

New Moderator Chamber of the FRG-1 Cold Neutron Source for the Increase of Cold Neutron Flux

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Introduction

The GKSS research centre Geesthacht GmbH operates the MTR-type swimming pool reactor FRG-1 (5 MW) for more than 45 years. The FRG-1 has been upgraded and refurbished many times to follow the changing demands of safe operation and today's needs of high neutron flux for scientific research.

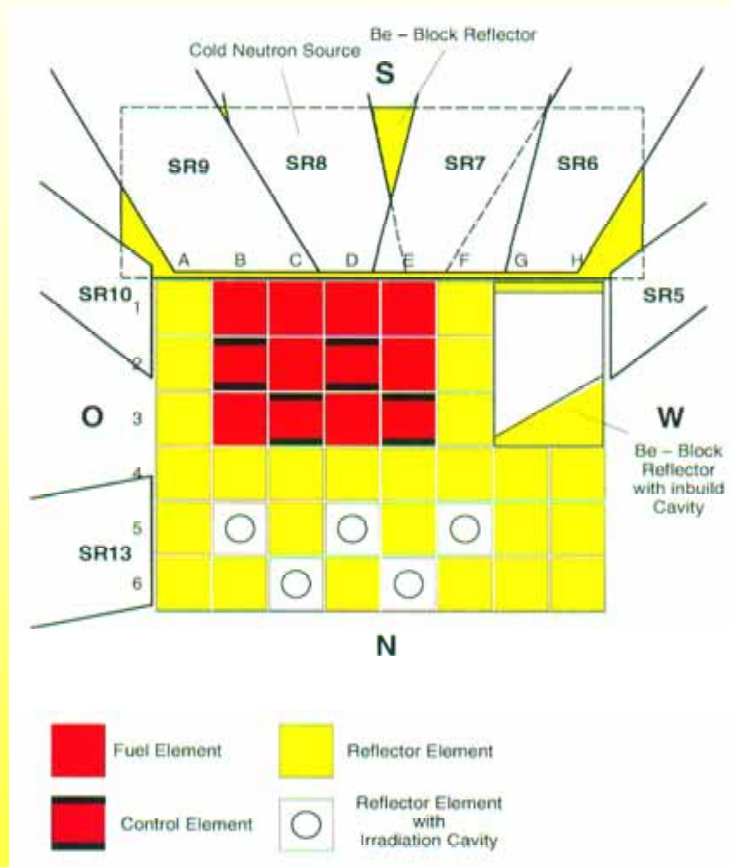
High neutron fluxes with highest availability is the permanent demand of the science on the operation of a neutron source.



GKSS RESEARCH CENTRE



FRG-1 Compact Core



Cold Neutron Source

GKSS installed a cold neutron source (CNS) at the FRG-1 in 1988. Principal component of this CNS is the moderator chamber with a discus shape. The moderator is supercritical gaseous hydrogen.

In order to increase the yield of cold neutrons, a study was made for a new layout of the moderator chamber in 2003. The new fundamental design of the moderator chamber is based on a hemispherical shape, thereby increasing the cold neutron flux by approx. 60% with the use of focusing effects.

Existing Moderator Chamber



New Moderator Chamber

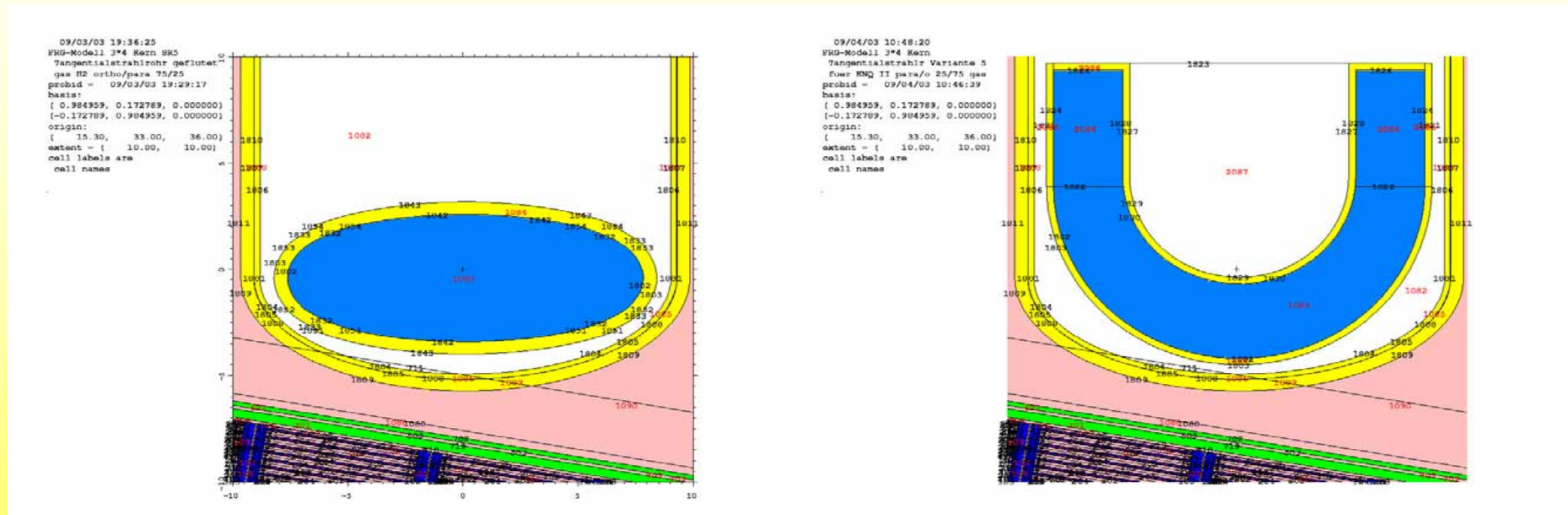
For a further increase of the important cold neutron flux, the moderator chamber of an existing spare unit should be replaced by a new one. Model of the new layout were the focusing moderator chambers of the American research reactors MURR and ORNL. These new moderator chambers resulted in gain factors between 50 to 150%.

The following conditions formed the basis for the design and licensing procedure of the GKSS moderator chamber:

New Moderator Chamber

- The same material specification for the moderator chamber as for the existing chamber.
- The same technical inspection as for the existing one
- The same incident conditions (pressure, melting etc.) as for the existing one.
- Comparable nuclear heating for the new and exiting chamber.
- Simple design (hemispherical shape) and fabrication

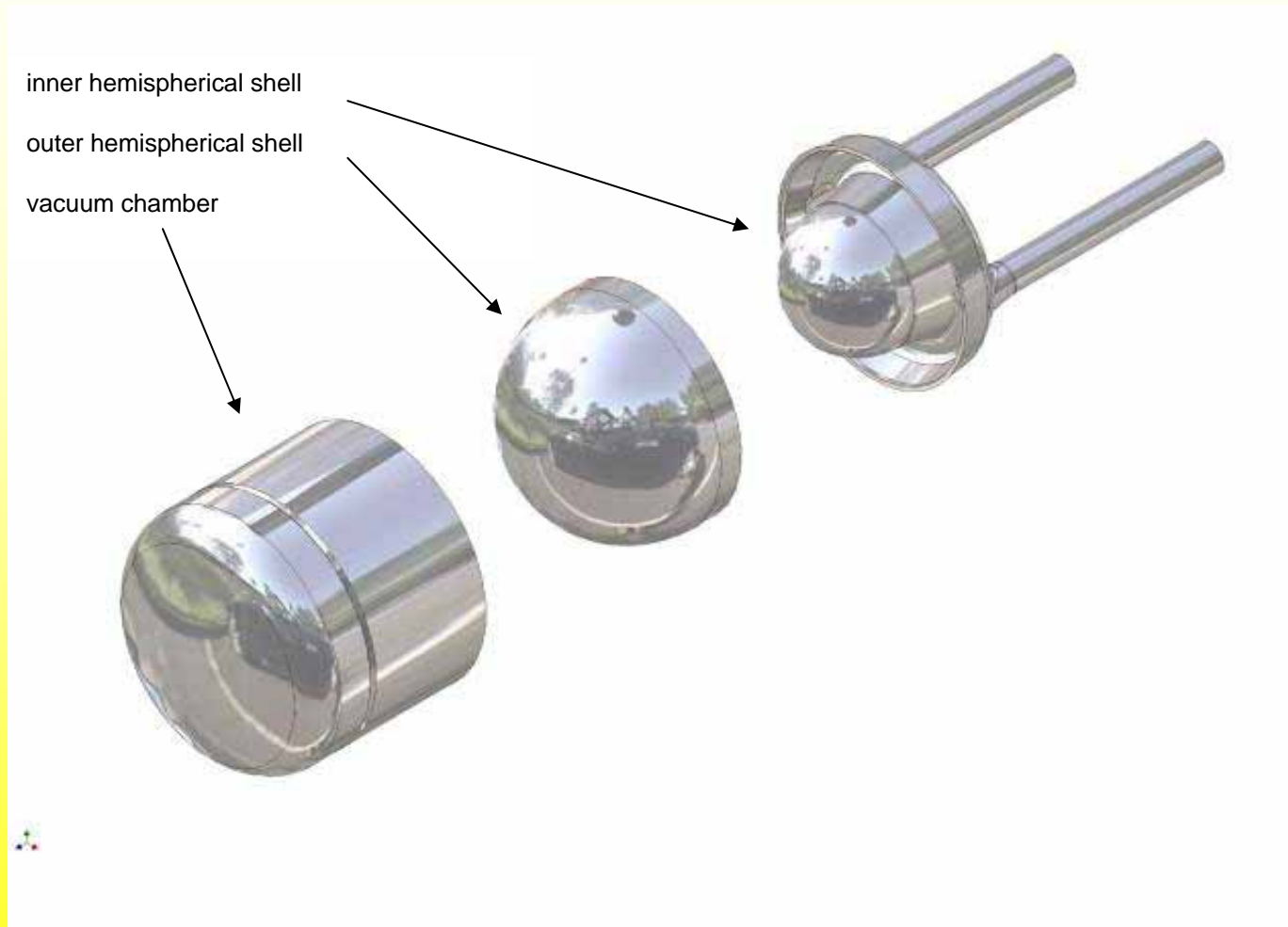
MCNP model of moderator chamber



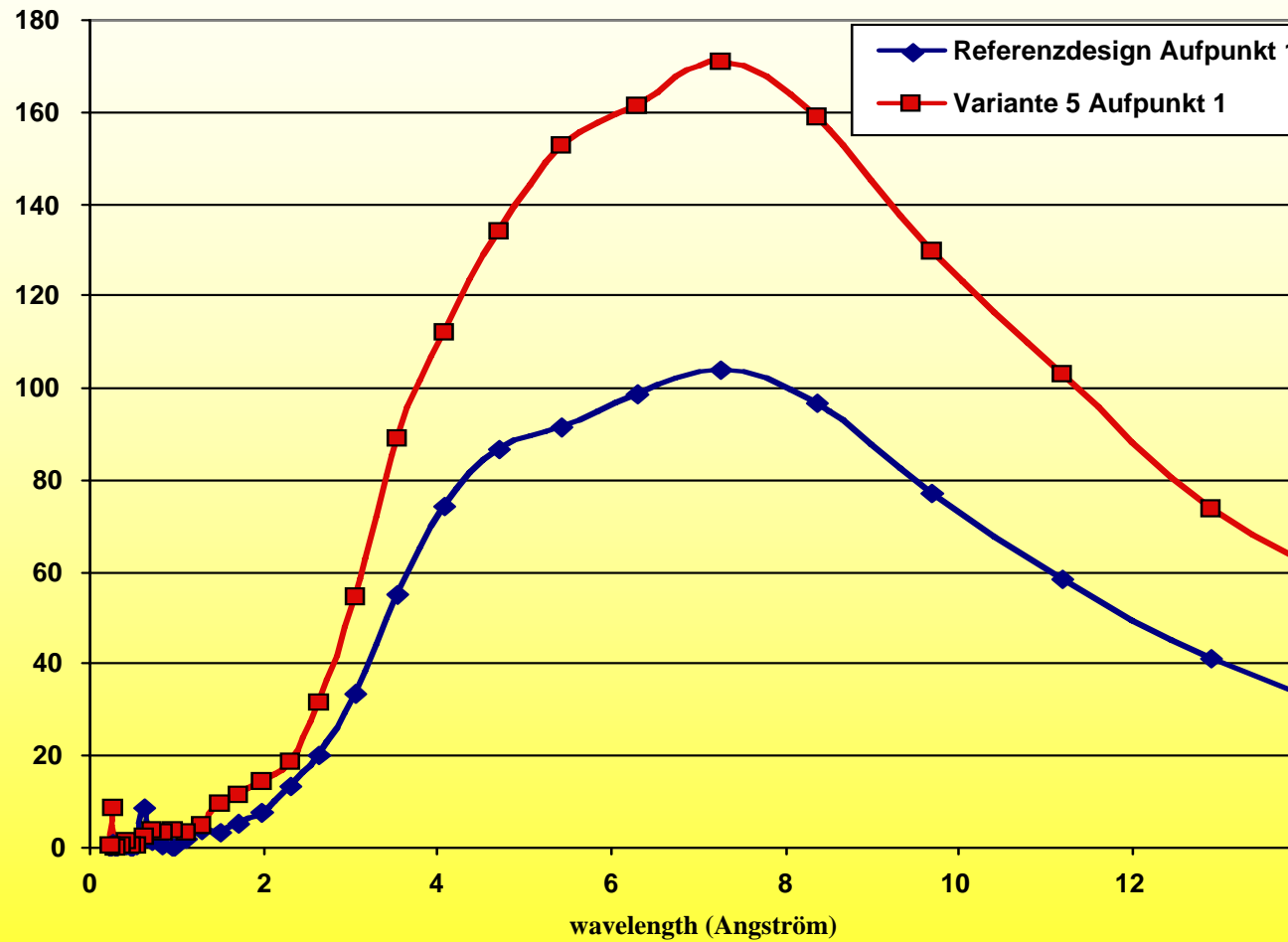
reference design

optimised design

Exploded view of new focusing cold neutron source



NEUTRON GAINFACTOR



Inner hemispherical shell



Outer hemispherical shell

New Moderator Chamber with Thermoelements



Experimental facilities using cold neutrons



Summary

GKSS has already realized a continuous increase of the neutron flux by 2 core compactions and by the installation of the first elliptical CNS. The installation of the focussing moderator chamber is a new step for a further increase of the important cold neutron flux. With the additional gain of cold neutrons by approx. 60%, the FRG-1 results in an interesting middle flux neutron source available to the national and international user community.