Background

Concerns about clean air and global warming among their customers led car manufacturers to develop hybrid cars. A few models already reached the market but the manufacturers anticipate that the production figure will hit the million mark at the horizon 2010. Hybrid cars make an extensive use of power electronics, which implies – relatively - large size semi-conductor components. The initial doping of those components is best made by neutron irradiation, which achieves a better doping uniformity than chemical processes. Silicon doping becomes therefore a growing market for a number of research reactors, in supplement to their medical isotopes productions.

With the SIDONIE facility in operation since 1992, the doping of silicon is not a new activity at BR2. However, SIDONIE is limited to 5" diameter ingots whereas the trend is to 6" and 8" diameter.

Objectives

The purpose of POSEIDON (POol Side Equipment for Irradiation and DOping of silicon by Neutrons) is to allow the large scale irradiation of 6" and 8" diameter silicon ingots.

Principal results

Adequate doping conditions are met when silicon ingots are irradiated in a thermal neutron flux, with as little fast flux component as possible. In addition, the neutron and gamma fluxes should not be too important in order to avoid too much heat generation in the ingot. These conditions can be produced in BR2 by using a large block consisting of a neutron moderator. This will be located in the reactor pool against the BR2 vessel at core level. Due to the particular shape of the BR2 vessel – a hyperboloid – this irradiation position is not easy to access.

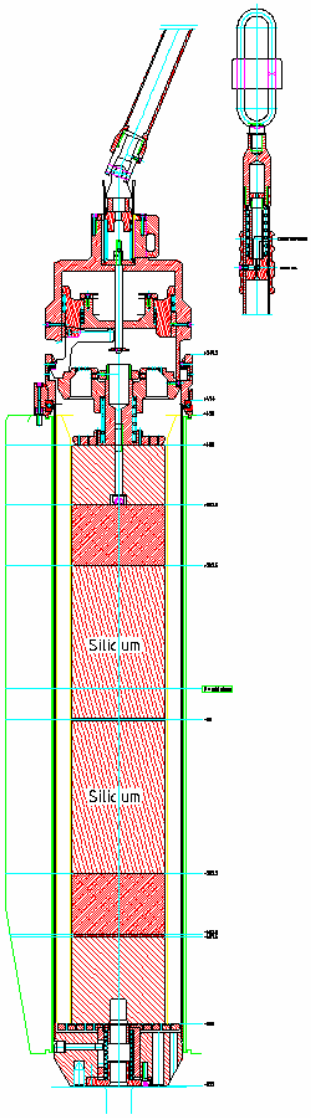
Therefore, the large block that is referred to as the POSEIDON facility, is penetrated by six irradiation channels and it, hangs like a pendulum at the working floor in BR2 pool. In the loading position (vertical) it is clear of obstacles above, like the reactor top cover. In the irradiation position, it is pushed against the vessel by a system installed in the pool.

The six irradiation positions are each sized for the irradiation of 8" ingots, loaded in baskets.. Two ingots are stacked up in each position. The doping of 6" ingots will be performed in the same positions using special adaptors to fill the gap.

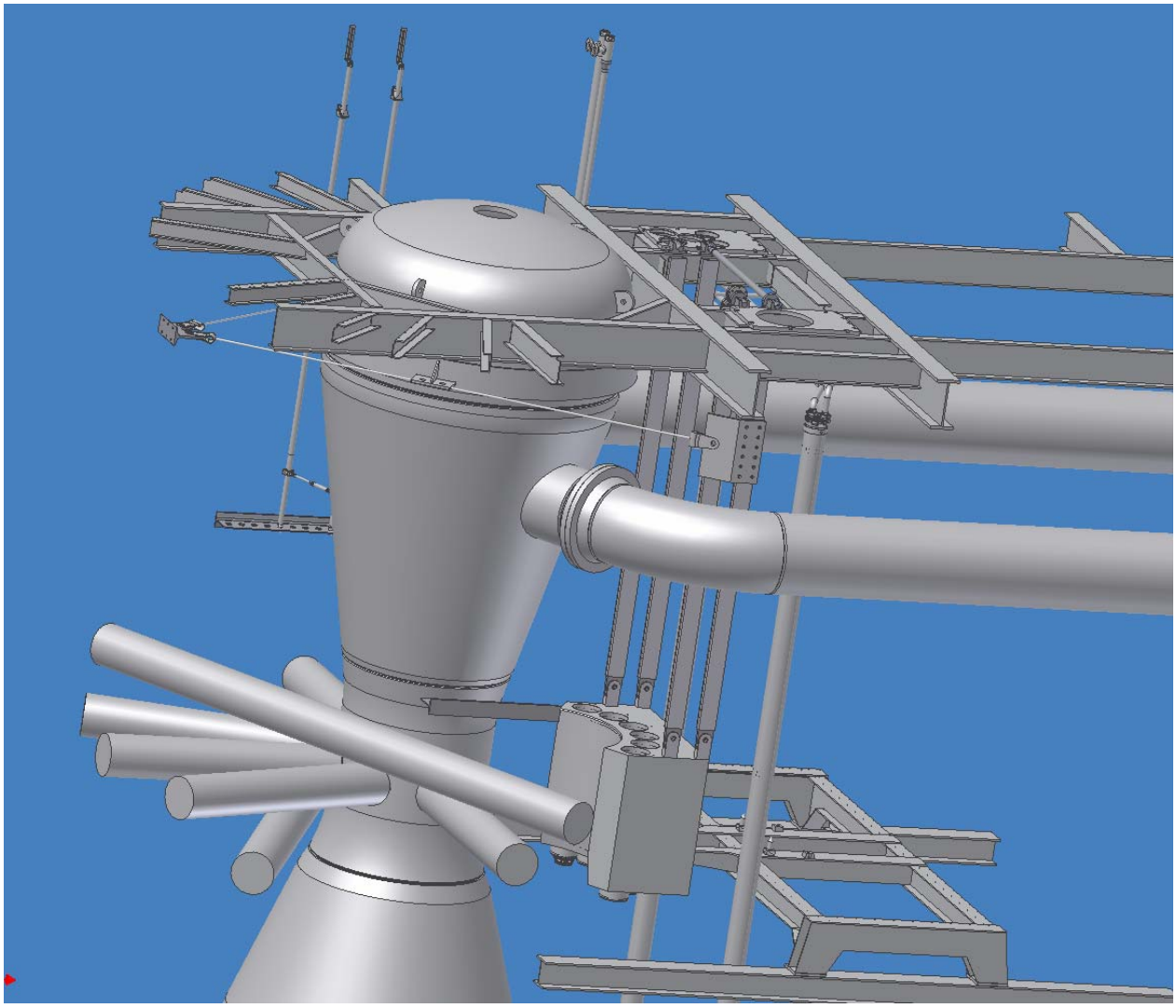
The radial flux gradient will be compensated by the rotation of the ingots during the irradiation. The axial flux gradient will be compensated by switching the positions of the upper and lower ingot at mid-irradiation.

The production capacity of POSEIDON is very much influenced by the target resistivity required by the customer (the lower the resistivity, the longer the irradiation duration).

With the very high production rate that is anticipated, considerable effort is devoted to handling systems: assistance for the loading of the irradiation baskets (an 8" ingot weighs 18 Kg), for the switching of upper and lower ingot, for the storage before, during and after irradiation, for the recovery of the ingots, their decontamination, control and packaging before shipping.



POSEIDON
irradiation basket



BR2 vessel and POSEIDON irradiation block in the loading position

Future work

The detail design of the irradiation system of POSEIDON is almost completed. The procurement of components is under way. The ancillary systems for upstream and downstream ingots handling are still in an earlier detail design phase.

The final assembly of components will be done mid-2007 and the first qualification irradiation is foreseen end October 2007.

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