Introduction

The utilization of nuclear fission reactors with their inherent production of long-lived radioactive isotopes like transuranium elements and fission products makes a careful treatment of the spent nuclear fuel mandatory.
Transmutation, i.e. transformation of long-lived isotopes into other short-lived or stable isotopes or elements by changing the nuclear structure through e.g. neutron irradiation can help us to ease nuclear waste management problems.
Of particular interest for the scientific community in recent years are hybrid systems, commonly called Accelerator-Driven Systems (ADS) or Accelerator-Driven Transmutation of Wastes (ATW), integrating a sub-critical reactor core, i.e., a fissile material assembly unable to support a self-sustained chain reaction, with an intense spallation neutron source driven by a powerful particle accelerator.
The basic goal of ADS is reduction of hazards related to handling and management of spent fuel through nuclear transmutation and, possibly, improvement of operational safety of nuclear power facilities, especially in the case of cores fuelled with dedicated (high actinide content) fuels which can not be handled in critical reactors because of the poor dynamics and safety characteristics of such cores.
Compared to the well established critical reactor systems, ADS systems have different physics, kinetic, dynamic and radioprotection behaviour, which needs further experimental exploration.

The proposed **SAD** facility is the first low power **ADS** prototype, coupling all the main components of an ADS for future nuclear waste incineration.

Participating Institutions

Leading Institution

International Intergovernmental Organization
Joint Institute for Nuclear Research,
141980, Joliot-Curie 6, JINR, Dubna, Russia
Project manager Valery Shvetsov: shv@nf.jinr.ru

Other Participating Institutions

Federal State Unitary Enterprise Research and Development Institute of Power Engineering (NIKIET Russian abbreviation)

Industrial Association “Mayak”

Federal State Unitary Enterprise State Special Project Institute (GSPI Russian abbreviation)

Russian Scientific Research Institute of Inorganic Materials (VNIINM Russian abbreviation)

Foreign Collaborators

Kungliga Tekniska Högskolan - KTH,
Nuclear and Reactor Physics, Dr. Waclaw Gudowski

Forschungszentrum Karlsruhe - FZK,
Institut für Reaktorsicherheit, Dr. Cornelis Broeders

Centro de Investigaciones Energéticas Medioambientales y Technológicas - CIEMAT,
Dr. Enrique Miguel Gonzalez Romero

Commissariat à l'Energie Atomique - CEA, Cadarache,
Dr. Frederic Mellier

Timeline

Project startup - November 2003
Project design - April 2005
Licensing - 2005
First criticality tests - 2007

Subcritical Assembly at Dubna

SAD

Proton Accelerator 660 MeV and Subcritical MOX Blanket for a 20 kW Prototype ADS

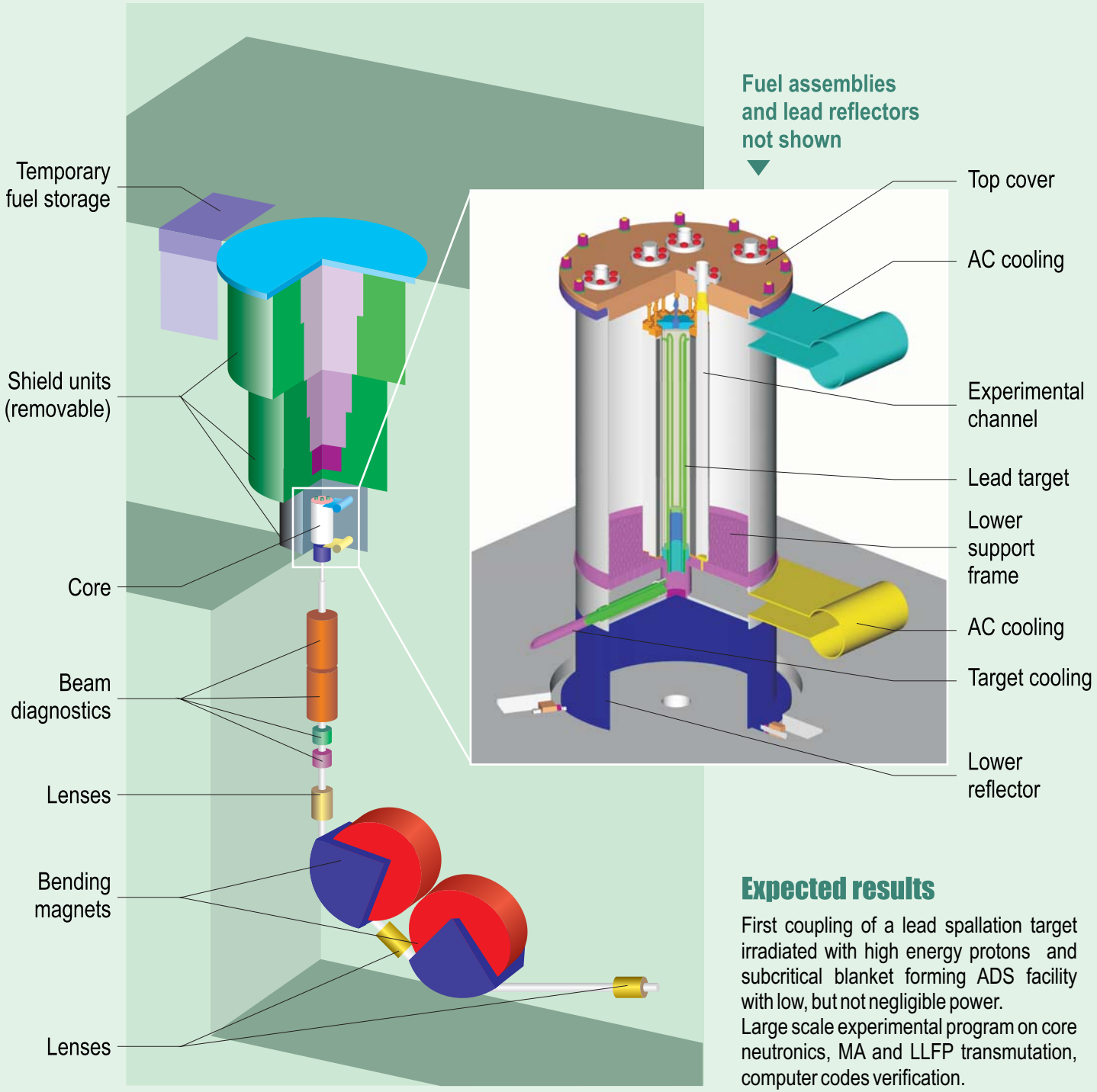
SAD basic features

System	Parameter	Value
Target	Number of elements	19 hexagonal prisms
	Material	Lead
	Pitch, mm	36
	Spacing between prisms, mm	1.5
Active Core	Height, cm	60
	Number of fuel assemblies	141
	Number of fuel elements per one assembly	18
	Fuel density, g/cm^3	10.4
	Plutonium dioxide percentage, %(mass)	29.5
	^{239}Pu percentage in Pu, %	95
	^{235}U content in U, %(mass)	0.4
Fuel Element	Pitch, mm	7.95
	Clad tube diameter, mm	6.9
	Clad tube thickness, mm	0.4
	Fuel pellet diameter, mm	5.95
	Fuel height, cm	58

Experimental program

The experimental program is still in the definition phase. It will include the following topics:

- Analysis of the coupling of a lead spallation target with a fast sub-critical core;
- Study of reactivity parameters: α, ρ/β_{eff}, β_{eff}/τ;
- Measurements of incineration/transmutation rates of actinides and long-lived fission products;
- Measurement of spallation products yields;
- Investigation of spallation neutrons shielding and radioprotection problems;
- Dynamics experiments at low but not negligible power.



Expected results

First coupling of a lead spallation target irradiated with high energy protons and subcritical blanket forming ADS facility with low, but not negligible power.
Large scale experimental program on core neutronics, MA and LLFP transmutation, computer codes verification.