



EU-CARD2 / MAX Workshop

Introduction



MAX

MYRRHA ACCELERATOR EXPERIMENT
RESEARCH & DEVELOPMENT PROGRAMME



**EuCARD-2: Enhanced European Coordination for Accelerator
Research & Development**

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- **Safe and harmonised** management of radioactive waste
- **Enhanced safety** of design and operation of existing and future reactors
- **Lift uncertainty about health risks after low radiation dose** due to industrial and medical applications
- **Ensure transfer of knowledge** to future generation in the field
- **Integration of European research** programming and implementation
- **Challenges need to be addressed worldwide**



1. Excellent science

1. *European Research Council*
2. *Future and Emerging Technologies*
3. *Marie Curie actions*



4. Research infrastructures

...EUCARD2

2. Industrial leadership

1. *Leadership in enabling and industrial technologies*
2. *Access to risk finance*
3. *Innovation in SMEs*

3. *Societal challenges*

1. *Health, demographic change and wellbeing*
2. *Food security, sustainable agriculture*

3. ***Secure, clean and efficient energy*** **...MAX**

4. *Smart, green and integrated transport*
5. *Climate action, resource efficiency and raw materials*
6. *Inclusive, innovative and secure societies*

EC Proposal 80 Bi€....

.... Council 8 Feb 71 Bi€

..... Council approval on 28 June 2013





Fuel research

$$\Phi_{\text{tot}} = 0.5 \text{ to } 1.10^{15} \text{ n/cm}^2.\text{s}$$

Material research

$$\Phi_{\text{Fast}} = 1 \text{ to } 5.10^{14} \text{ n/cm}^2.\text{s}$$

($E_n > 1 \text{ MeV}$) in large volumes

Fission GEN IV



Fusion

$$\Phi = 1 \text{ to } 5.10^{14} \text{ n/cm}^2.\text{s}$$

(ppm He/dpa ~ 10)
in medium-large volumes

Multipurpose
hybrid
Research
Reactor for
High-tech
Applications

High energy LINAC
600 MeV – 1 GeV
Long irradiation time

**Fundamental
research**

50 to 100 MWth

$$\Phi_{\text{Fast}} = \sim 10^{15} \text{ n/cm}^2.\text{s}$$

($E_n > 0.75 \text{ MeV}$)

Waste

$$\Phi_{\text{th}} = 0.5 \text{ to } 2.10^{15} \text{ n/cm}^2.\text{s}$$

($E_n < 0.4 \text{ eV}$)

**Radio-
isotopes**

$$\Phi_{\text{th}} = 0.1 \text{ to } 1.10^{14} \text{ n/cm}^2.\text{s}$$

($E_n < 0.4 \text{ eV}$)

**Silicon
doping**



MYRRHA

Strongly embedded



in Euratom FP



Topic	FP5	FP6 EUROTRANS DM.	FP7
Coupling	-	DM2-ECATS	FREYA
Fuels	CONFIRM FUTURE	DM3-AFTRA 	FAIRFUELS, F-BRIDGE, ASGARD, ALICE
Thermal- Hydraulics	ASCHLIM		THINS, SEARCH, MAXSIMA
Materials	MEGAPIE, SPIRE, TECLA	DM4-DEMETRA	MATTER, GETMAT
Design	PDS-XADS	DM1-DESIGN	CDT, MAX, SARGEN-IV, SILER
LFR	- 	ELSY	LEADER
Infrastructures	-	VELLA, MTR-I3	HELIMNET, ADRIANA, DELOITTE Study
Scenario studies	-	PATEROS	ARCAS
Partitioning	PYROREP, PARTNEW	EUROPART	ACSEPT, SACSESS
Total budget / EU contribution	~€51M/€20M	~€71M/€36M	~€145M/€74M



- **2001: International Strategic Guidance Committee**
- **2002: International Technical Guidance Committee**
- **2003: Review by Russian Lead Reactor Technology Experts (ISTC#2552p project)**
- **2005: Conclusions of the European Commission FP5 Project PDS-XADS (2001-2004)**
- **2006: European Commission FP6 Project EUROTRANS (2005-2009): Conclusions of Review and Justification of the main options of XT-ADS starting from MYRRHA**
- **2007: International Assessment Meeting of the Advanced Nuclear Systems Institute**
- **2008: European Commission FP7 Project Central Design Team (CDT) at Mol for MYRRHA detailed design**
- **2009: MIRT of OECD/NEA on request of Belgian Government**
- **2012: MYRRHA accelerator under MAX project**

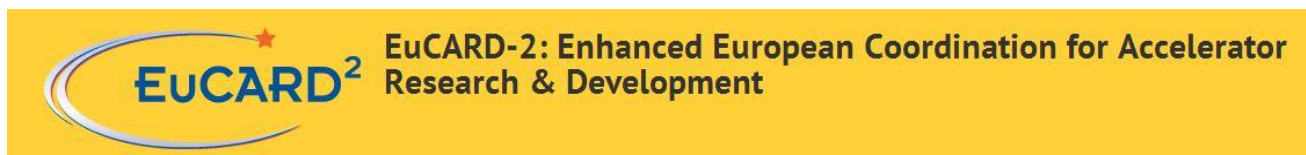


The review committee was composed of:

Alban Mosnier, CEA/F4E, IFMIF, Chair
Roger Garbil, EC EURATOM Fission, co-Chair
Dan Berkovitz, SOREQ, Israel
Robin Ferdinand, GANIL, France
John Galambos, SNS, United States
Peter Ostroumov, ANL, United States
Andrea Pisent, INFN, Italy
Maurizio Vretenar, CERN, Switzerland

12-13 November 2012 , as main conclusions:

- **Progress of the MAX project well appreciated**
- **Need to create a core accelerator team within the MYRRHA team as soon as possible**
- **Collaboration with EU accelerator projects (CERN, ESS, EuCARD1-2, TIARA and so on) and the US (from SNS and ANL) should be strongly fostered**



A workshop to be organised at CERN in March 2014 (in the new year but before the annual EuCARD2 meeting)

Having 20-30 participants from Europe only, involving people from MYRRHA, SPL, ESS but also other possibly interested groups

The workshop should purely **concentrate on accelerators for an ADS (or linacs for an ADS)**

- **To identify R&D needs and see if there is a way to share the work/to find synergies**
- **The moment is important because the MAX community should prepare its MAX2 proposal within the 2014-2015 Euratom call and foster a potential accelerators collaboration within the EC infrastructures' call**

D – Cross-cutting aspects for Nuclear Fission and Radiation Protection

NFRP 9 – 2015: Transmutation of minor actinides (Towards industrial application)

\... This research should contribute to the **further development of state of the art installations that would allow transmutation** in the most effective way, **as for example using sub-critical or critical reactors**. It should also have to go beyond the state of the art in terms of safety aspects of transmutation. The development of innovative fuel and targets for the transmutation of minor actinides should also be considered in this proposal, as well as the development of advanced experiments and numerical simulation tools. **Full advantage should be taken of existing knowledge and competence. International cooperation could be beneficial in this area.**

Funding scheme: Research and innovation action (**indicatively a 3 to 4 Mi€ Collaborative project could be foreseen for MAX2, up to 8 Mi€ available in this topic, maybe MAX2 part of a bigger MYRRHA project proposal...**)



CERN and SCK-CEN join forces to develop particle accelerators

The Belgian Nuclear Research Centre (SCK-CEN) and the European Organization for Nuclear Research (CERN) are going to work together intensively to develop high-intensity particle accelerators. The two research institutions signed a cooperation agreement on this subject in Geneva on 28 October.

The Belgian Nuclear Research Centre has been involved in CERN research projects for a long time, as have various Belgian universities. The two research institutions have now decided to collaborate specifically around particle accelerator technology. In practical terms this involves a particle accelerator which SCK-CEN is developing for its [MYRRHA project](#) and the HIE-ISOLDE infrastructure at CERN. MYRRHA is a multifunctional research infrastructure made up of a sub-critical reactor driven by a particle accelerator.

CERN in Geneva is a world authority in the field of accelerators, and the Study Centre for Nuclear Energy has been able to build up a great deal of expertise together with numerous Belgian and European partners in the area of accelerator technology, in particular on improving the reliability of the proton bundle.

The two research institutions are going to share their knowledge and experience in the area of research into high-intensity linear accelerators and the development of high-capacity targets for the production of high-energy neutrons and radio isotopes for HIE-ISOLDE and ISOL@MYRRHA.

ISOL@MYRRHA is a research infrastructure that is to be developed in the context of the MYRRHA project which will be deployed for an entirely new class of experiments in fundamental interactions, nuclear physics, atomic physics, the physics of solid matter, biological and medical applications. The two institutions will exchange researchers under the terms of this cooperation agreement and SCK-CEN will be able to make use of CERN's infrastructure.



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European Energy Commissioner Günther Oettinger made a working visit to SCK•CEN.

The visit of the European delegation focused entirely on the MYRRHA project.

Belgian Secretary of State for Energy, Melchior Wathelet and

Secretary of State for Sustainable Development, Servais Verherstraeten, attended the visit in order to underline the **importance of this project for Belgium and the region.**



EU Success stories



....



AIRBUS

European Space Agency

Arianespace

CERN

**Let's keep in mind
the key drivers for
pan-European
Research and Innovation
success**



CERN was founded 1954: 12 European States Today: 20 Member States



~ 2300 staff
~ 790 other paid personnel
> 10000 users
Budget (2011) ~1000 MCHF

20 Member States: Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom

1 Candidate for Accession: Romania

8 Observers to Council: India, Israel, Japan, the Russian Federation, the United States of America, Turkey, the European Commission and UNESCO

Welcome

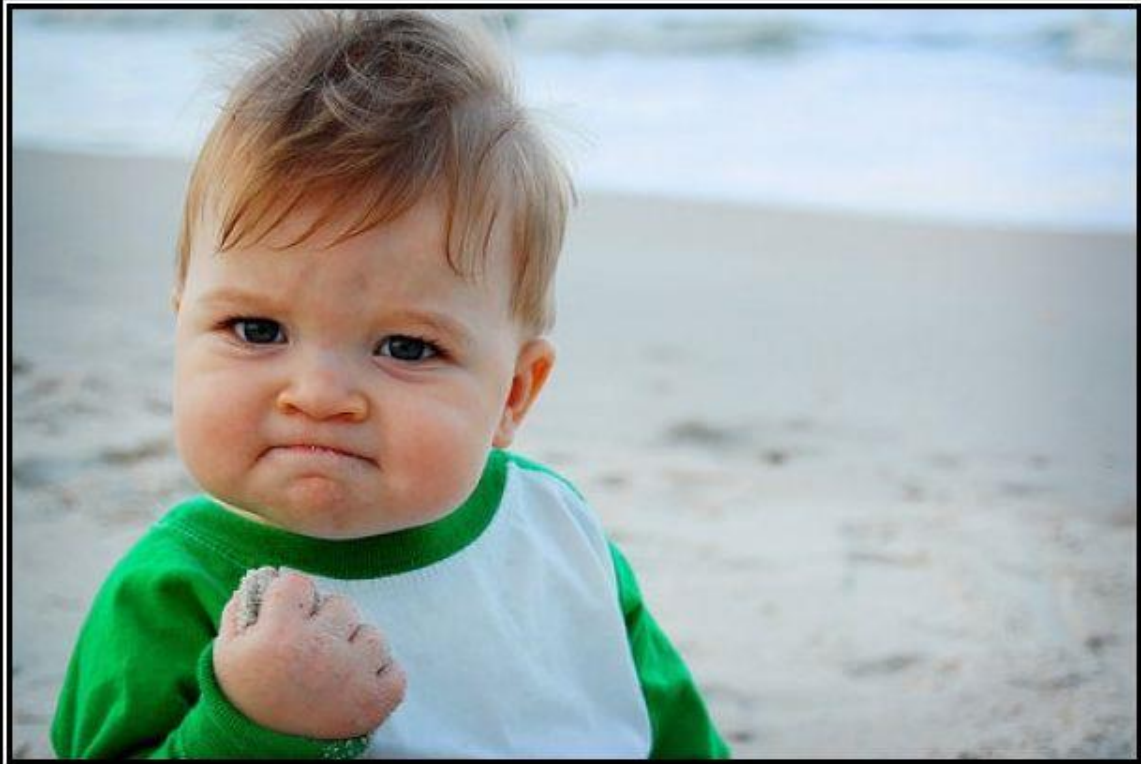
Dr Octavi Quintana Trias
EURATOM Director
11 January 2011

European Commission Research Directorate-General

To



Accelerating Science and Innovation

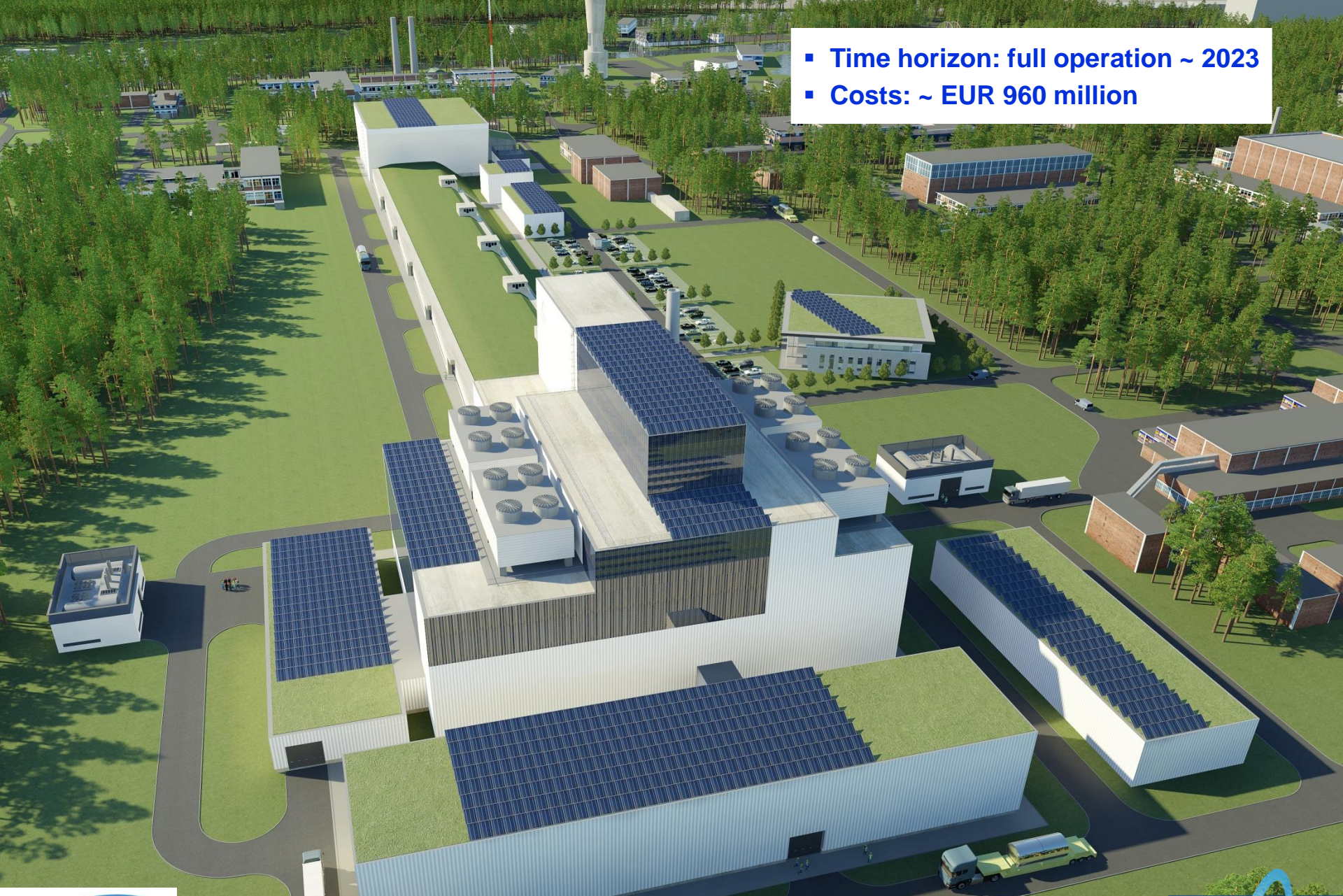


S U C C E S S

Because you too can own this face of pure accomplishment



- Time horizon: full operation ~ 2023
- Costs: ~ EUR 960 million



MYRRHA: EXPERIMENTAL ACCELERATOR DRIVEN SYSTEM
A pan-European, innovative and unique facility



Many thanks....



1957



 **European Union**
50 Years of Peace, Prosperity, and Partnership



Available Links

- EU Energy research: http://ec.europa.eu/research/energy/index_en.htm
- Euratom Seventh Framework Programme: http://cordis.europa.eu/fp7/euratom/home_en.html
- Information on FP7 and access to programmes and calls: http://cordis.europa.eu/fp7/home_en.html
- Euratom Seventh Framework Programme funded projects http://cordis.europa.eu/fp7/euratom-fission/library_en.html
- **CORDIS publications**
 - http://cordis.europa.eu/fp6-euratom/library_en.html
 - http://cordis.europa.eu/fp7/euratom-fission/library_en.html
 - **Euratom FP6 Research Projects and Training Activities, Volume I-II and III (PDF)**
 - **Volume I** ftp://ftp.cordis.europa.eu/pub/fp6-euratom/docs/nuclear_fission_eur21228_en.pdf
 - **Volume II** ftp://ftp.cordis.europa.eu/pub/fp6-euratom/docs/nuclear_fission_eur21229_en.pdf
 - **Volume III** ftp://ftp.cordis.europa.eu/pub/fp7/docs/euratom-fission_eur22385_en.pdf
 - **Euratom FP7 Research Projects and Training Activities, Volume I (PDF)**
 - **Volume I** ftp://ftp.cordis.europa.eu/pub/fp7/docs/fin-266-euratom-web-jun09v02_en.pdf
 - **Volume II** <http://ec.europa.eu/research/energy/pdf/euratom-fp7-vol-2.pdf>
 - **Volume III**
http://ec.europa.eu/research/energy/euratom/publications/pdf/euratom_fp7_research_&_training_projects_volume_3.pdf
- Research*eu magazine http://ec.europa.eu/research/research-eu/index_en.html
- **Strategic Energy Technolog Plan SET-Plan** http://ec.europa.eu/energy/technology/set_plan/set_plan_en.htm
- FISA 2009 http://cordis.europa.eu/fp7/euratom-fission/fisa2009_en.html
- **Financial Framework 2014 – 2020 “Horizon 2020”**
- http://ec.europa.eu/budget/reform/index_en.htm
- http://ec.europa.eu/budget/biblio/documents/fin_fwkw1420/fin_fwkw1420_en.cfm
- http://ec.europa.eu/research/horizon2020/index_en.cfm
- **2013 Symposium on ‘Nuclear Fission research for a low carbon economy’**
 - <http://www.eesc.europa.eu/?i=portal.en.events-and-activities-symposium-on-nuclear-fission>
- **FISA 2013 and Euradwaste’13** http://cordis.europa.eu/fp7/euratom-fission/fisa-euradwaste-2013_en.html