



# ***CEG - THE CONTACT EXPERT GROUPS - as a Tool for Programmatic Mode of Operation***

***(Information review)***

***Presented by Lev V. Tocheny, edited by W. Gudowski DED, ISTC***

***ISTC = International Science and Technology Center, = Moscow, Russia =  
CEG-Partitioning and Transmutation -11 , EC, Brussels January 22-23, 2007***



**Reminder!**

**What is ISTC?**

**INTELLECTUAL NONPROLIFERATION,  
GLOBAL SAFETY AND SECURITY**

**through**

**Science, Technology and Partnership**

Practical objective in Partnership:  
NON PROFIT Vehicle for Sustainable  
Scientific/Technological Collaboration  
Minimizing Failure Risks!!!

# OUTLINE



## 1. *Introduction (about ISTC)*

## 2. *Review of project series:*

- *Benchmarking, Verification, Critical experiments*
- *Sky-Shine experiments*
- *New concepts:*
  - *Heavy-metal technology (Lead, Lead-Bismuth)*
  - *HTGR*
  - *Molten salts*
  - *Supercritical pressure water*
- *CEG - RAW Partitioning and Transmutation*
- *CEG – SAM Severe accident study*
- *CEG –PLIM Plant Life Management*
- *CEG-FUSION*

## 3. *Summary*

# *ISTC turns into Programmatic Mode of Operation*



## **◆ Focus on some research area**

- *More coherence with research priorities of funding Parties, e.g. compatibility with FP in Europe*
- *Better sustainability of the projects, i.e. more strategic choices*
- *More OBJECTIVE oriented projects*
- *More active Foreign Collaborators*

**Consequently: more importance for International Contact Expert Group – (CEG)**

- *pool of ACTIVE foreign collaborators and on-going projects,*
- *more active dialogue with Russian partners*
- *incubation and smooth coexistence of partner projects*

***We BADLY need CEG also in non-nuclear fields***

# **Vision of a future role of CEGs**



- **High priority of CEG's project preselection for funding**
- **Forum for foreign collaborators and partners in ISTC partner program**
- **New project incubator and partner project incubator**
- **A vehicle for sustainability of the projects and post project research activities**
- **Advisory role for the Scientific Advisory Council – a concept under preparations!**

# Existing CEG's

- **CEG “Partitioning and Transmutation”**
- **CEG “Severe Accident Management”**
- **CEG “Plant Life Management”**
- **CEG “Fusion”**
  
- **earlier on - CEG “Pu Disposition – MOX” and CEG “GT-MHR”**

## **ISTC – Area of Importance**

### ➤ Goals:

**# to prove to international Public, that new nuclear concepts are:**  
safe,  
effective, and  
accepted

### ➤ Methods:

**# basic-type, demonstration-type, international-type experiments**  
**(in advance of computer or paper-type arguments);**

**# the results have to be available for international analysis**

### ➤ Problems:

**# nuclear experiments require licensing, long time preparation, high-skilled personnel, special materials and tools, budgeting**

## **ISTC – Area of Importance** (continue):



➤ **ISTC**: *set of demonstration- type basic-type experiments, which fit closely with INPRO and GIF program, with EU VI/ VII FWP, - had been done (or under development now) with international collaboration*

- *The ISTC clients have ready, licensed, and equipped unique nuclear installations, high-skilled personnel*
- *The projects managing is international process*
- *Project planning and project results are available for international collaborators*
- *Project results may be passed to international centers for further international benchmarking (OECD/NEA and/or others)*

## ◆ *Benchmarking, Verification*

## **Benchmarking, Verification**



### ***New codes and algorithms:***

- ***Neutronics***
  - ***Monte-Carlo, Finite-difference methods***
  - ***Parallel algorithms***
  - ***Updated cross-sections***
- ***Neutronics & Thermo-Hydraulics***

***5 projects***

# **Benchmarking, Verification, Critical Experiments LWR / VVER-1000 with MOX**

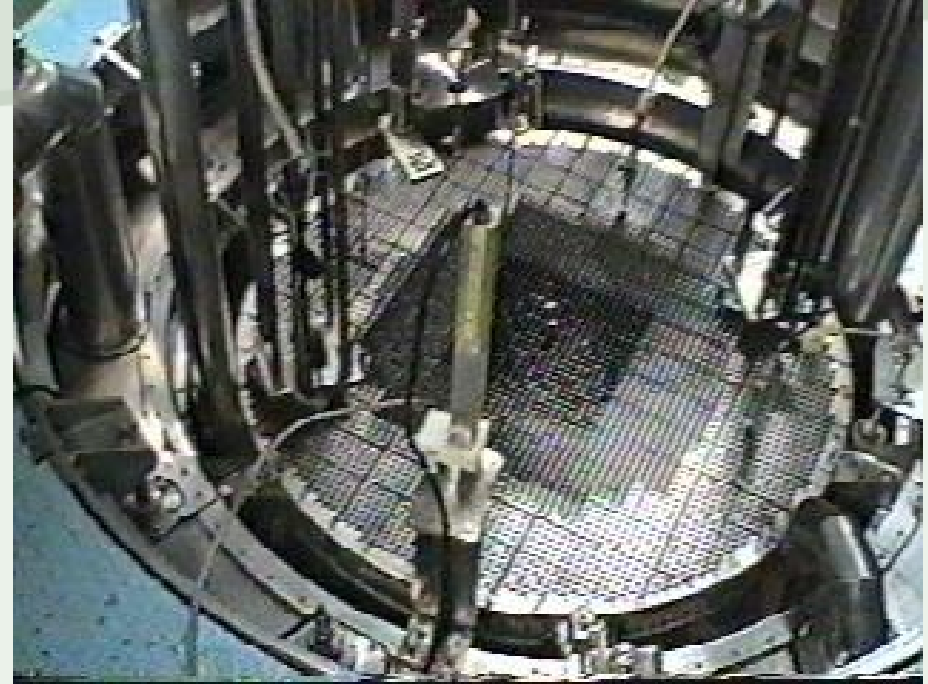
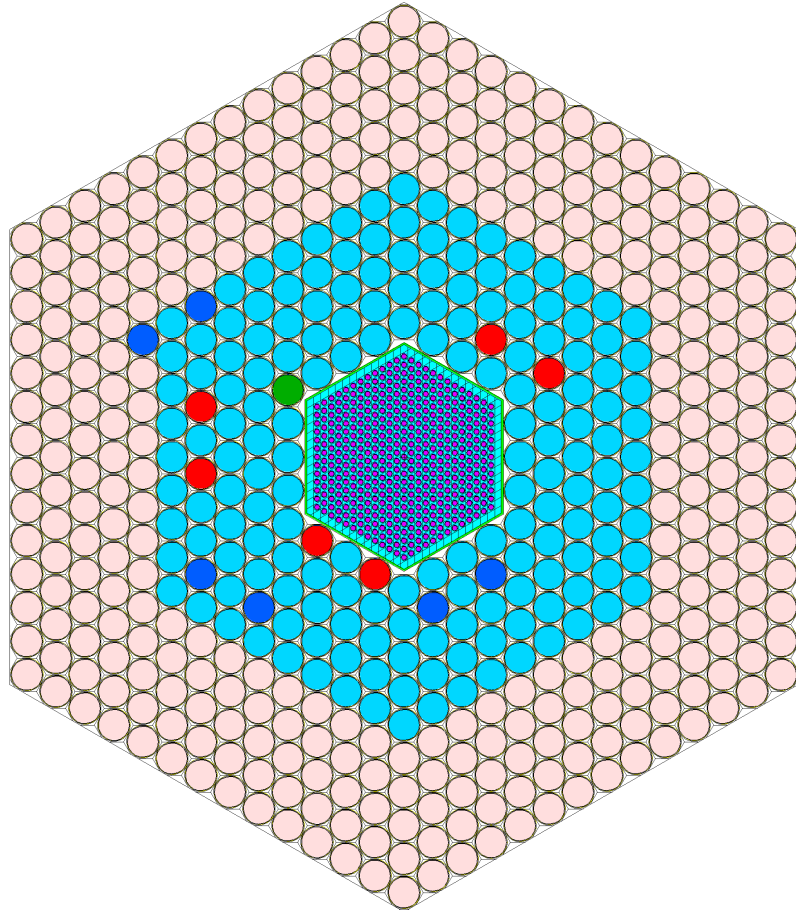


**#0371/ #371.2 –**

**“Pre-SUPR program = Loading VVER by three MOX FAs”**

- **Computer codes and data validation**
- **Work out the demands to the new experiments:**
  - ❖ **Measured parameters**
  - ❖ **Core configurations**
- **Reconstruction of the facilities BFS-1 and RFGS**
- **Manufacturing and placing UOX and MOX pins at BFS-1 and RFGS facilities**
- **Licensing of experiments**

# Benchmarking, Verification, Critical Experiments: Pre-SUPR (MOX)



*Pre-SUPR: Model of BFS-1 with central insert: VVER-type fuel elements.*

- *three pairs of Control rods,*
- *three pairs of KO,*
- *Automatic control rod*

*BFS –critical stand family (IPPE, Obninsk)*

# Benchmarking, Verification, Critical Experiments: ICSBEP Handbook



## ➤ IPPE (Obninsk): BFS Family: BFS-1, BFS-2, COBRA, BR-1, MATR

**#815 / #815.2 - Evaluation of Critical Safety Data and Uncertainty Analysis for the International Bank for Critical Experiments (ICSBEP)**

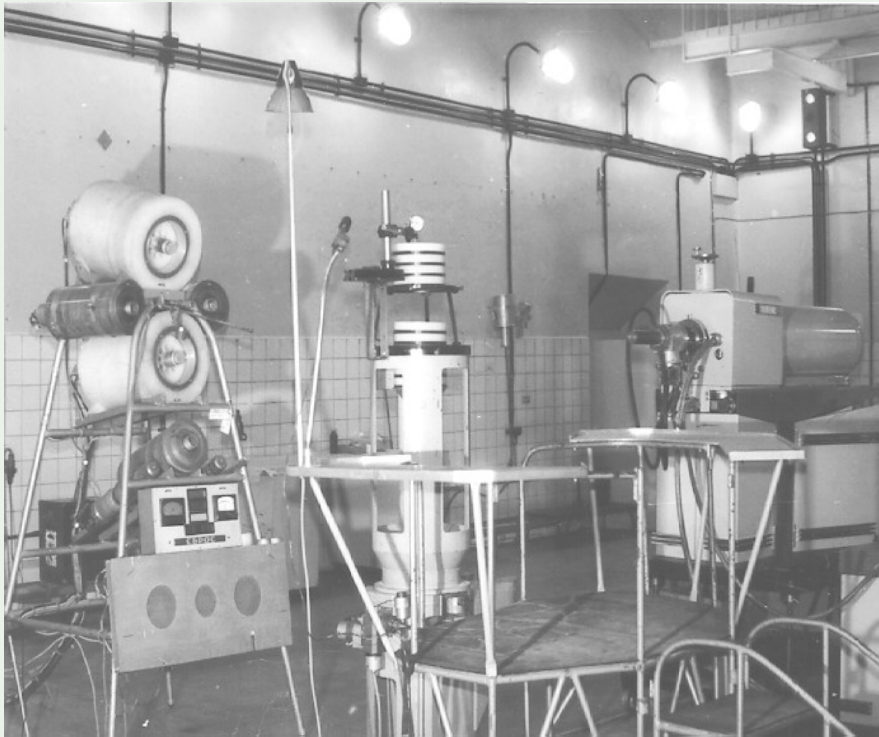
**#1483 - Evaluation of K-infinity Experiments for Mixtures of HEU with Structure Materials (Stainless Steel, Steels with Molybdenum, Nickel, Chromium and Zirconium)**

**#1808 - Analysis and Evaluation of Safety Criteria of Spent Fuel Underground Disposition via Critical Experiments**

**#2423 - Benchmarking of Thorium Critical Experiments on the COBRA Facility**

**Benchmarking, Verification, Critical Experiments  
LWR / VVER-1000 with MOX  
VNIITF (Chelyabinsk-70)**

➤ **# 0116** – “Verification of Reactor Data Bases” (NIKIET, VNIITF):



**Critical stand FKBN-M / ROMB**

**FKBN-M facility** (straight up),

On the left - detectors system,

On the right - neutron generator.

**#3110** - Experiments on the ROMB Critical Assembly for ICSBEP:

// beryllium moderator // lead reflector // un-reflected with HEU.

# **Benchmarking, Verification, Critical Experiments: (proposals):**

➤ **IPPE (Obninsk): BFS Family: BFS-1, BFS-2, COBRA, BR-1, MATR**

**#2603 - Database on BFS and COBRA Critical Experiments**

**#2661 - Experimental Study of Fast Reactors Safety with Lead Coolant**

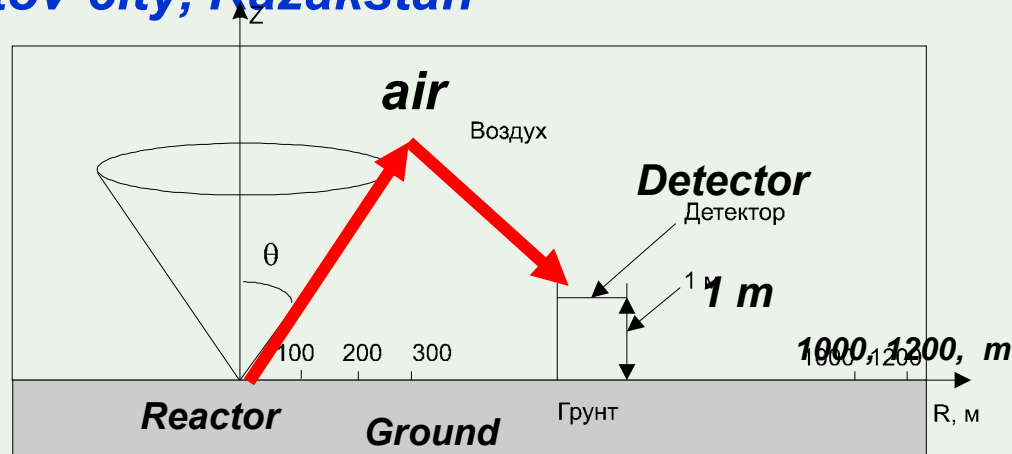
**#3239 - Experiments for Lead and Lead-Bismuth Cooled Reactors**

**#XXX- Experiments with MA**

## SKY-SHINE EFFECT

### #0517 - Experimental Studies of Reactor Radiation Scattering in the Atmosphere

- *NIKIET named after Dollezhal, Moscow;*
- *Kazakstan National Nuclear Center / Institute of Atomic Energy, Kurchatov-city, Kazakstan*



*Two special experimental reactors, located in desert area in Semipalatinsk-21, Kazakhstan, were used ( IVG-1M and RA)*

# **Benchmarking, Verification, Experiments (Radiological characteristics):**



## ***Verification of codes and data versus measurements***

### ***➤ # 0273 and #1316***

***(Bochvar VNIINM): At the Fuel Fabrication plant:***

***Uranium fuel, MOX fuel, spent fuel, regenerated fuel***

### ***➤ # 0841 (Khlopin Radium Institute, St-Petersburg)***

***Conditions at the Kola NPP***

## ***New Reactor Concepts***

# ***New Reactor Concepts (GIF, INPRO)***



- ◆ ***Fast Reactors, cooled by –***
  - ***Sodium,***
  - ***Lead,***
  - ***Lead- Bismuth***
  
- ◆ ***HTGR***
  
- ◆ ***Molten Salt Reactor***
  
- ◆ ***Supercritical regimes***

# **Lead / Lead-Bismuth – Reactor concepts**



**# 1418**

***BREST –300: 300 MW Demo  
lead-cooled power reactor with  
inherent safety (Monograph),***

***NIKIET***

**➤ #1762**

***Small power reactor with  
lead-bismuth coolant,***

***IPPE***

***KAERI - Korea,  
RIT - Sweden,  
Mitsui – Japan***

**➤ #2661- BFS critical stand (reactor core modeling)    *IPPE***

## ***Lead / Lead-Bismuth – Fundamentals***

- ◆ ***Hydrodynamics and Heat/Mass Transfer Processes***
- ◆ ***Interaction with Structural Materials, Water, Air***
- ◆ ***Improvement of Corrosion Resistance of Steels in Pb and Pb-Bi Alloys***
- ◆ ***Laser Separation of Lead Isotopes***
- ◆ ***Control of Oxygen Content in Lead Coolants***

**5 PROJECTS**

***IPPE, NIIEFA, PROMETHEY***

***FZK, CEA, CIEMAT, ENEA, RIT, SCK-CEN  
ANL, Mitsui***

# **Lead / Lead-Bismuth: Fuel Materials (Nitride fuel)**



## **#2680 - *Minor Actinide Transmutation in Nitrides Fuel Environment***

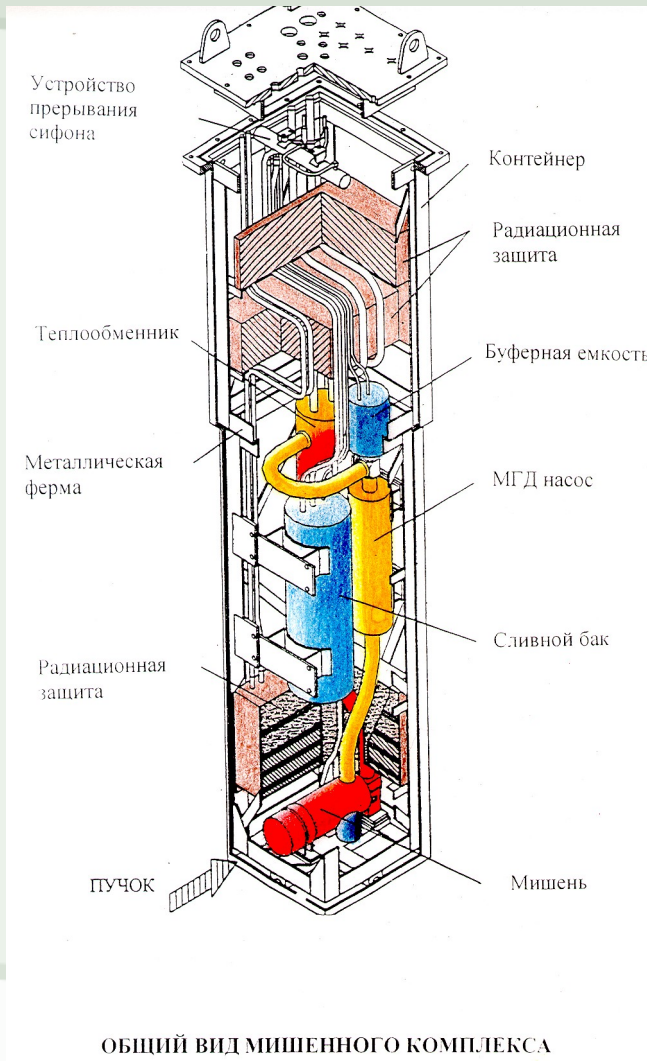
**IPPE, NIAR** *(on-going project)*

- ***Experimental study and modeling of basic properties of (Pu,Zr)N and (Pu,Am,Cm,Zr)N samples.***
- ***Modeling of nitride fuel under irradiation up to high burn-up in fast neutron spectrum.***
- ***Feasibility study of fabricating nitride fuels with inert matrix, containing curium***

## *(ADS system analysis)*

- ◆ *Lead-Bismuth contour with target (1 MW)  
for US LANSCE accelerator* **[#0559, #2083]**
- ◆ *View on CIRCE Facility* **[#1702]**
- ◆ *View on MYRRHA Conceptual Design* **[#2552]**

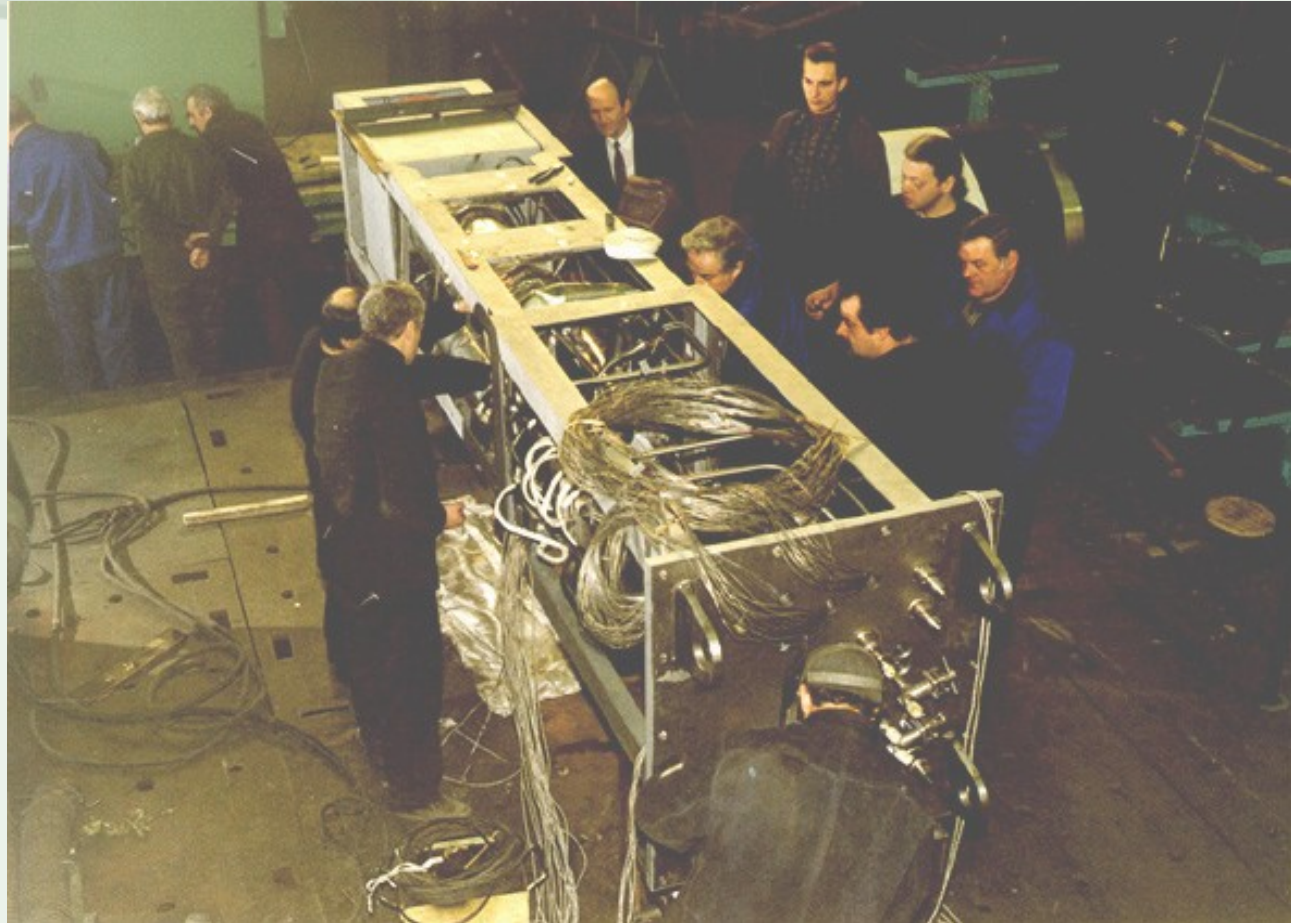
# Lead-Bismuth #559- #2083



*1 MW Pb-Bi TARGET*

*IPPE and GIGROPRESS  
(Russia)*

# **Lead-Bismuth #559- #2083 (1 MW Pb-Bi target)**



***The last nails: - from Obninsk – to Las Vegas – with love***

# GT-MHR HELIUM-COOLED REACTOR



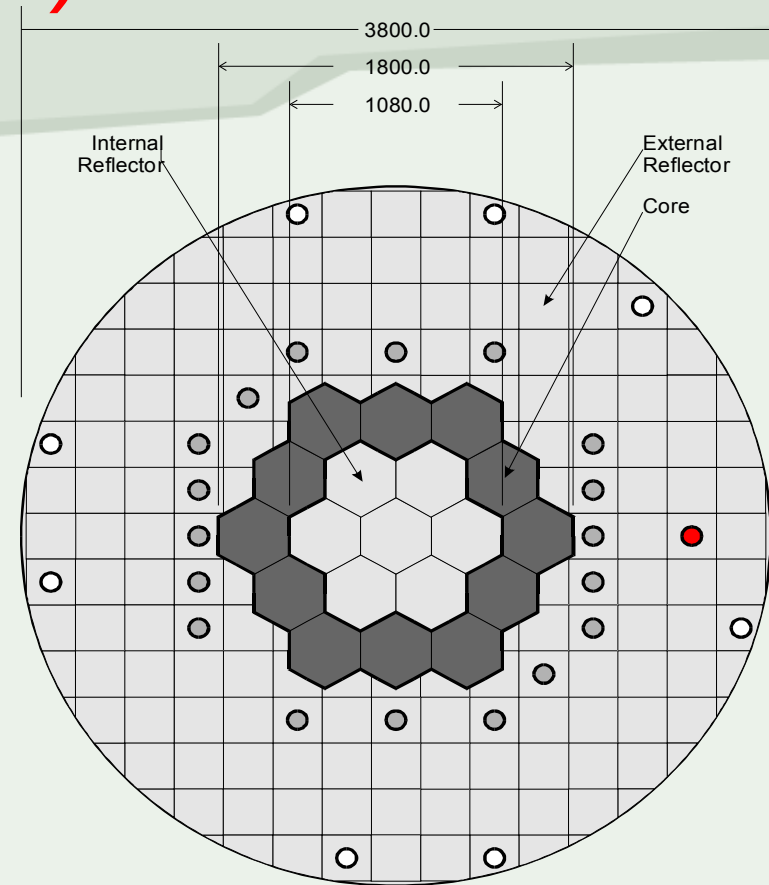
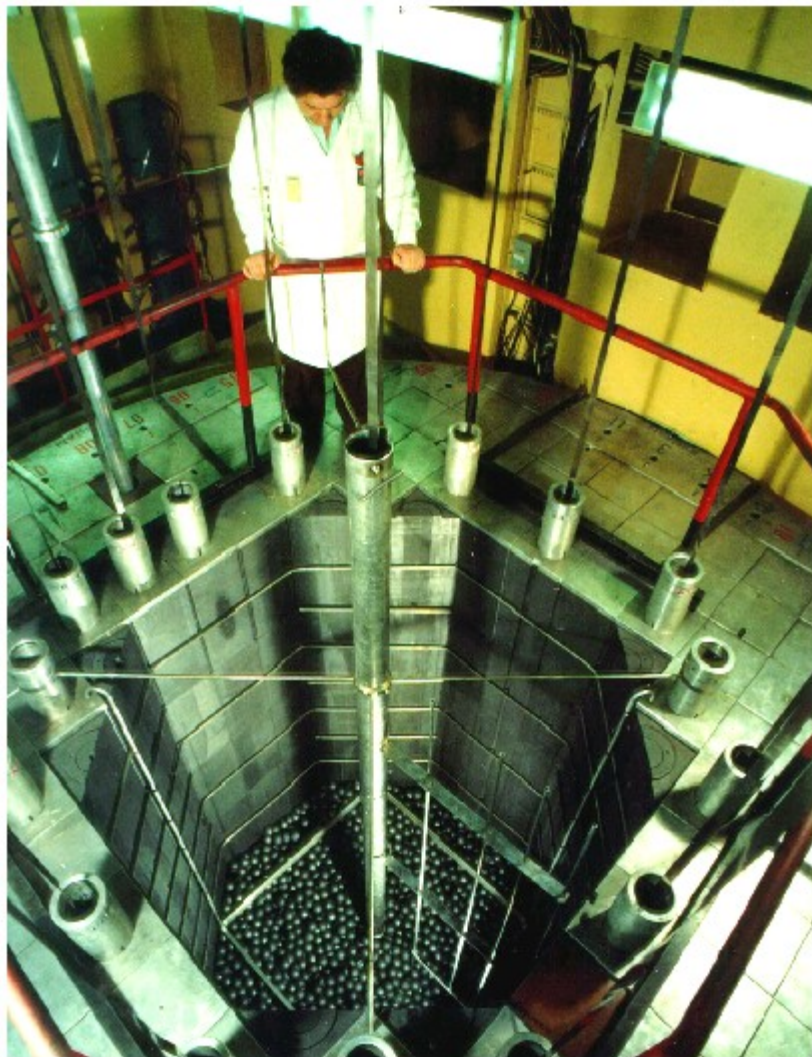
## PRINCIPALS:

- # 685 *ASTRA – Study of GT-MHR nuclear safety*
- # 269 *Conceptual design of Modular Helium Reactor*

## ENGINEERING

- # 352 *Study of technologies for high-temperature components*
- # 769 *High-temperature recuperator*
- #1194 *Special steels and welded joints*
- #1313 *Materials testing for turbo-compressor*
- #1410 *Microsphere-type fuel (for ASTRA experiments)*

# ASTRA critical installation for HTGR modeling (Kurchatov KIAE) - # 0685.2



- Channels for control and nuclear safety rods
- Ionization chambers and neutron counters channels
- Neutron source channel

Figure 3. ASTRA Critical Assembly. Version 3.  
Core - hexprisms.  
Internal reflector - hexprisms.  
External reflector - cuboids.

# **GT-MHR HELIUM-COOLED REACTOR**



## **ENGINEERING**

**OKBM, KIAE VNIINM, etc.**

**Partner – JAERI (Japan)**

- **#2379** *Experimental study of the cooler model*
- **#2395** *Creation of gas seal for shaft*
  
- **#2399** *Design of powerful diaphragm coupling*
- **#2400** *Experimental study of the seal mock-up*

# Molten Salts



- **VNIITF / KIAE #1606** - *“Molten Salt Loop for Waste and Plutonium Disposal”*

- Measurement of molten-salt characteristics
- Structural materials verification (corrosion, etc.)

- **KHLOPIN RI #1608** - *“Molten Salts for RAW Treatment”*

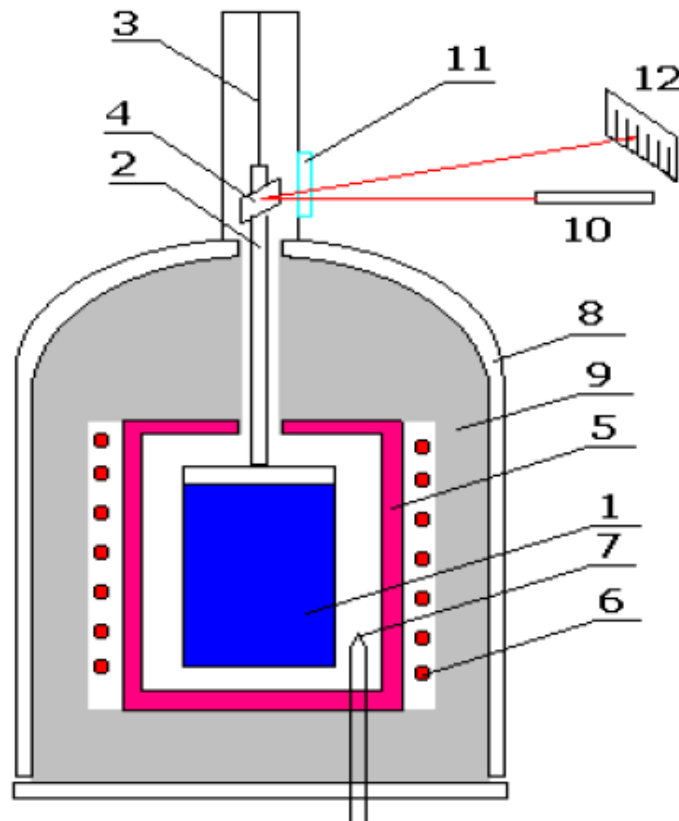
- Extraction and evaporation LL nuclides
- Concentrating of the liquid RAWs
- Production of solid mineral-like matrix

- **Actions: EUROPART, EC, IAEA and ISTC**

- Technical training in France (March, 2006) and in Russia (November, 2006)
- International topical Workshop, EUROPART / ISTC (June, 2006, Italy)

# Molten Salts

## # 1606 : Measurement of molten-salt characteristics



1. crucible with molten salt
2. rod
3. string
4. mirror
5. thermostatic insert
6. heater
7. thermocouple
8. vessel
9. thermoinsulation
10. He-Ne laser
11. window
12. scale

**Figure1:** The scheme of experimental facility for kinematic viscosity measurement.

# ***NPP with Supercritical Pressure Water***



**# 2689 - Supercritical Pressure Water for Nuclear Power Engineering (IPPE, Obninsk)**

**# 3213 – Modeling for Channel-Type Reactor with Coolant of Supercritical Parameters (NIKIET, Moscow)**

# ***CEG RAW Partitioning and Transmutation***



***1997 – 2007***

***11 meetings  
(EU, USA, Russia, Korea)***

***Chairman – Prof. Wacław Gudowsky  
(1997- 2006)***

***Chairman – Dr Ved Bhadnagar  
(2006 – 2007)  
Secretary - Michel Hugon***

# CEG “RAW Transmutation”: Technical problems



## Subject:

*Irradiated (spent) fuel =  $^{235}\text{U}$ , Pu, MA (Am, Np, Cm), Fission Products*

## Goals:

*To reduce radio-hazard of RAW*

*(up to  $10^4$  times - to the level of natural Uranium)*

## Methods:

- *Additional irradiation (Reactors, ADS-Accelerator Driven System, Fusion)*
  - *Extraction;*
  - *Partitioning;*
  - *Irradiation;*
  - *Post-irradiation processing;*
  - *Final stage – vitrification, long-term storage, final burial*

# CEG “RAW Transmutation”: Technical problems (continue)

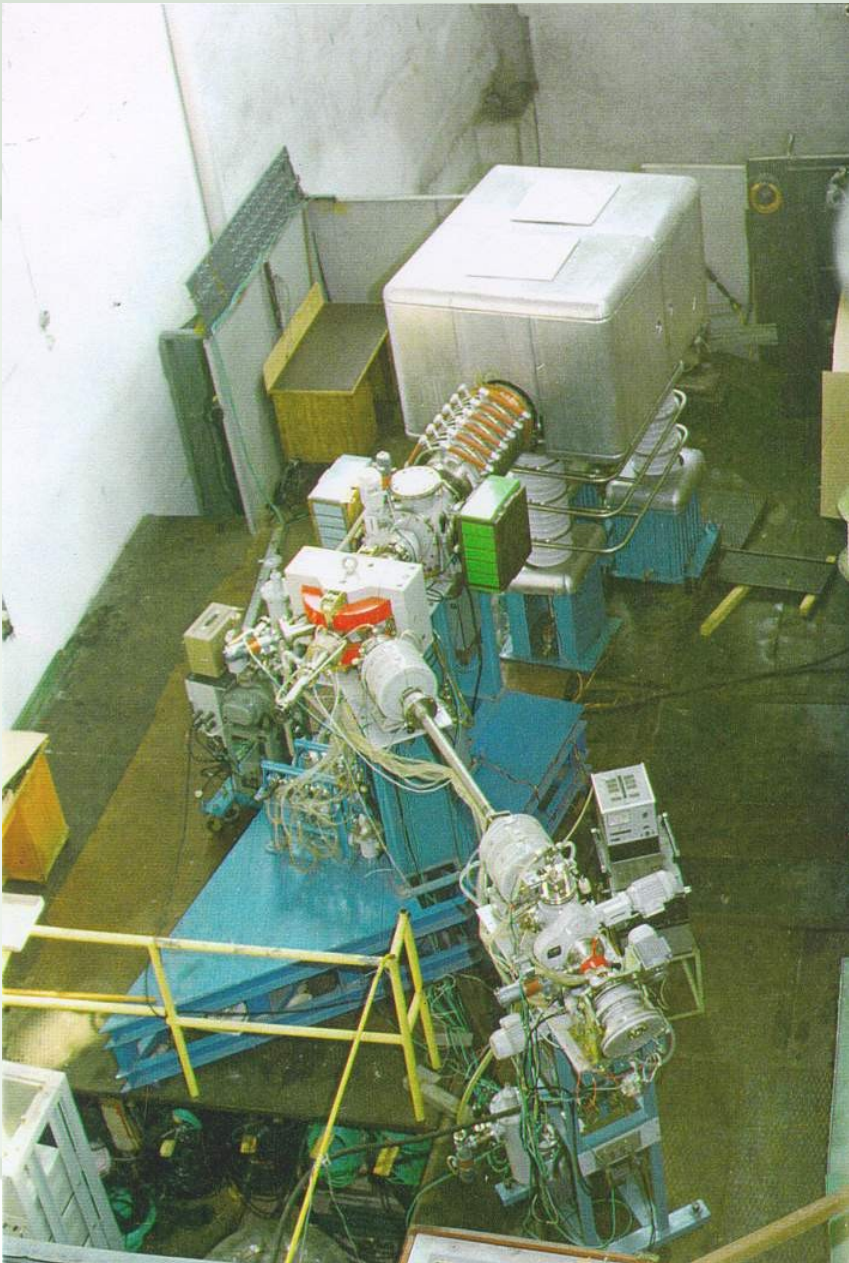


- *Conceptual studies*
- *Large-Scale Demo-Experiments*
- *Irradiation tests (by neutrons in-reactor, by accelerated particles beams)*
- *Nuclear data (neutron, spallation cascade, etc. – measures, libraries)*
- *ADS – Power target, Accelerator components*
- *Radio-Chemistry – Partitioning, Extraction*
- *Materials – Fuels, Construction materials\_*

# Transmutation: Reactor concepts

- *BREST–300: 300 MW Demo lead-cooled power reactor with inherent safety (Monograph) , NIKIET* [#1418]
- *Small power reactor with lead-bismuth coolant, IPPE* [#1762]
- *Transmutation in Fast Reactors - Experimental and calculation investigation of the reactor concept with extreme neutronics and thermal-hydraulic characteristics, NIKIET* [# 0134]

**Large-Scale Demo-Experiment  
Minsk, Belarus**



• # B-070 : **YALINA**

• *neutron generator,*

• *Uranium (enriched) blanket*

• *Two international on-site workshops in 2005*

• *On-site technical training*

**“SAD-YALINA” Steering committee**

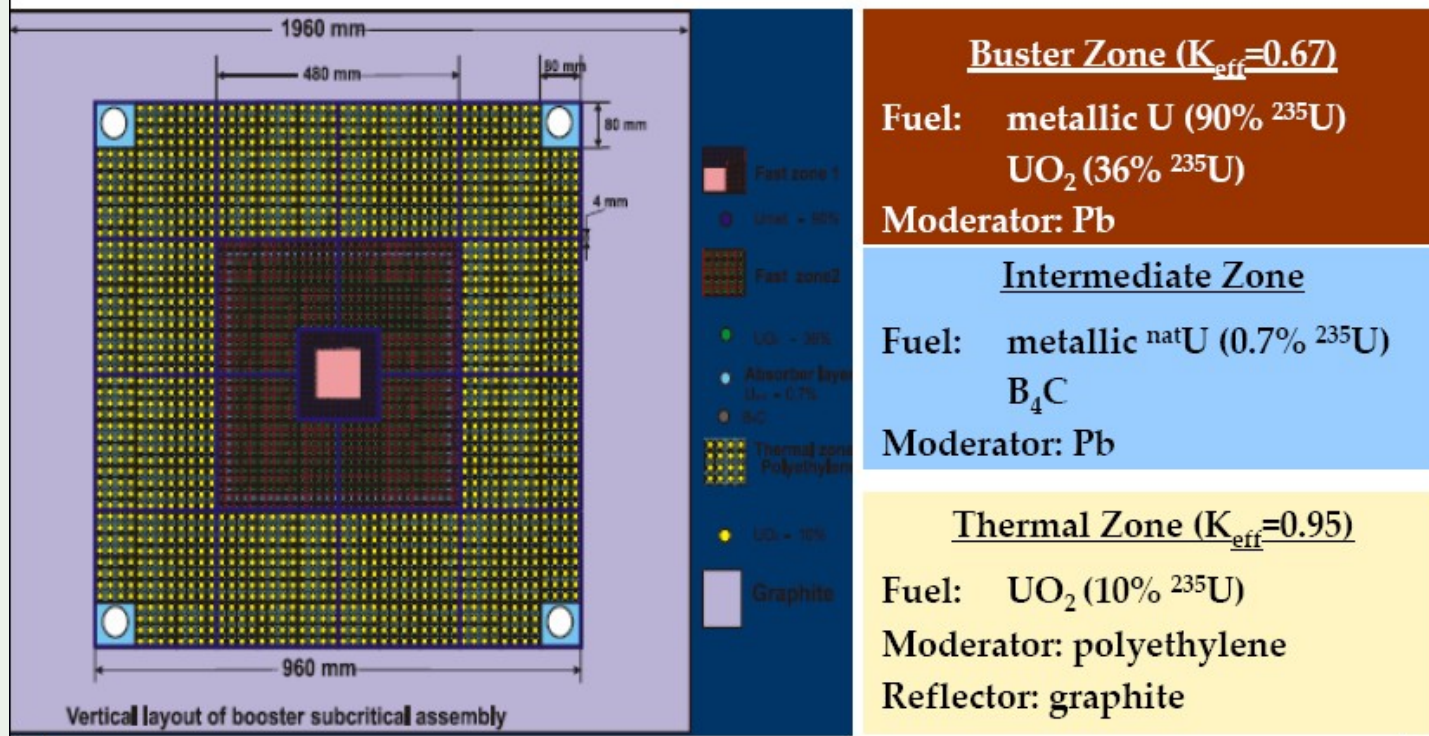
**CEA, EUROATOM/ CIEMAT, FZK, RIT (Sweden), IAEA**

• **Actions:** *Extension of experiments*

# ADS: YALINA: Large-Scale Demo-Experiment Minsk, Belarus

## YALINA-B /buster configuration

The fast zone – considered as a volume source – close to the spallation target of SAD and MYRPHA experiments



# **ADS: Large-Scale Demo-Experiment**

## **SAD – Subcritical ADS in Dubna**



### **•# 2267 SAD (JINR, Dubna)**

- Subcritical Uran-Plutonium blanket (30 kW), driven by proton cyclotron (660 MeV);**
- Lead-Bismuth target**

### **SAD-YALINA Steering committee**

- CEA, EUROATOM/ CIEMAT, FZK, RIT (Sweden), IAEA**
- EUROTRANS, EUROPART, ECATS**

# **ADS: SAD**

## **-- Large-Scale Demo-Experiment, Dubna**



***The proton accelerator with energy 660 MeV.***

- Beam transport line.***
- Replaceable targets of various length and material (Pb, W, Pb-Bi).***
- Subcritical multiplying assembly (BN-600 type),  $K_{eff} = 0.95$ .***
- Reflector and radiation protection.***
- Systems of cooling of a target and blanket.***
- Protective and monitoring systems.***

## **Transmutation: Nuclear Data**

◆ *Above 30 projects fulfilled (up to 3 GeV):*

- *Spallation reactions;*
- *Neutron-induced reactions;*
- *Proton-induced reactions*

◆ *Review: #2578, “Transmutation of radioactive nuclear waste – present status and requirement for the problem” –*

*Review of results , coordination of study*

• *Actions:* *to publish review and some project reports in journals*

## ***CEG Partitioning and Transmutation: Radiation Chemistry, Molten Salts***

- ***RIAR, #3261 “Study of curium thermodynamics in molten chlorides”***
  
- ***Khlopin: #2068/ # 3405 “Chemical problems of minor actinides recovery for transmutation”***
  
- ***Actions (IAEA and ISTC): to arrange international topical Workshop (June 2006, Italy) for coordination with EU FW Programs (EUROPART) = done***

# **CEG “SAM” – SEVERE ACCIDENTS MANAGEMENT**



■ *Corium study and modeling:*

*METCORE, CORPHAD, EVAN, INVECORE*

■ *Chernobyl lava data-base/ models (above 7 000 measurements):*  
*CHESS*

■ *Quench-type experiments:*  
*QUENCH, PARAMETER*

*Dozen projects*

*NITI, IBRAE, KIAE, RIAR, LUCH, GIDROPRESS, VNIPIET,  
S-P TU, Kaz NNC*

*Collaborators : FZK, FZR, IRSN, ITU, CAE, Framatome, and others*

# **CEG “SAM” – SEVERE ACCIDENTS MANAGEMENT**



*CEG SAM – “Severe Accident Management” (10 meetings)*

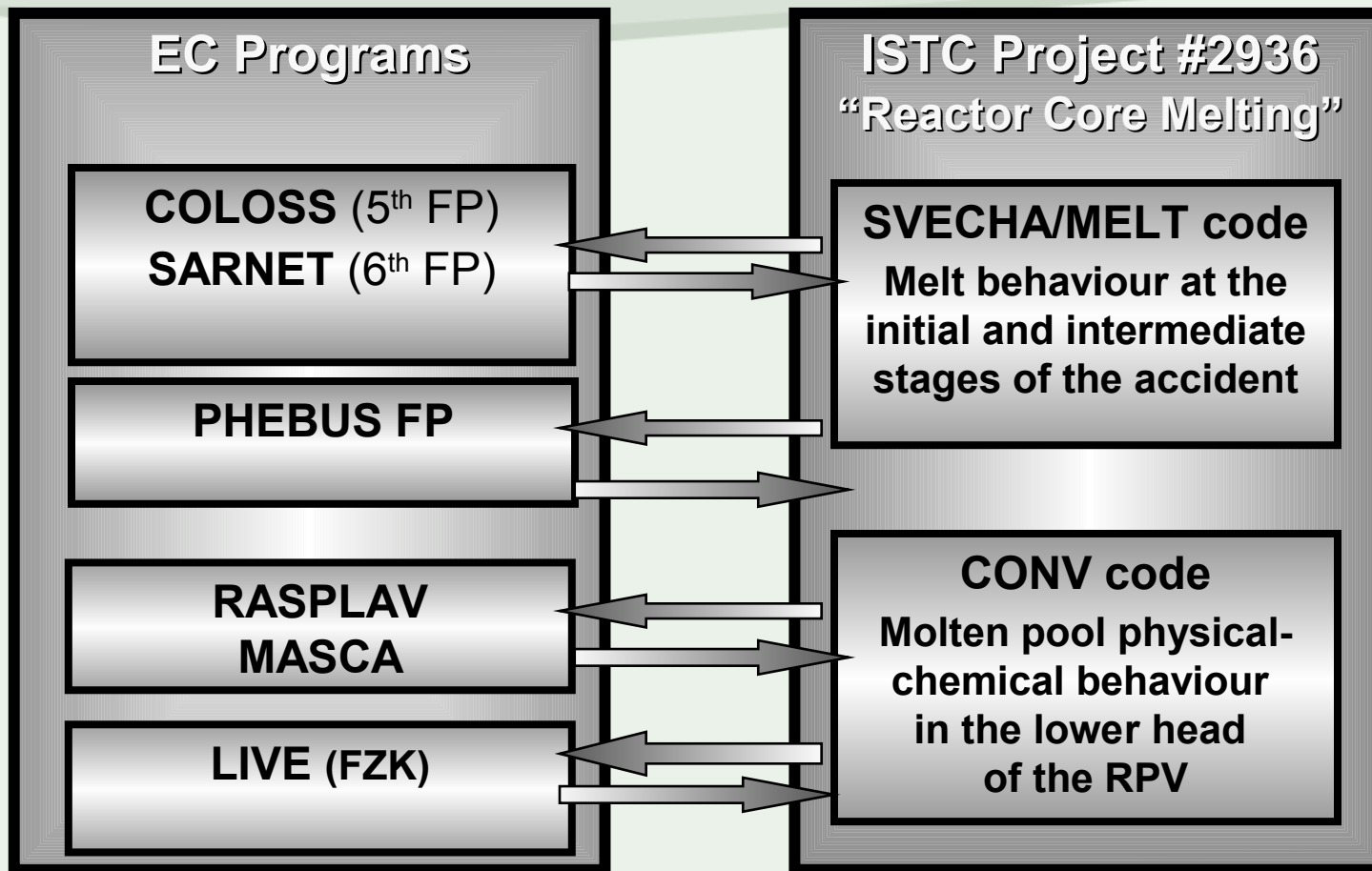
*Above twenty collaborators (EU, Canada, Korea)*

*Chairman - Dr. Alejandro ZURITA (2001 – 2005)  
- Dr. Michel HUGON (2005 –2007)*

*Co-Chairman - Dr. Lev TOCHENY*

*Secretary -Dr. Peter HOFMANN*

# Severe Accident Management (CEG SAM)



# ***Plant Life Management (CEG PLIM)***



***Five CEG meetings 2004 – 2006***

***STCU – Ukraine experts joint CEG-PLIM***

- ***Rome, Italy***
- ***Podolsk, Russia***
- ***Madrid, Spain***
- ***St-Petersburg, Russia***
- ***Bergen, the Netherlands***
- ***(Next 6<sup>th</sup> CEG meeting – June, 2007, to be determined)***
- ***Chairman – Dr. Marc Deffrennes***
- ***Co-Chairman – Dr. Lev Tocheny***
- ***Secretary – Dr. Antonio Ballesteros***

# ***Plant Life Management (CEG PLIM)***



## ***Dozens of VVERs are out of Russia***

- ***Methods for measurements of reactor vessel and internals parameters;***

### ***Methods for plant-life assessment;***

- ***Computer modeling and codes;***
- ***Data-bases;***
- ***Normales and Codes.***

Accordingly to the ISTC Data-Base:

- Total number of related projects and proposals - 75,  
*including:*
- Hybrid Systems and Fuel Cycle – 6
- Inertial Confinement Systems – 13
- Magnetic Confinement Systems – 14
- Other – 17
- Plasma Physics – 25

# **CEG FUSION**



***Two CEG meetings in 2006 (EC, Brussels)***

***STCU – Ukraine experts joint CEG***

- Chairman – Dr. M.Q. Tran***
- Co-Chairman – Dr. Lev Tocheny***
- Secretary – Dr. Alejandro Zurita***

# ***NEAR FUTURE EVENTS and PLANS***



➤ ***Links ISTC – EU FP-7 , GIF, INPRO, GNEP***

➤ ***Two-ways information exchange***

➤ ***New CEG - ?? – GIF***

➤ ***Seminars, Proceedings***

➤ ***Web-Page***

## ***NEAR FUTURE PLANS - PROBLEMS***

- ***Links with GIF, coordination for innovatives***
- ***Activity for INPRO***
- ***Links with EU FWPs***
- ***CEG HTGR – renovation of group for GIF***

**THANK YOU !**

**СПАСИБО !**