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Verification and validation of Light Shutter System for the European Spallation Source (ESS)

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To protect the experimental areas inside the instrument halls at the European Spallation Source (ESS) from radiation and to safely feed neutron beams to the neutron instruments the target is surrounded with a shielding structure called bunker. To protect the bunker from gamma radiation during shutdown at ESS a subsystem of the Neutron Beam Extraction System (NBEX), the Light Shutter System (LSS) was developed by ESS. The LSS consists of a 4 m long frame with a fixed jackscrew connected to an actuator package with brakes, actuator and resolver mounted below of the frame. The two movable blocks Gamma Beam Shutter (GBS) and Bridge Beam Guide (BBG) as well as the fixed Floor Filler Block (FFB) are contained in the frame. Besides protecting the bunkers with GBS, the LSS can also be used to accommodate an optical unit in the Bridge Beam Guide (BBG). By positioning the BBG, a very high repeat accuracy must be ensured despite the heavy blocks. To verify this repeat accuracy of 50 microns as well as the LSS operability, the Vertical Handling and Test Stand (VHTS) is set up with a prototype of LSS at the institute ZEA-1 Engineering and Technology of the central institute of engineering, electronics and analytics of Forschungszentrum Jülich GmbH. In case of a fast shutdown or malfunction, the control loop of the actuator will be opened and the GBS, weighing a ton, falls down due to gravity. In this case the integrated shock absorber decelerate the blocks in a safe position and the bunker is protected from gamma radiation. To detect movement and deformation loads the test stand will be equipped with laser and motion trackers as well as markers. In addition, various shock / acceleration and force sensors will be installed. All sensors as well as the actuator will be connected to a control system, which enables operation and fast data acquisition. The VHTS, the LSS itself, a remote handling concept and all measurement and control components for concept verification are presented as well as the experimental test setup.

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