

# Long-term behavior of corium after the accident (using the data of the Chernobyl NPP accident)

**"CHESS-2" – anticipated Project of the ISTC #3702**

Topical Meeting on ISTC Projects  
1648, 2916, 2936, 3194. Podolsk-  
Moscow, July 3-5, 2007



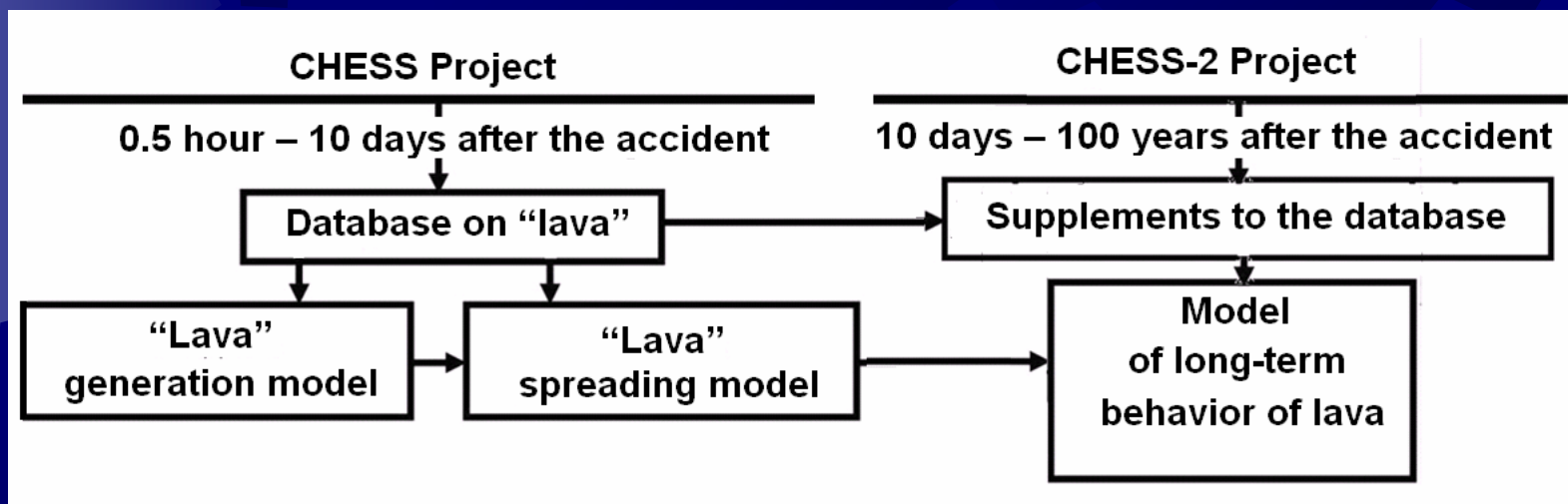
# CONTENT

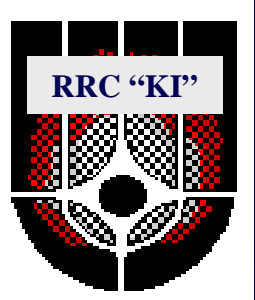
- **Objectives of new Project #3702 and its interface with Project #2916 (CHESS-1)**
- **Tasks of the Project #3702**
- **Interface with STCU Project # 4207 “Long-term prognosis of transformation of the fuel-containing materials (FCM) in Chernobyl Shelter”**

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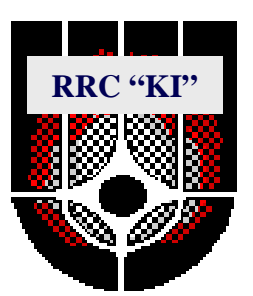
# CHES-1 and CHES-2 interface





## General objectives of CHESS Projects

- ❖ **Data acquisition on corium properties and its variations for all the time up today;**
- ❖ **Simulation and long-term prediction of the behavior of “lava” up to 100 years ahead in the course of its storage in the “Shelter” under the new confinement**
- ❖ **Elaborating recommendations on safety measures during storage and ultimate removal of “lava” from the “Shelter”**



# Practical application

- ✦ In case of severe reactor accident resulted in corium formation, there is no practical opportunity to withdraw quickly fuel containing material outside the Unit, or properly isolate it (like in case of the ChNPP).
- ✦ What can we expect from the accidental fuel inside the building from the viewpoint of the LFCM transformation?
- ✦ How much time do we have before drastic measures for fuel withdrawal / isolation will be necessary?
- ✦ What sort of corium will we have to the time of its withdrawal and disposal of?





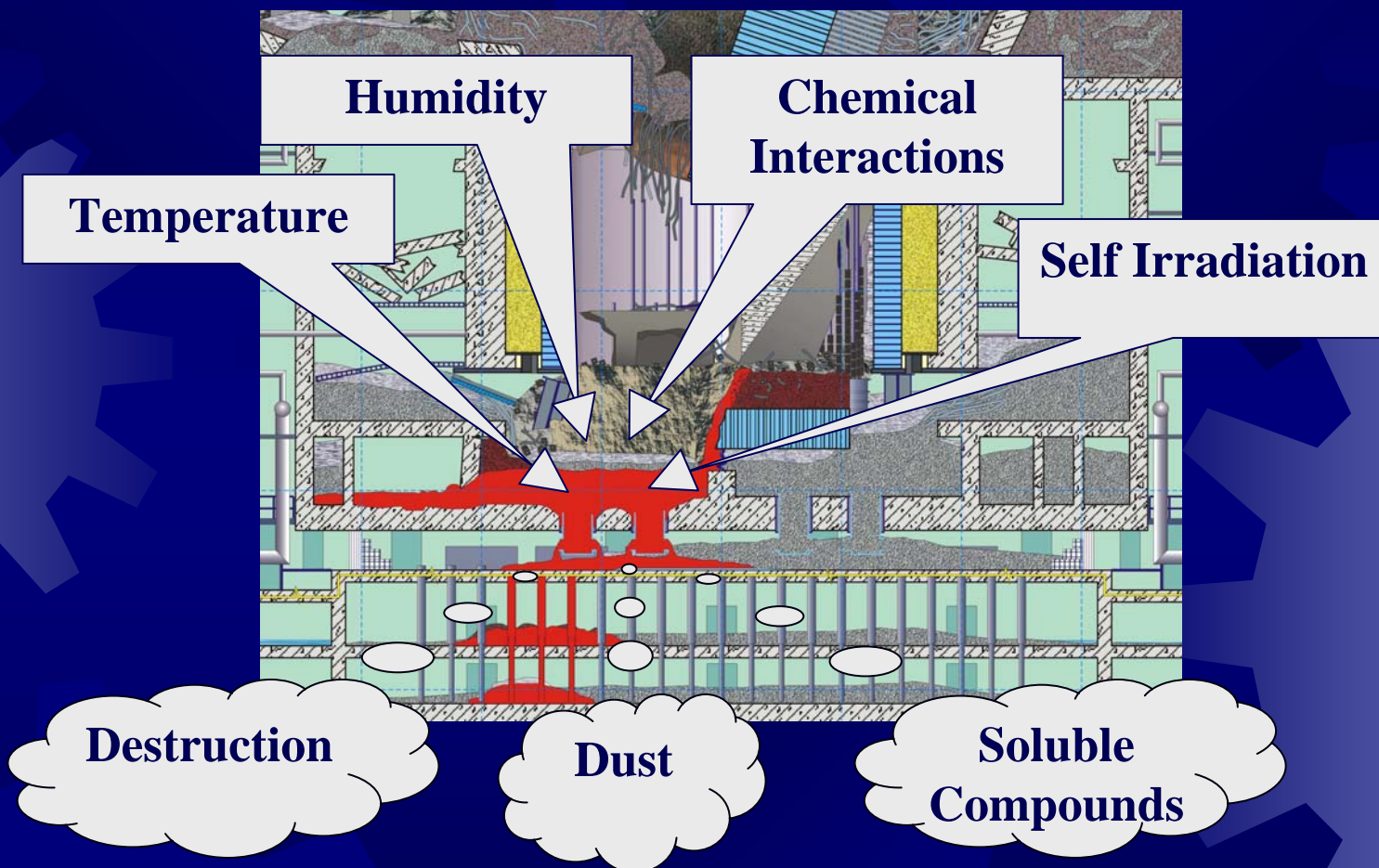
## Practical application (new)

★ Reaction to hypothesis of generation of hazardous amount of **submicron aerosols** by “lava” inside Sarcophagus – contribution to decision on ongoing Shelter-2 construction:

- participation in planning and data processing of the experiments for studies of submicron aerosols in the Shelter;
- forecast of submicron particles (if any) spreading over the Shelter from lava surface.



# Chernobyl experience



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*initial data acquisition and analysis*

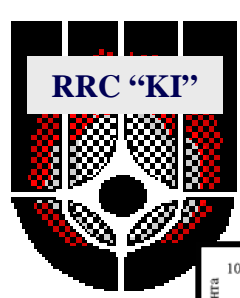
- **Description of macro-properties of Chernobyl "lavas", their different types and forms (ceramics, pumice, slag, etc.) generated after corium solidification, of physical and chemical properties and factors influencing their distinctions**

- **Structure and physical and chemical properties of Chernobyl "lavas" at the micro-level (the main matrix and types of inclusions, distribution of radioactivity between the matrix and inclusions, etc.)**

- Identification of the main mechanisms of the Chernobyl HP formation and factors determining the differences between the HP types;
- Classification of HP according to the physical and chemical characteristics (matrix, coefficients of the radionuclides fractionation, fuel burn-up, types of inclusions, chemical stability);
- Modernization of the UIAR database "Hot particles" and its update with the obtained information

30 microns





#3702 (Russia)

#4207 (Ukraine)



*analysis of impacts on FCM*

- Examination of the effects of humidity regimens
- Examination of the effects of temperature
- Radiation model of “lava” taking into account both external exposure and its own radioactivity. Special attention will be focused on dose buildup in “lava” material resulting from  $\alpha$ -decay processes



- Identification of the main sources of RA formation in Shelter;
- Dependence of the airborne concentrations in the Shelter rooms on external factors including seasonal ones;



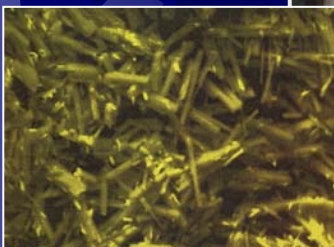


#3702 (Russia)

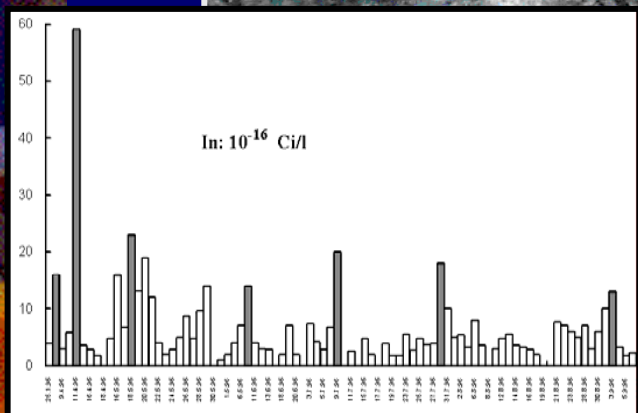
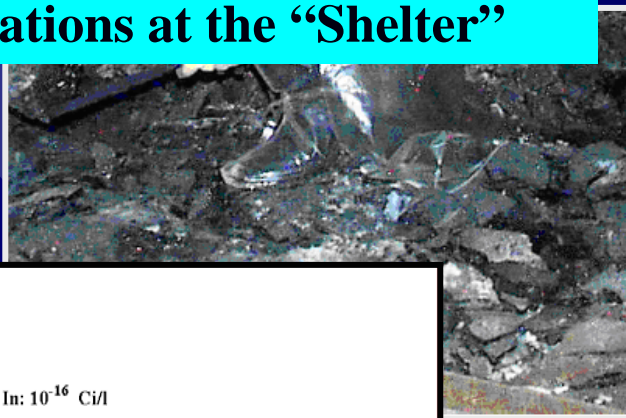
#4207 (Ukraine)

*analysis of real data obtained*

**• Investigations at the “Shelter”**



- Determination of the RA characteristics (dispersal rates and radionuclide composition);
- Evaluation of the possibilities to control the FCM state and destruction mechanism/rates.



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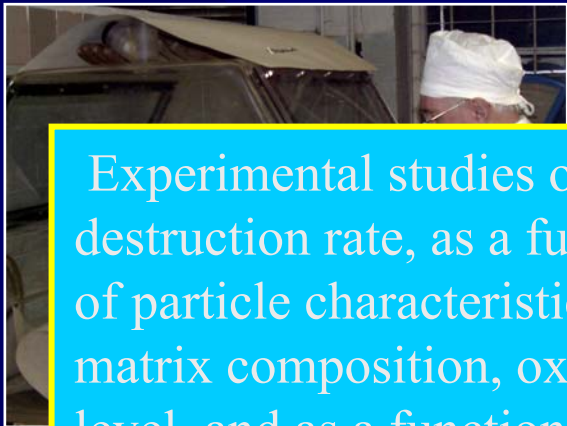
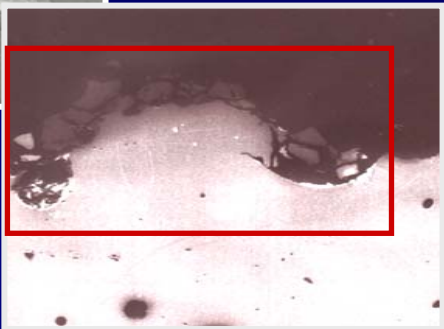
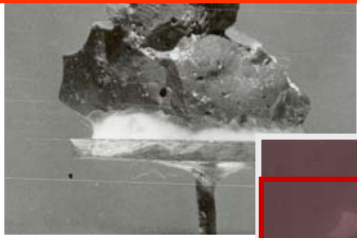
#4207 (Ukraine)



*laboratory studies of the samples*



**• Generalization of the results of monitoring of “lava” samples having been in laboratories and at special storages of RRC KI, Radium Institute, etc.**

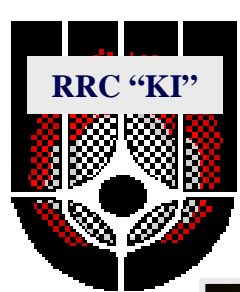


Experimental studies of FP destruction rate, as a function of particle characteristics: matrix composition, oxidation level, and as a function of the medium:

- a) air: humidity, temperature;
- b) aqueous: composition, pH, temperature







## Task 4. Study of existing LFCM analogues and results of their studies under long-term storage



- Collection and analysis of the data on vitrified waste;
- Identification of waste types similar to “lavas” and their properties



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## **Task 5. Model of the long-term behavior of corium**

**5.1. Establishing the dependence of dynamics of solidified corium behavior on variations in its internal composition and external conditions at present.**

**5.2. Usage of calculation, theoretical and experimental data obtained for vitrified waste to generate corium behavior model.**





## Resources required

<b>Participating personnel</b>	<b>19 (13 “weapon” scientists);</b>
<b>Project duration</b>	<b>30 months;</b>
<b>Estimated cost</b>	<b>345,000 USD</b>