CENTRAL DESIGN TEAM FOR A FAST-SPECTRUM TRANSMUTATION EXPERIMENTAL FACILITY

A TRANSMUTATION FACILITY IN BELGIUM

CDT

The materials testing reactor BR2 (Belgian Reactor 2), located in Mol, Belgium, is used for nuclear research and production of medical isotopes. It will eventually be replaced by MYRRHA ('Multi-purpose Hybrid Research Reactor for High-tech Applications'), an experimental accelerator-driven system (ADS). MYRRHA will be a new kind of research reactor, also capable of demonstrating the technical feasibility of efficient transmutation, which can significantly reduce the toxicity and quantity of the long-lived components of nuclear waste.

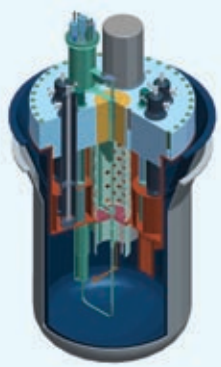
The Central Design Team (CDT) for such a Fast-Spectrum Transmutation Experimental Facility (FASTEF) is a multi-disciplinary, European team representing experts from both industry and research organisations. Working on SCK-CEN premises in Mol, CDT is advancing the design of the MYRRHA-FASTEF concept to make it ready for demonstration. The new system will be able to function in two configurations: initially subcritical (i.e. using spallation neutrons produced by a particle accelerator) and, in the next phase, in critical mode.

Scope of the project

With fast-neutron Generation IV nuclear reactors, spent fuel is reprocessed in a 'closed fuel cycle'. Each of these reactor systems uses a different type of coolant (e.g., sodium, lead or helium). Research infrastructures are essential for the development, design and construction of demonstrators of each new type of reactor.

MYRRHA is a flexible, fast-irradiation facility designed for the study of fuels, materials and high-level waste transmutation in both Generation IV systems and fusion reactors. It can work both as a critical system and as a subcritical ADS. It will be used to demonstrate the ADS concept, which is central to the design of dedicated radioactive 'waste burners'. MYRRHA, as the European Technology Pilot Plant for a Lead Fast Reactor, will also play a crucial role in the roadmap for the development of lead-cooled fast reactors.

Today's view of MYRRHA layout



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Project details

Project type // Small or medium-scale focused research collaborative project

Project start date // 01/04/2009

Duration // 36 months

Total budget // EUR 3 900 000

EC contribution // EUR 2 000 000

www.sckcen.be/myrrha

Activities

CDT builds on designs developed under previous Euratom Framework Programmes (most recently EUROTRANS). One major difference in the objectives of the current MYRRHA project is that the FASTEF needs to operate as both a subcritical and critical system. The design must include both operation modes from the start. CDT will carefully review design modifications to the MYRRHA ADS. A strategic objective of the project is to define specifications and design choices for FASTEF.

Once the specifications and design choices have been defined for the FASTEF's critical mode, the design of the facility's sub-critical mode will be further detailed and complemented. The necessary design changes for critical mode operation will be implemented. CDT will clearly define and develop conceptual designs for a limited set of experimental devices for the FASTEF (working in sub-critical or in critical mode).

CDT will also study all of the FASTEF facility infrastructures (auxiliaries and global plant layout). The result will be a comprehensive description of the characteristics and main technical requirements of the auxiliaries for both the subcritical and the critical options, as well as in an overall plant layout. Roadblocks in any of several key areas, such as fuel design and procurement can hinder the future realisation of the facility. CDT will address all of these issues.

Expected results

The CDT team will bring the design of MYRRHA-FASTEF to an advanced level with a comprehensive and detailed set of specifications that will make it possible to start construction in 2016. MYRRHA-FASTEF will need to be able to host several experimental devices (to support material and fuel research), produce radioisotopes for medical purposes and make high-quality doped silicon for power electronics (necessary components of hybrid vehicles and renewable energy technologies). It must also demonstrate the ADS technology for transmutation, serving as test-bed for larger-scale transmutation efforts. MYRRHA-FASTEF will also contribute to the demonstration of lead-cooled fast-reactor technology.

MYRRHA is foreseen to be in full operation by 2023. It will initially operate as an ADS to demonstrate the efficient transmutation of long-lived radioactive-waste components in subcritical mode. Following this demonstration, the accelerator can be decoupled from the reactor allowing MYRRHA to be run as a critical, flexible, fast-spectrum irradiation facility. In both operation modes, MYRRHA will be used for fuel research for innovative reactor systems, material research for Generation IV systems and fusion reactors and other applications.

Societal impact

CDT addresses the need to find sustainable ways of managing high-level, long-lived radioactive waste. Separating the components of radioactive waste and transmuting them into less toxic, shorter-lived elements is highly desirable as it will reduce the amount and heat load of material going into deep geological repositories and keep the lifespan of such radiotoxic elements to manageable timescales. It is hoped that ADS can be used to achieve this on a large scale. A demonstration of the ADS concept in MYRRHA will make it possible to evaluate the viability and economics of concentrated transmutation via ADS in a double-strata fuel-cycle approach. MYRRHA will also support the development of Generation IV systems, particularly in the development and demonstration of a lead-cooled fast reactor.

Important public events

CDT will collect the different reports produced during the project, and its Coordination Committee will encourage publications in peer-reviewed journals as well as visibility at international conferences. An open workshop will be organised at the end of the project, and Master-level students will be welcomed in CDT through the European Nuclear Education Network. The project website will be used to disseminate information to the general public.

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