HANDLING SYSTEM FOR THE VIMOS BEAM MONITOR DURING THE MEGAPIE TEST

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INTRODUCTION

Vimos is one of two new safety systems for the operation of the Megapie Target. It is an optical beam detection system that monitors the beam density at the entrance of the target and will trigger a beam switch-off, if this becomes too high. A high beam density onto the target could damage the container, resulting in a leakage of liquid metal, and must be avoided.

A likely cause of high current density is when part of the proton beam bypasses the upstream Target E.

A Vimos monitor is to be installed during the shut down 2004 for testing with the conventional SINQ target.

The system consists of a "glowing" foil sitting directly in the proton beam near the target and viewed by a video camera. The camera needs to be in a low radiation environment and will be mounted about 10 m below the foil (see Fig. 1) and view it through a mirror system. A most detailed description of the system may be seen in references [1] and [2].

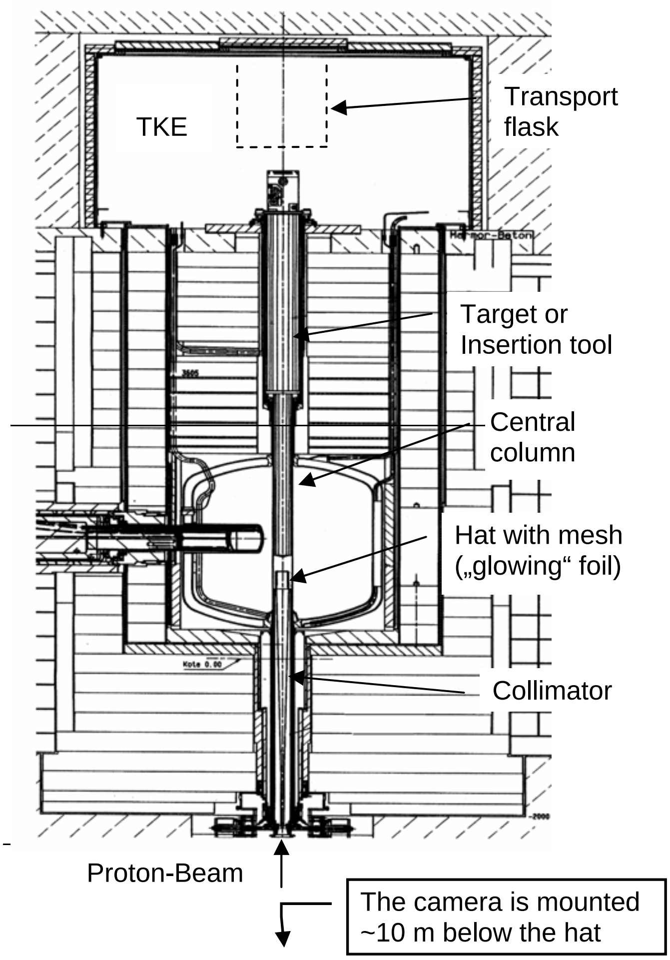

Fig. 1: Overview of the Vimos hat in the target block.

This report describes the system for mounting and dismounting the glowing foil.

VIMOS HAT AND INSERTION TOOLS

The glowing foil will be a highly stressed device, exposed to high temperatures and to up to hundred beam interruptions per day. Rather than a foil, a mesh made of tungsten was chosen as a structure better able to stand the fatigue stresses.

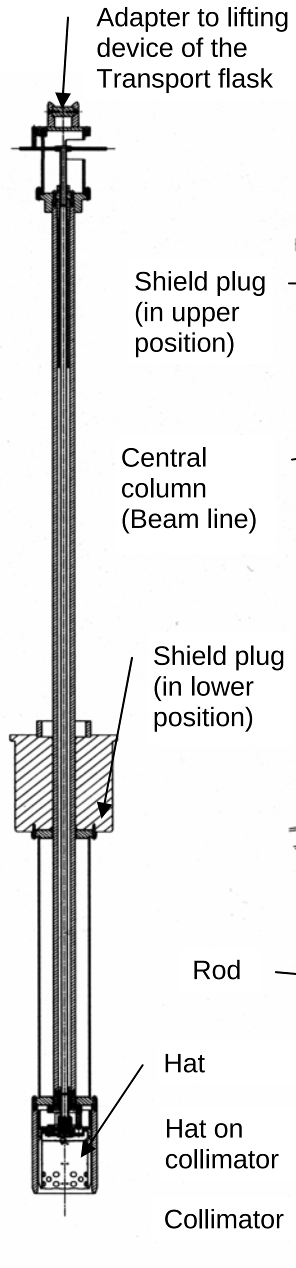

Fig. 2: Insertion tool with the hat (in transport flask).

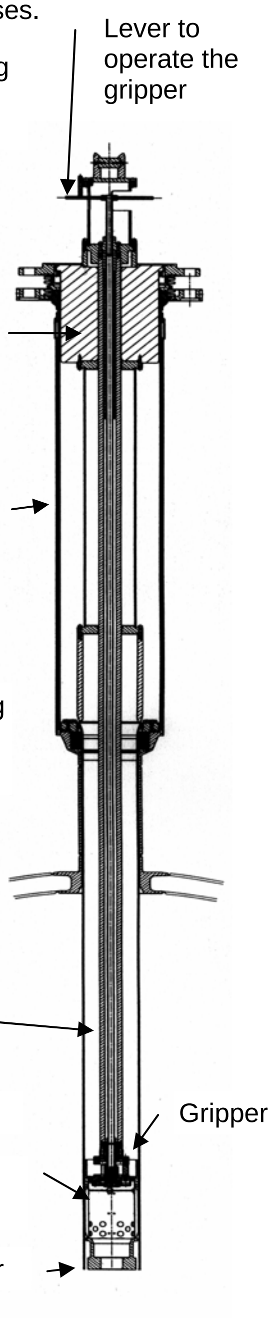

Fig. 3: Insertion tool in the central column (beam line).

The mesh is mounted on top of a thin walled cylindrical support that will stand on top of the collimator; the mesh will be located about 30 cm from the target (see Fig. 1). This device is named “hat”. It is made of a 1.2 mm thin aluminum plate and weighs 800 g. with the mesh. It is heated mainly by thermal radiation from the mesh and by backscattered neutrons from the target. The energy deposition has been calculated with MCNPX [3]. Since the hat has a bad heat contact to the collimator, it is mainly cooled by thermal radiation.

During normal operation (1.4 mA on the SINQ target with a beam diameter of ca. 10 cm), the temperature of the hat wall will reach ca. 300°C. This rather high temperature can be accepted, since the hat is practically not exposed to any external load. The temperature of the mesh - heated directly by the protons - will be approx. 1000°C. This is the lowest required temperature of the visible range of the camera.

The hat is to stand on the collimator (see Fig. 1) and will be inserted some 6 m down the central column. Because of the high gamma dose rates and the contamination hazard at the top end of the central column this task requires a special handling tool. The basic tool (see Fig. 2 and 3) consists of a long rod with a grabbing mechanism at its lower end to attach and detach the hat. To achieve good control, the actual insertion operation is to be done by hand so that an essential component is a shield plug that blocks the top of the central column.

Mounting and dismounting of the insertion tool will be done with the SINQ transport flask and the upper end includes a suitable adapter to its lifting mechanism. This also requires suitable infrastructure in the target storage area to be provided.

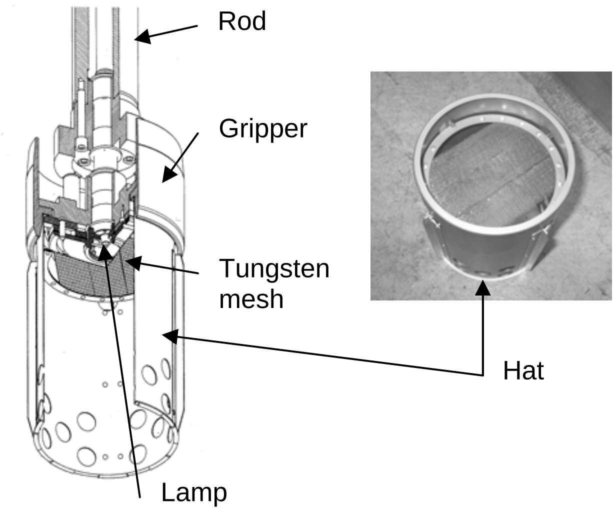

Fig. 4: Hat with gripper.

To adjust the camera and the optics, a lamp has been added to the bottom of the tool in order to illuminate the net. Also for inspections of the mesh, the lamp can be removed and replaced by an endoscope inserted from the top.

TARGET STORAGE AREA INFRASTRUCTURE

One section of the target storage area has been equipped with an insert to accommodate the handling of the hat: loading the handling tool (with the hat) into the SINQ transport flask, dismounting the tool from an activated hat, dismounting an activated hat from the target storage area (see Fig. 6).

The lower part of the insert includes a shielded vessel for an irradiated hat (see Fig. 5) and the hat is loaded into it with the insertion tool, using the same sequence of operations as used to mount it in SINQ. The shielded vessel is also the transport flask for the hat; after the removal of the insertion tool, the top of the vessel is closed with a shield plug, then the whole insert extracted from the storage tube with the hall crane and finally the vessel is detached for transport to the ATEC hot cell.

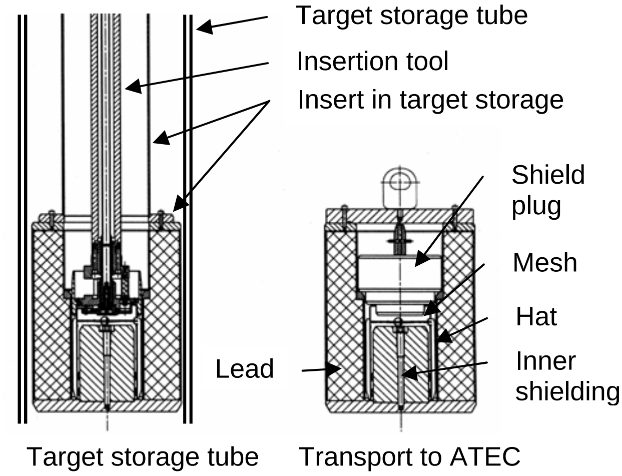

Fig. 5: Insert (lower part) and shielded vessel for the hat in the target storage area.

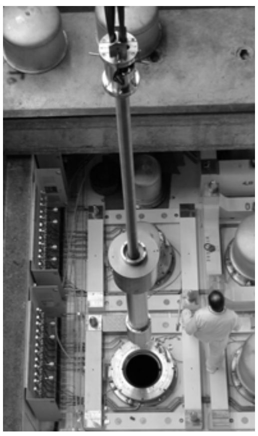

Fig. 6: Inserting the tool in the target storage insert with the hall crane.

REFERENCES

[1] K. Thomson, Megapie document MRP-3-TK34-003/1, PSI, April 6, 2003.

[2] K. Thomson: VIMOS, *A Novel Optical Safety Device for MEGAPIE*, PSI Scientific Report 2002, Vol III, p. 144.

[3] E. Pitcher, private communication.