Background

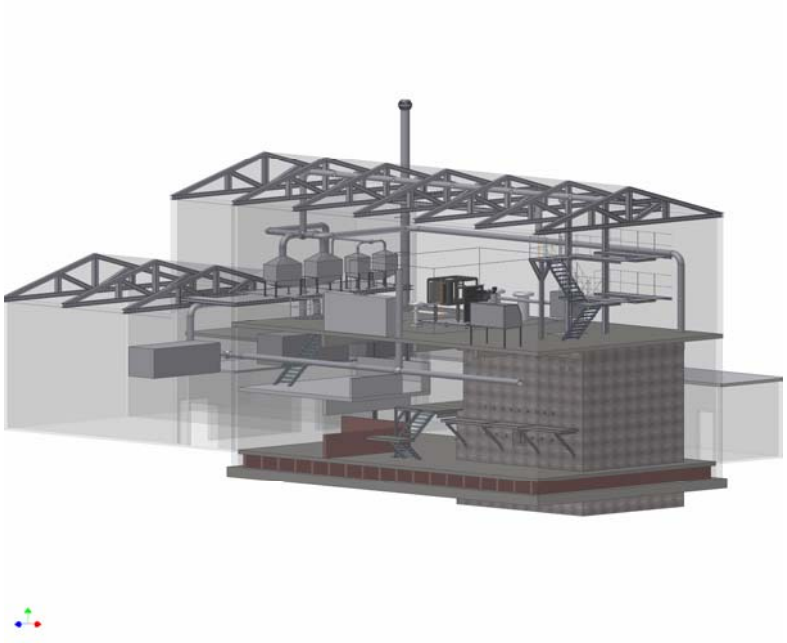
The GUINEVERE project is a project within IP-EUROTRANS, a programme in the 6th Framework Programme (FP5) of EURATOM. The IP-EUROTRANS project addresses main issues for Accelerator Driven Systems (ADS) development in the framework of partitioning and transmutation for nuclear waste volume and radio toxicity reduction. The GUINEVERE project is carried out in the context of domain 2 of IP-EUROTRANS, ECATS, devoted to specific ***e***xperiments for the ***c***oupling of an ***a***ccelerator, a ***t***arget and a ***s***ubcritical core. A major item to be investigated by these experiments is the validation of the subcriticality monitoring for an ADS since the guarantee of subcriticality is of fundamental importance for the safety of an ADS. Analyzing the outcome of the FP5 MUSE project with regard to this issue, two points were left open for significant improvement. To validate the methodology for reactivity monitoring, a **continuous beam** is needed, which was not present in MUSE. In the definition of MUSE, from the beginning also a strong request was made for a **lead core** in order to have representative conditions of a lead-cooled ADS which was only partially answered by the MUSE-programme. For this purpose, there is a need for a lead fast critical facility connected to a continuous beam accelerator.
Since such a programme/installation is not present at the European nor at the international level, SCK•CEN has proposed to use a modified VENUS critical facility located at its Mol-site and to couple it to a modified GENEPI deuteron accelerator working also in continuous mode and with beam trips: the GUINEVERE-project (**G**enerator of **U**ninterrupted **I**ntense **NE**utrons at the lead **VE**nus **RE**actor).

Objectives

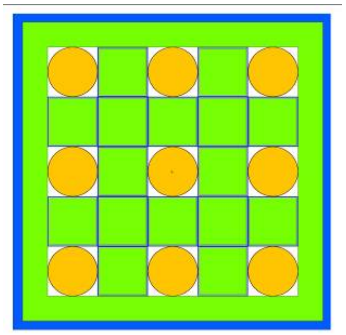
During 2007 and 2008, the VENUS facility will be modified in order to allow the experimental programme to start by the middle of 2009. These experiments aim to provide an answer to the questions of on-line reactivity monitoring, sub-criticality determination and operational procedures in an ADS by 2010.

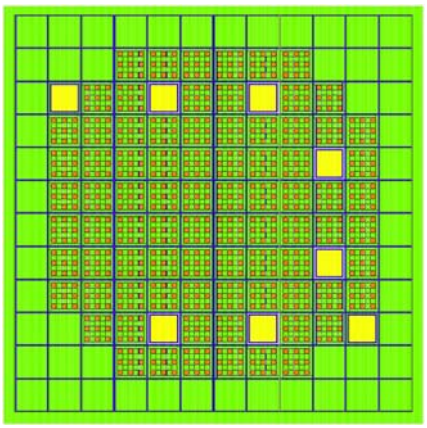
Principal results

The execution of the GUINEVERE project will consist of two types of modifications at the SCK•CEN site. First of all, there are the modifications which are connected to the installation of the new GENEPI-C accelerator at the VENUS critical facility and its coupling to the core. The second type of modifications is linked with the adaptation of the VENUS critical facility to host a fast lead core, further on referred to as VENUS-F. The construction of the accelerator GENEPI-C will be carried out by the French research centre CNRS. For the penetration of the accelerator into the core, it was decided early in the project to have a vertical penetration because it has significant scientific advantages. An additional floor has to be constructed on top of the existing installation. The detailed technical drawings of the necessary modifications have been made and the stability studies of the existing foundations have been carried out. In the figure below you see the drawing of the additional floor with the ventilation system on top of the already existing bunker in the VENUS hall.

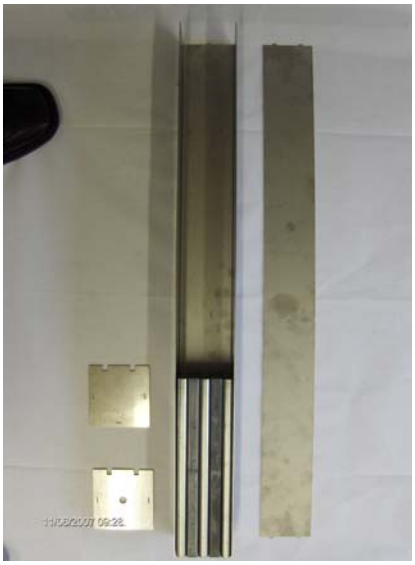


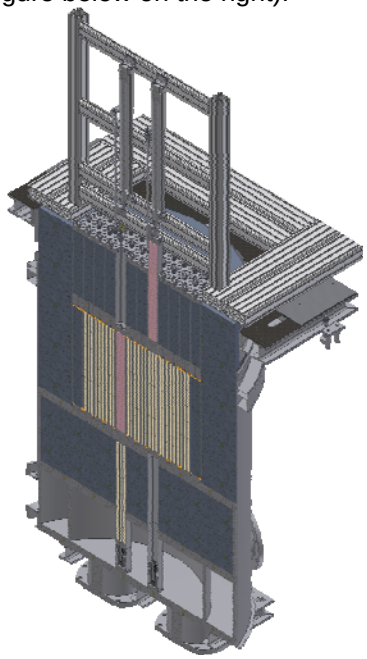
To obtain a fast lead core in the VENUS vessel, all internals were removed and will be replaced by a core made of lead and uranium fuel. The fuel is provided by CEA in the framework of the IP-EUROTRANS project and will be returned after completion of the project. Based on uranium rodlets of about 1.27 cm diameter, lead plates and square lead rodlets of 1.27 cm thickness a fuel assembly is made based on the pattern given in the figure below on the left. The active height of the core region is about 60 cm. About 80 to 90 fuel assemblies are needed to obtain a critical configuration. The core region is contained within a 12x12 square of assemblies. The other assemblies (green squares in the figure on the right) are lead assemblies simulating the reflector. To allow a safe shutdown in all situations, 6 safety rods made of boron carbide with a fuel/lead follower are foreseen in the core (yellow squares in the core region of the figure on the right). The control rods (yellow squares in the periphery region of the figure on the right) are made of boron carbide.





In order to validate the concept of the fuel assembly and to test the modalities of the assembling procedure, a dummy element has been constructed (see figure below on the left). The test of the dummy assembly was positive, only minor revisions were necessary. The assemblies are arranged in a square matrix surrounded by a radial and axial lead reflector of about 40 cm thickness (figure below on the right).





At present most of the detailed design has been finished and safety studies have been initiated. Particular attention is given to possible reactivity effects, shielding aspects and radiological and industrial risks.

Future work

Future work will consist of adapting the VENUS facility in 2008, obtaining the license to operate the facility in 2009 and carrying out the experimental programme in 2009 and 2010.

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Main reference

P. Baeten et al., The "GUINEVERE"-project at the VENUS facility", HPPA conference proceedings, Mol 2007