ALLEGRO (European Atomic Energy Community, Europe)

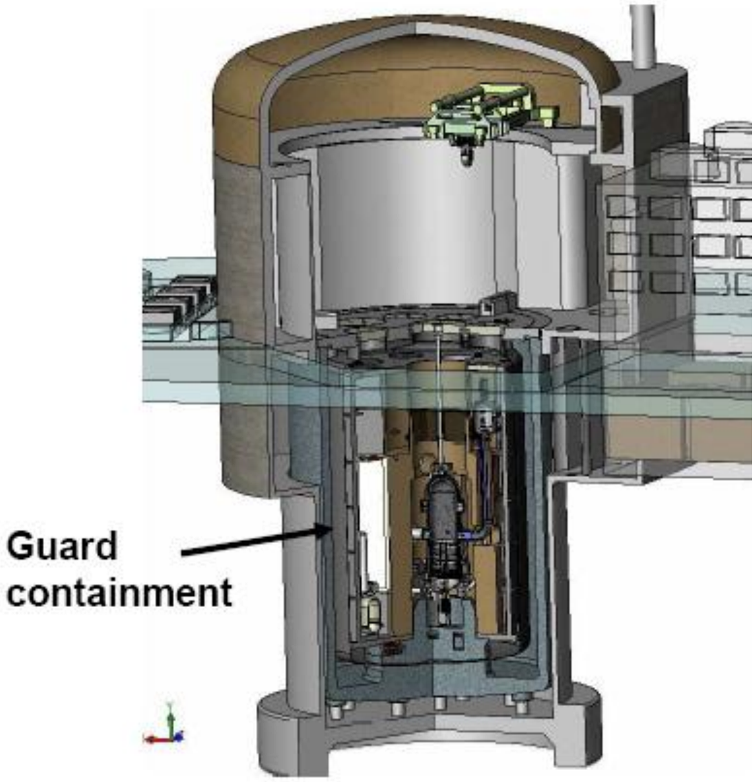

FIG. 26. ALLEGRO reactor building

Full name:	*ALLEGRO*
Designer:	*EURATOM*
Reactor type:	*Gas-cooled Fast Reactor*
Electrical capacity:	*XX.X MWe*
Thermal capacity:	*75 MWth*
Coolant	*Helium*
Primary Circulation	*Forced/Natural*
System Pressure:	*X MPa*
System Temperature:	*530 °C*
Fuel Material:	*MOX*
Fuel Cycle:	*XX Months*
No. of safety trains:	*# trains*
Emergency safety systems:	*Active/passive/hybrid*
Residual heat removal systems:	*Active/passive/hybrid*
Design Life:	*XX Years*
Design status:	*Pre-conceptual Design*
Planned deployment/1st date of completion:	*Month Year (and first unit name if in operation)*
New/Distinguishing Features:	*First step to an electricity generating prototype*

Introduction

On the Gas Fast Reactor (GFR) development roadmap, the Experimental and Technology Demonstration Reactor (ALLEGRO) is the first necessary step towards an electricity generating prototype. It is a low power (~ 75 MWt) helium-cooled fast reactor including the main objectives qualification of GFR fuel and sub-assembly concept, demonstration of core operation and control with the appropriate instrumentation, establishment of a first GFR safety reference framework and acquisition of first of a kind GFR operating feedback experience.

In the GFR fuel development plan, ALLEGRO is located in between the irradiation of samples in material testing reactors and the full demonstration at a GFR electricity generating prototype scale. Launched in 2005 for 4 years, the Gas Cooled Fast Reactor Specifically Targeted Project of the EURATOM 6th framework program includes preconceptual ETDR (previous ALLEGRO name) design and safety studies. The CEA is mainly in charge of core physics, reactor system design and global plant layout. Nexia Solutions is in charge of sub-assembly design, whereas AMEC is in charge of the absorbers and control and instrumentation and NRG of reflector and shielding studies. The GoFastR program, which started in 2010 and will last for three years, includes new partners for ALLEGRO, mainly from central Europe, Czech Republic (RC-Rez) and Hungary (AEKI and University of Budapest).

Description of the Nuclear System

The core design includes a two-step approach: First core (start-up core) using conventional MOX fuel and steel cladding with some experimental GFR fuel sub-assemblies and second core (refractory core) using only GFR reference fuel (carbide fuel with ceramic cladding). The start-up core is composed of 81 MOX fuel S/As with 6 control/shutdown rods (CSD) and 4 diverse shutdown (DSD) rods. After one year of operation, the core will be loaded with 350 experimental GFR S/As. The objective is to irradiate these S/As for about 2000 equivalent full power days with acceptable representative GFR conditions.

The preliminary system design is based on intermediate loops with two primary helium loops able to remove 75 MW without energy conversion. It includes two intermediate heat exchangers compatible with the helium inlet/outlet temperatures of both the start-up and demonstration cores (respectively 260/530°C compatible with the MOX fuel option and 400/850°C). The secondary loops include pressurized water, which avoids the issue of high temperature materials which would have been raised with a gas-gas heat exchanger option. The final heat sink is the atmosphere. An additional circuit reservation has been made to possibly test high temperature processes or components using part of the reactor power (10 MW).

Description of the Safety Concept

Other characteristics are the safety neutronic coefficients of the MOX core. It is noticeable that the void effect remains quite low whereas the Doppler Effect always tends to stabilize the power in case of fuel temperature increase.

Deployment Status and Planned Schedule

In parallel to the pre-conceptual design process, the ALLEGRO R&D plan has been launched to qualify the appropriate calculation tools and the specific helium technology necessary in addition to the VHTR mainstream development. This includes in particular a core physics test program; air and helium tests on reduced size sub-assemblies; system transient analysis codes benchmarking and qualification; high temperature resistant thermal barriers (1250° C for one hour); DHR blowers with quite large specifications (from 3 to 70 bar with constant mass flow rate); specific instrumentation for core thermal monitoring and fuel handling; and specific GFR environment purification systems. The R&D plan is now broadened at the European level through the 7th Framework Program ADRIANA project which aims at identifying the needs and research infrastructures for SFR, GFR and LFR systems.