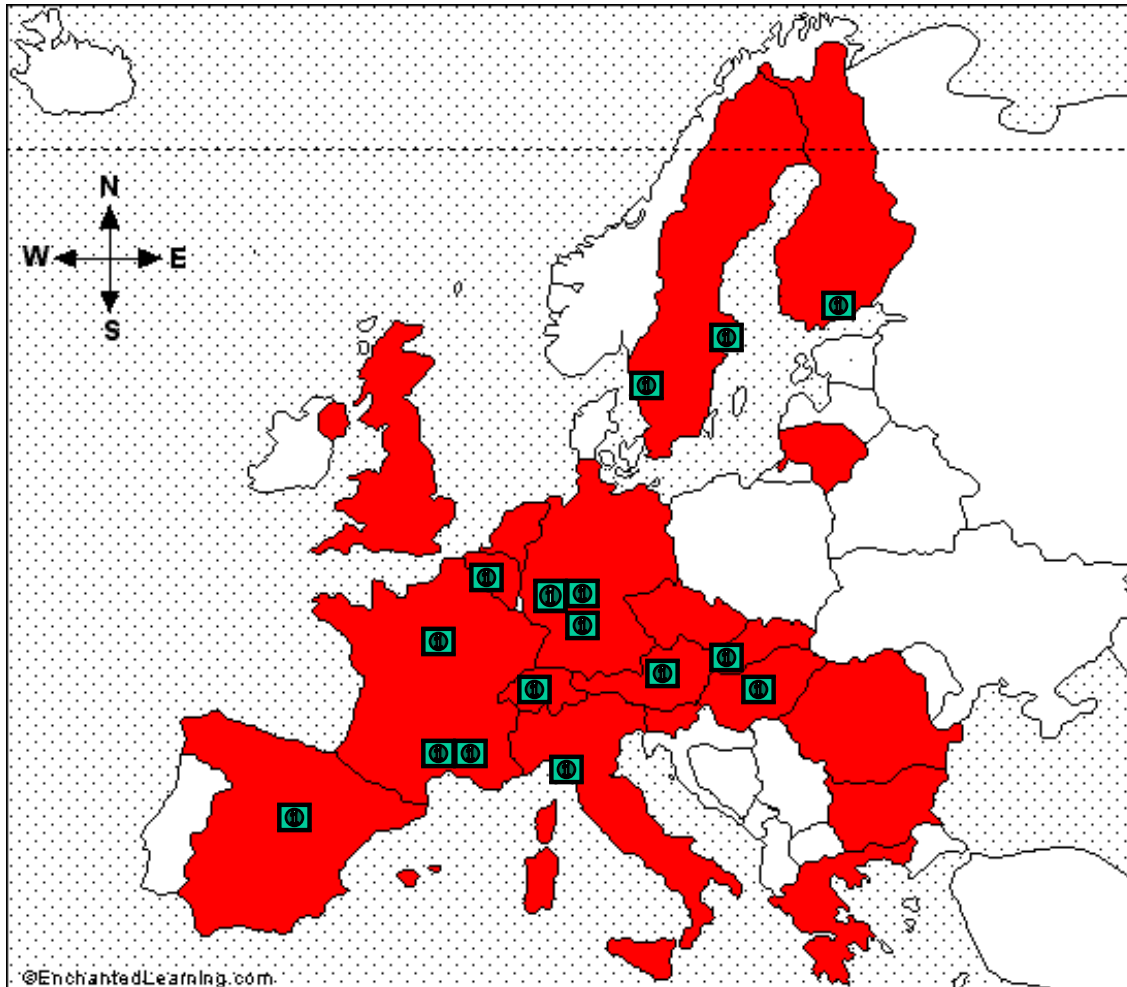


Knowledge dissemination

- 2 Courses, one book under preparation
 - On severe accident phenomenology (Cadarache, January 2006)
 - 2nd session in 2007 (Probabilistic Safety Assessment methodology ?)
- Mobility programme plan
 - Half a dozen delegations under way or achieved



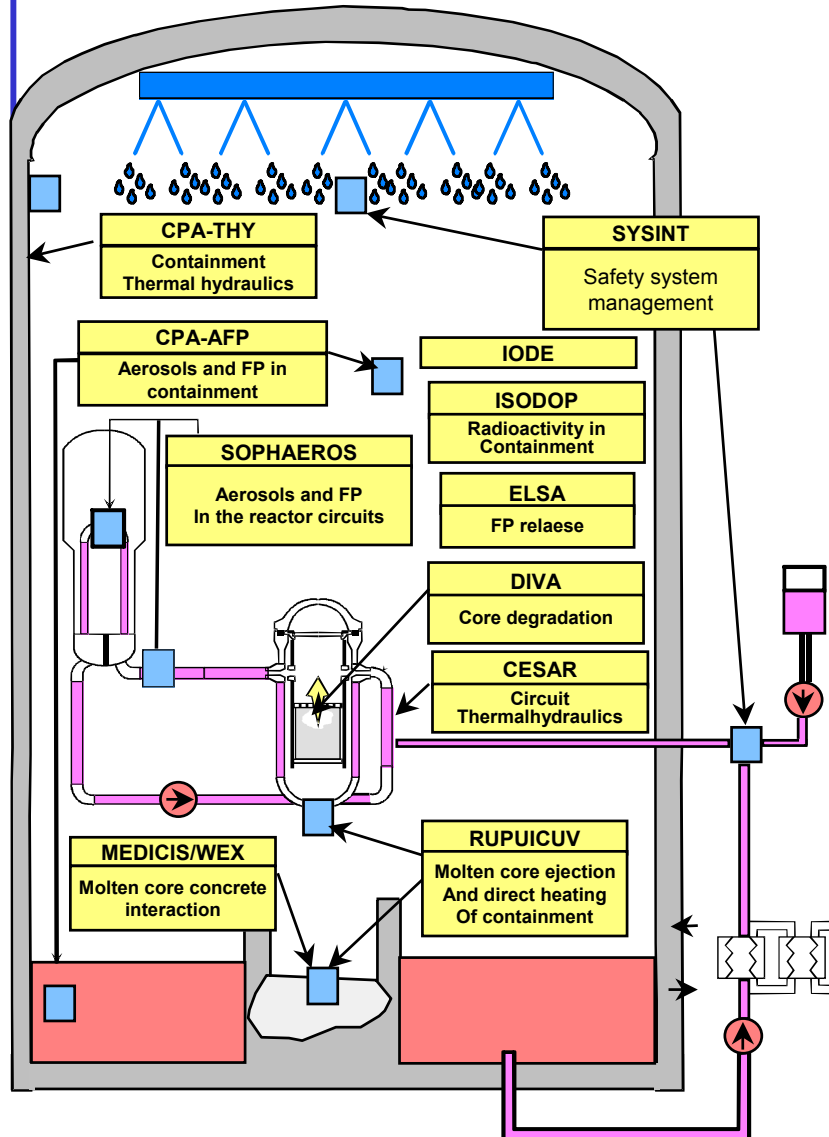
Common interpretation of experimental programmes supporting SARNET activities



- **22 expert circles jointly analyse experimental data and elaborate physical models**
- **The inputs are provided by:**
 - more than 50 recent or underway experimental programmes
 - Coming from 18 SARNET organisations
- **Model improvements are already proposed for ASTEC**



Numerical Simulation / ASTEC software



- Integral numerical simulation of reactor accident with core melting (Severe Accidents)

- IRSN-GRS property : ~ 10 m-y/y in charge of software development and user support

- Has been distributed to 25 SARNET organizations

- SARNET scientists support for model improvement and physical assessment:

- ASTEC capitalizes in terms of models all the knowledge produced in the frame of the Network

- 40 trained users contribute to joint validation programme (mobilizes around 20 m-y/year)

- Major version (V1.2) has been delivered in August 2005

- Size: ~ 350 000 instructions

- Speed: ~ 3-10 hours to compute 24 h of transients

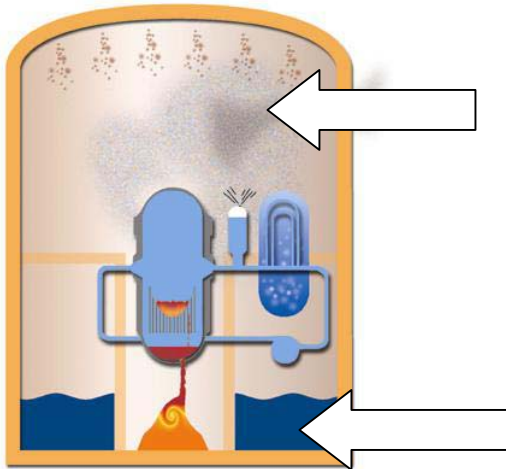
Appendices

Examples of experimental programmes supporting the joint activities

- EPICUR (IRSN, France)
- PECA (CIEMAT, Spain)
- RUSET (AEKI, Hungary)
- VULCANO (CEA, France)
- QUENCH (FZK, Germany)

EPICUR (IRSN, France)

- Iodine behaviour in containment

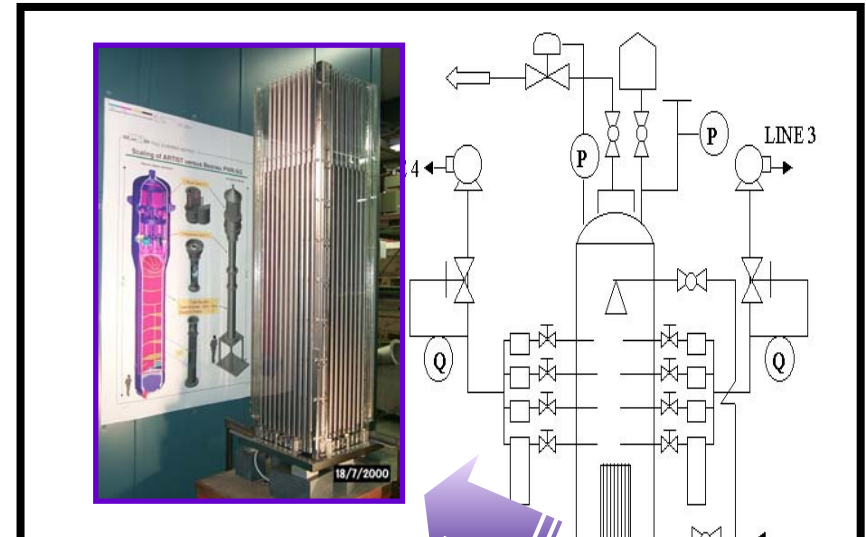
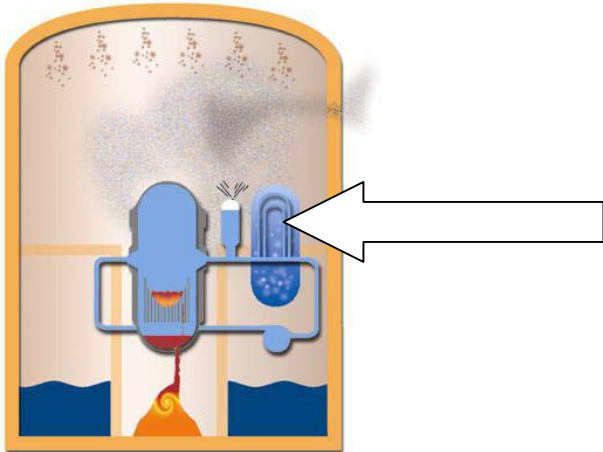


- Quantification of the production of volatile Iodine species, which are not trapped by aspersion systems nor by filters of venting devices
- Containment thermochemical and radiative conditions are simulated in a small vessel which is irradiated by a Cobalt 60 source (10kGy/h)
- Results will be used to assess/improve IODE models (ASTEC)



PECA (CIEMAT, Spain)

- Aerosol retention in the Steam Generators



- Investigates situations where Steam Generator tubes are broken
- The Steam Generator is simulated by a bundle of 117 tubes (1.5 m), in which a gas flow entraining aerosols is injected
- Detailed measurements of aerosols speed and depositions of the tube bundles (complementary results / large scale facility ARTIST, PSI, Switzerland)
- Results will be used to improve SOPHAEROS models (ASTEC)



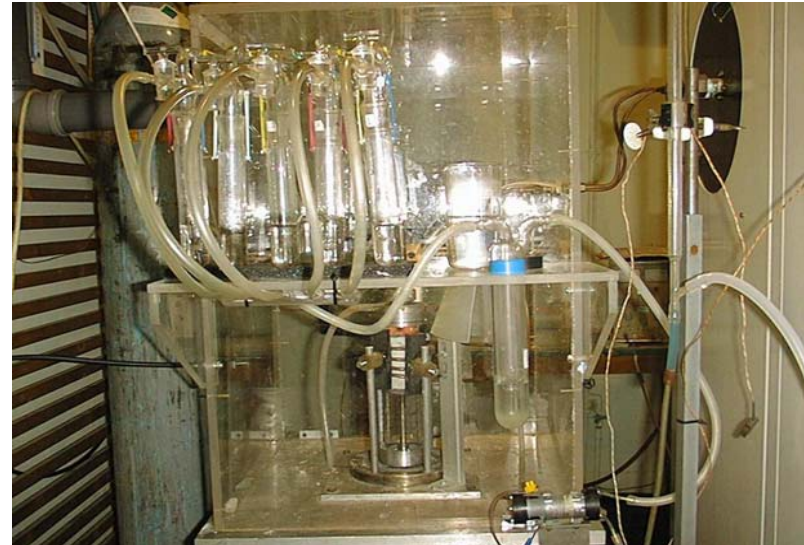
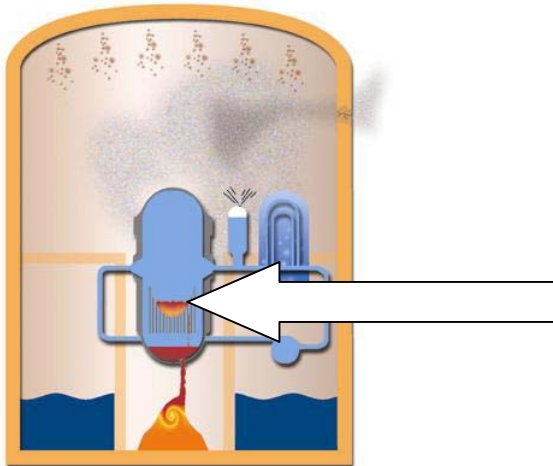
GENERALIZED
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OUT

LINE 2

RUSET (AEKI, Hungary)

- Ruthenium release from degraded core

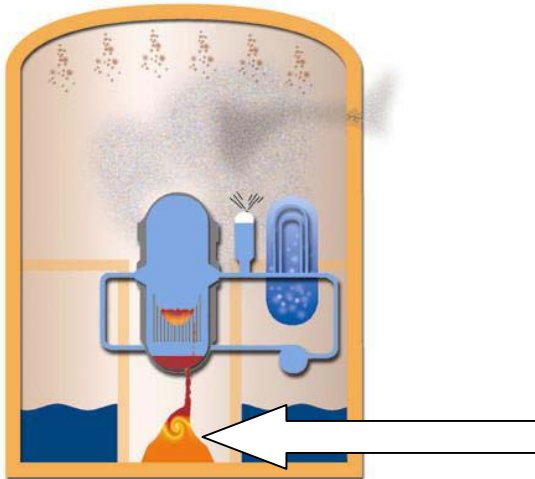


- Address the question of Ruthenium release that could become significant in case of air penetration in the core
- Mixtures that are representative of core materials are heated for different oxidizing conditions
- Gaseous and aerosol forms of released Ruthenium caught respectively by filters and by liquid solutions
- Results will be used to assess ELSA models (ASTEC)



VULCANO (CEA, France)

- Corium progression out of the reactor vessel

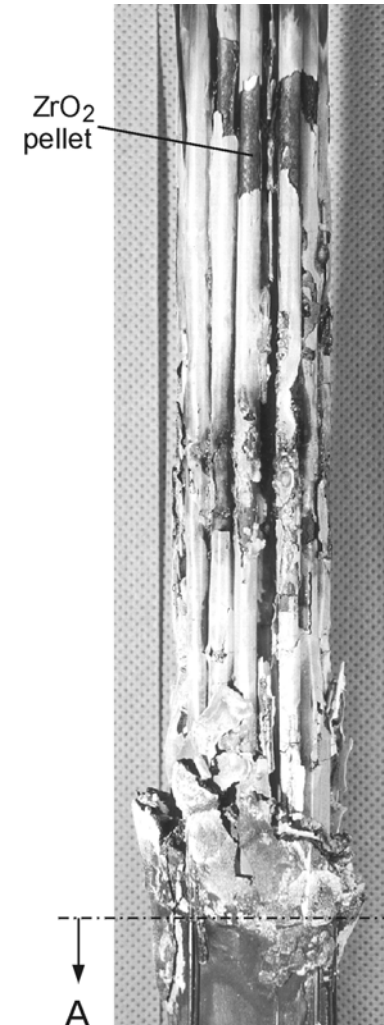
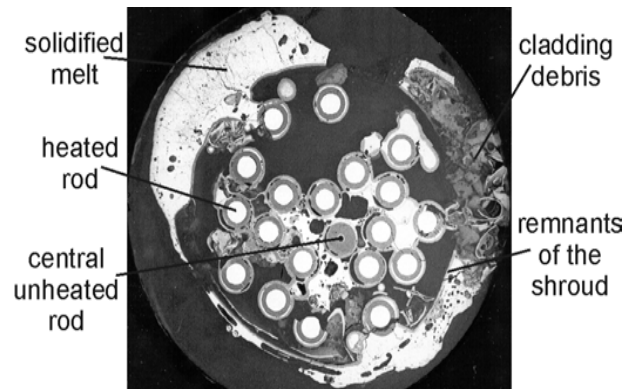
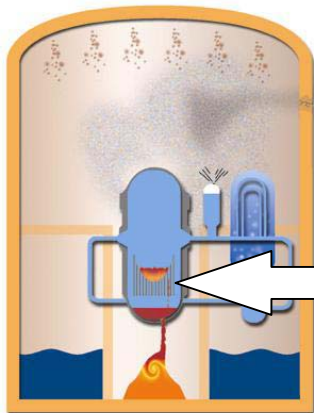


- Up to 70kg of material representative of a core melt are heated up to 3200°C and poured in a concrete crucible or on a concrete surface.
- Kinetics of concrete floor ablation
- Retention performance of core catcher systems
- Results are used to assess/improve MEDICIS models (ASTEC)



QUENCH (FZK, Germany)

- Core degradation and Hydrogen production



A bundle of 21 rods (simulant material) are heated up to degradation and quenched by steam or water injection.

Post mortem examinations and on line measurements of temperature and of hydrogen production are used to assess core degradation models of DIVA (ASTEC)

