SafeG

SAFETY OF GFR THROUGH INNOVATIVE MATERIALS, TECHNOLOGIES AND PROCESSES

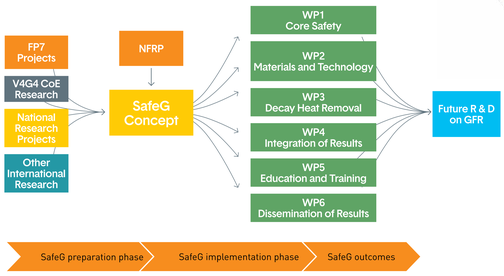
SafeG Project overview

The global objective of the SafeG project is to further develop the gas-cooled fast reactor (GFR) technology and strengthen its safety. The project shall support the development of nuclear low-CO_2 electricity and industrial process heat generation technology through the following main objectives:

- **To strengthen safety of the GFR demonstrator ALLEGRO**
- **To review the GFR reference options in materials and technologies**
- **To adapt GFR safety to changing needs in electricity production worldwide with increased and decentralized portion of nuclear electricity by study of various fuel cycles and their suitability from the safety and proliferation resistance points of view**
- **To bring in students and young professionals, boosting interest in GFR research**
- **To deepen the collaboration with international non-EU research teams, and relevant European and international bodies**

The main task of the project is to answer the safety issues of GFR concept and to introduce the key safety systems of the ALLEGRO reactor. An important part of the design is to acquire new experimental data using the recent research experimental devices and special computational programs to carry out safety analyses and the study of relevant physical phenomena.

SafeG project consider the most urgent questions and open issues concerning the GFR technology and ALLEGRO demonstrator. To answer this question, SafeG project is divided into six technical work packages and one coordination work package.

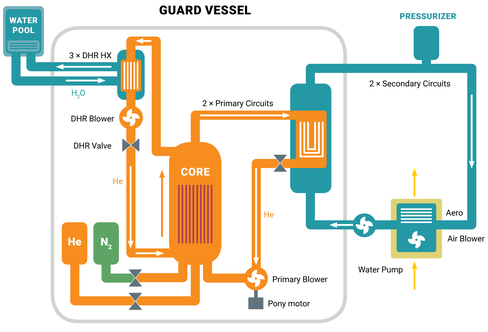


▲ SafeG concept diagram

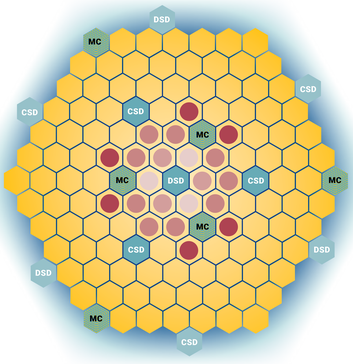
ALLEGRO – demonstrator of the Generation IV gas cooled fast reactor

The objectives of ALLEGRO are to demonstrate the viability and to qualify specific GFR technologies such as fuel, fuel elements, helium-related technologies and specific safety systems, in particular, the decay heat removal function, together with demonstration that these features can be integrated successfully into a representative system. The ALLEGRO reactor would function not only as a demonstration reactor hosting GFR technological experiments, but also as a test pad of using the high temperature coolant of the reactor in a heat exchanger for generating process heat for industrial applications and a research facility which, thanks to the fast neutron spectrum, makes it attractive for fuel and material development and testing of some special devices or other research works.

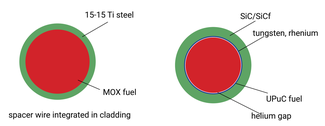
The ALLEGRO was originally designed by the French Alternative Energies and Atomic Energy Commission (CEA). Designed thermal power of the ALLEGRO reactor is 75 MW_{th} with no electricity production. Heat produced in the primary circuit is removed from the core through the heat exchanger to the atmosphere. The original design of the ALLEGRO consists of two He primary loops, three decay heat removal (DHR) loops integrated in a pressurized cylindrical guard vessel.



▲ Diagram of ALLEGRO reactor



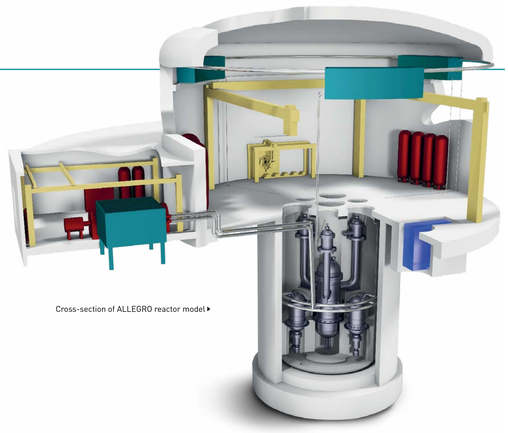
▲ Axial power profile of 75 MW_{th} ALLEGRO reactor core



▲ Cross-section of MOX assembly fuel rod and carbide assembly fuel rod

Ambition of the SafeG project

1) **Completing the ALLEGRO demonstrator safety concept:**
   - core optimization from the neutronic, thermo-hydraulic and thermo-mechanic point of view
   - design of diverse reactor control and reactor shutdown system
   - strategy of passive decay heat removal completed with the design of fully passive systems for the decay heat removal tested on experimental helium loop
2) **Upgrading the ALLEGRO demonstrator design and GFR concept** by innovative materials and technologies such as fuel cladding based on SiC composition, and construction materials capable to withstand extreme temperatures used for the primary system and safety related systems.
3) **Linking the national research activities and creating an integrated platform** aiming to share the knowledge, achieved results, and to coordinate activities, to spread new ideas and findings over the scientific society worldwide.
4) **Deepening the cooperation between Europe and Japan in the GFR research** through sharing the knowledge about advanced high temperature resistant materials for the fuel rod claddings and other primary system´s components.



Cross-section of ALLEGRO reactor model ▸

The 75 MW_{th} reactor shall be operated with two different cores. The starting MOX core is based on the technology of MOX fuel pellets and steel cladding 15-15 Ti (class AIM1). The second core will consist solely of the ceramic fuel (pellets from U-Pu carbide inside SiC/SiCf cladding) and will enable to operate ALLEGRO at the higher target temperature.

Project partners

- VUJE, a. s. (Slovakia) - Coordinator
- ÚJV Řež, a. s. (Czech Republic)
- Energiatudományi Kutatóközpont (Hungary)
- Narodowe Centrum Badań Jądrowych (Poland)
- Centrum výzkumu Řež s.r.o. (Czech Republic)
- Commissariat à l'énergie atomique et aux énergies alternatives (France)
- Jacobs Clean Energy Ltd. (United Kingdom)
- BriVaTech Consulting (Gerd Brinkmann)
- National University Corporation, Kyoto University (Japan)
- České vysoké učení technické v Praze (Czech Republic)
- Budapesti Muszaki es Gazdasagtudomanyi Egyetem (Hungary)
- Slovenská technická univerzita v Bratislave (Slovakia)
- University of Cambridge (United Kingdom)
- Nuclear AMRC, University of Sheffield (United Kingdom)
- Evalion s.r.o. (Czech Republic)

Duration

October 2020 – September 2024

Budget

4,495,010.00 €

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