



# U.S. Roadmap on ATW

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## Two main initiatives at European level

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### **R&D ACTIVITIES:**

- Paper-Work and Experiments carried out at CERN (started in 1993)
- 5<sup>th</sup> European Framework Programme (1999-2002)
- IABAT PROJECT WITHIN THE 4<sup>th</sup> EUROPEAN FWFP

### **DEMO ORIENTED INITIATIVE (started in 1998):**

- ADS\_TWIG: initially restricted to France, Italy and Spain. Now enlarged to all the interested European countries
- Two ASAP\_DEMO Reference Configurations

# 5<sup>th</sup> European Framework Programme

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- Proposals prepared and finalised during 1998-99
- All the main Research Organisations and Industrial Companies involved
- First deadline to submit proposal (under Partitioning & Transmutation item): October 1999

# 5<sup>th</sup> European FMWP: Open tasks for ADS

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- ADS System Analysis
- Irradiation Effects on Materials
- Pb-Bi, Corrosion and Quality Control
- MUSE Experiment
- Nuclear Integral Data
- Pb and Bi Nuclear Data
- Differential Measurements of Nuclear Data
- TOF experiment at CERN
- Fuel and Matrices
- Strategy Studies
- Pyrochemistry

# ADS Technical Working Group

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## **Main steps:**

- Created on May 1998 following the mandate of the Research Minister of France, Italy and Spain
- Interim Report issued on October 1998
- Recently (21<sup>st</sup> of April) enlarged to other interested European Countries (Austria, Belgium, Finland, Germany, Portugal)
- First Enlarged TWG Meeting: July, 27

**MINISTER'S ADVISORS GROUP MEETING ON**

**ACCELERATOR DRIVEN SUBCRITICAL SYSTEMS**

21<sup>st</sup> April 1998

INFN Headquarters  
Piazza dei Caprettari 70 - 00186 Roma  
tel. 39 06 6840031 - fax 39 06 68307924

**LIST OF PARTICIPANTS**

<b>AUSTRIA</b>	HELMUT RAUCH RAT WOLFGANG REITER
<b>BELGIUM</b>	PIERRE D'HONDT
<b>DENMARK</b>	HANS BJERRUM MØLLER
<b>FINLAND</b>	MIKAEL BJOERNBERG
<b>FRANCE</b>	HUBERT FLOCARD RÉNE PELLAT
<b>GERMANY</b>	GERHARD HEUSENER K. KUGELER
<b>PORTUGAL</b>	JOSÉ CARVALHO SOARES
<b>UK</b>	PETER STOREY
<b>SPAIN</b>	FERNANDO ALDANA JOSÉ M. MARTINEZ VAL
<b>SWEDEN</b>	PER-ERIK AHLSTROEM
<b>ITALY</b>	PAOLO FASELLA GIUSEPPE GHERARDI ENZO IAROCCHI ANGELO MARINO CARLO RUBBIA

c) The chairman of the Technical Working Group should invite representative of PSI (Switzerland) to participate.

6. The next meeting will take place in Rome on Friday September 17<sup>th</sup> 1999.

This meeting should discuss the recommendations of the Technical Working Group and adopt operational decisions, including ways to assure the mutual commitments of participants.

7. Participants agree that representatives from Switzerland and the Directors General of CERN and of JRC should be invited to the above meeting.

CONCLUSION OF MINISTER'S ADVISORS GROUP MEETING ON  
ACCELERATOR DRIVEN SUBCRITICAL SYSTEMS

21<sup>st</sup> April 1999

INFN Headquarters

The list of participants is given in Annex 1:

1. It was agreed that transmutation represents an attractive approach to radioactive waste disposal, being complementary to geological disposal.
2. All participants appreciated the proposal to extend the participation in the initiative to other European countries besides ESP FR IT, particularly considering that similar approaches are being undertaken in the USA and Japan.
3. The interim report of the ad hoc Technical Working Group established in 1998 has been accepted as a good basis for future work.
4. This work should be carried out by an extended Technical Working Group under the chairmanship of Carlo Rubbia. Participants in this group are given in annex 2.
5. The Technical Working Group must deliver its report, including operational recommendations by the end of July 1999.

The group will have to:

- a) Collect information on all work being undertaken in different countries and within the EU frame, with particular reference to the proposals under the EU Framework Program V (the deadline for the submission of the proposal is 4<sup>th</sup> October 1999).
- b) Identify all main research needs and propose an action plan to satisfy them, including tentative cost estimates, the attribution of tasks to participants and the use of existing facilities.

## LIST OF PARTICIPANTS TO THE ADS TECHNICAL WORKING GROUP MEETING

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### 1. Members

- 1.1 *Chair:* Carlo Rubbia, ENEA
- 1.2 *Austria:* Helmut Leeb, Institut für KernPhysik Technische Universität Wien
- 1.3 *Belgium:* Hamid Ait Abderrahim, SCK.CEN
- 1.4 *Finland:* Mikael Björnberg, University of Helsinki – VTT Energy
- 1.5 *France:* Bernard Carlucci, NOVATOME/FRAMATOME  
Alex Mueller CNRS-IN2P3  
Jean-Baptiste Thomas, CEA-DRN
- 1.6 *Germany:* Gerhard Heusener, FZK
- 1.7 *Italy:* Giuseppe Gherardi, ENEA-ADS  
Giuliano Locatelli, ANSALDO  
Marco Napolitano, INFN
- 1.8 *Spain:* José Maria Martínez-Vál, Scientific Adviser of the Spanish Office for  
Science and Technology  
Enrique González Romero, CIEMAT
- 1.9 *Scientific Secretary:* Stefano Monti, ENEA

### 2. Invited Guest

Massimo Salvatores, CEA

### 3. Logistic contact:

Mrs. AnnaMaria Fornasaro, CERN - Geneva

# Mandate of the Group of Advisors

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- Potentialities of ADS for transmutation of LLW
- Construction of a DEMO plant on a 10 years time schedule
- R&D: co-ordination between governmental agencies and industrial bodies
- Regional facility. European collaboration (support within 5th-FMWP). Collaboration with USA and Russia
- Appropriate industrial platform (agreement among interested European partners)

# Mandate of the Group of Advisors

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10 years European programme in three time phases:

- ① European partnership: setting up of a Technical Working Group
- ② R&D programme: final design of the demonstration facility
- ③ Construction and operation

# Mandate of the Group of Advisors

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Issues to be considered:

- Accelerator technologies
- (beam) window technologies
- liquid metal technologies
- Material testing
- Fuel cycles
- Safety and site licensing

## Mandate of the Group of Advisors

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“The TWG should give a cost estimate for the necessary, related activities, namely the generalised R&D and the demonstrator”

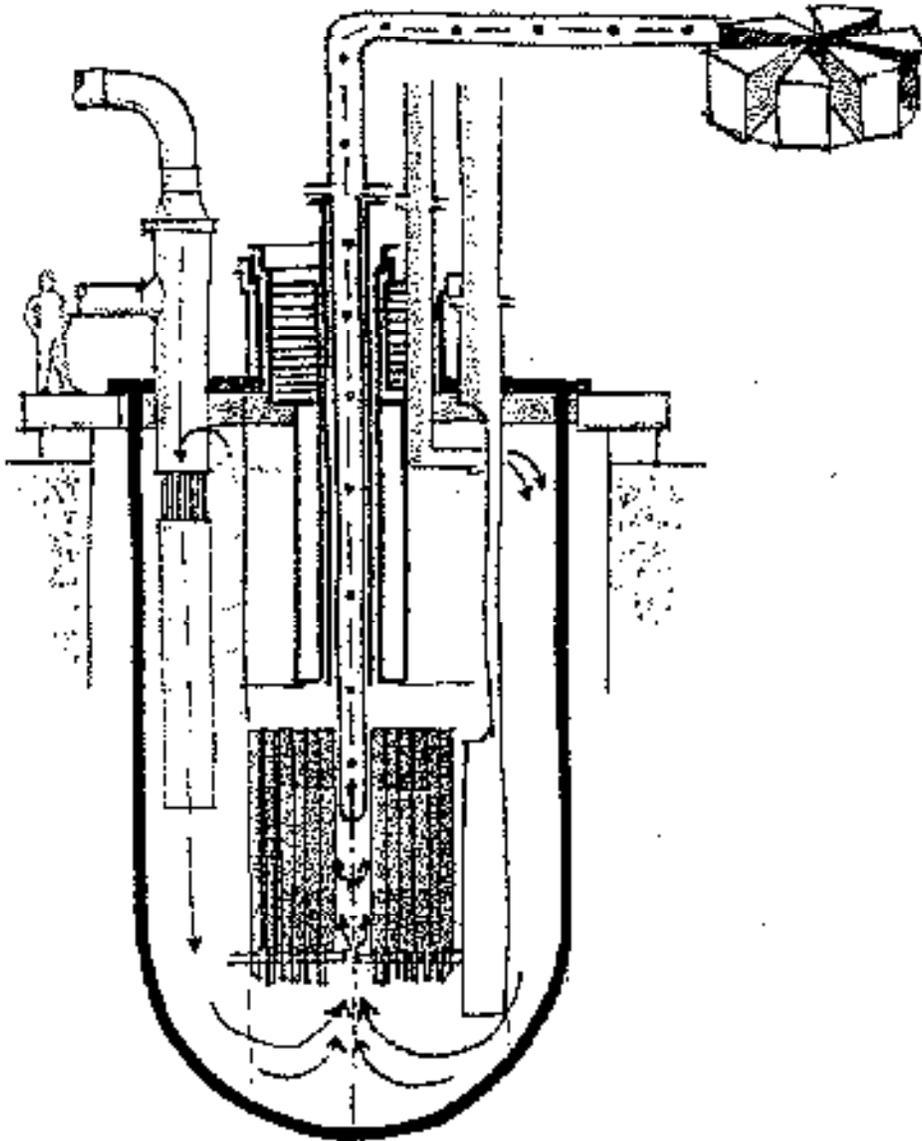
“The initial expenditure rate for 1999 has been recommended to be not less than 10 MECU/country in order to keep the necessary momentum”

**ANSALDO**

Ansaldo Nucleare  
Ramo d'Azienda di Finmeccanica S.p.A.

# Energy Amplifier Demonstration Facility Reference Configuration

## Summary Report



# Programme for ADS\_DEMO Development

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- Core, Target & Reactor Design
- Shielding
- Remote Handling
- Safety Analysis & Accident Consequences
- Plant Transients
- Design Review
- Large Facility for Thermo-hydraulic Tests
- Purification Tests
- Handling Tests
- Proliferation Resistant Technologies (inert matrices, pyrochemistry)
- Accelerator/Sub-critical System Interface
- Strategy Studies
- Spallation Module
- Quality Control of Pb-Bi Primary Coolant

SYSTEM	OPTIONS	USA	European TWG	NOTES
ACCELERATOR	LINAC	X	X	
	CYCLOTRON		For DEMO	
TARGET	LBE	X	X	
	SOLID	X (Na-cooled)	X (gas-cooled)	
BLANKET	LBE	X	X	
	SODIUM	X		
	GAS		X	
FUEL	METAL ALLOY	X		
	OXIDE		X	
	NITRIDE			JAPAN
FUEL PROCESSING	PYROMETAL.		X?	
Front end	AQUEOUS	X		
FUEL PROCESSING	PYROMETAL.	X	X	
ADS				
LLFP BURNING	IN TARGET	X	X	
	IN FUEL	X		

## General Comments to the USA Roadmap of ATW

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- Low confidence and high risk in developing a DEMO plant which must operate from 5 % to 100 % of full power (up to 840 MW)
- Fuel form (metal-matrix metallic dispersion fuel): serious problems for fabrication. How long for licensing of this fuel (and fuel assembly) used in conjunction with LBE ?
- Sodium is a mature and well known technology (at least in France, Japan, Russia and USA) but with a very low public acceptability
- Developing of primary pumps for LBE in pool configuration is a difficult task

## General Comments to the USA Roadmap of ATW

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- More attention to the monitoring/control of neutron flux in a sub-critical system
- No mention to methods for monitoring/controlling oxygen content and purification of primary LBE in pool configuration (which are expected to be significantly different than in loop configuration)
- Difficulties in cover gas and LBE purification in the case of no physical separation between target and blanket (because of spallation products)

## Comments to the Report on Accelerator

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- Very big LINAC accelerator even for the DEMO plant
- Reliability of splitters: risk of having 45 mA onto the same target
- How to get individual beam current control of the different units by means of splitters
- The splitters will be tested only in the PROTO phase
- Very high  $K_s$  (low sub-criticality degree) for obtaining 840 MW with 11.25 mA and 1 GeV proton beam (around 0.97 and even more)
- Accelerator Reliability and Availability Issue: improving of order of magnitudes with respect to the present state-of-the-art