Fast shutter concepts for the new ITER core CXRS upper port plug baseline considering the actuator located inside and outside the port plug

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**INTRODUCTION**

The ITER core charge exchange recombination spectroscopy (CXRS) diagnostic, designed to analyze and study the plasma, is located in the vacuum vessel (VV) upper port #3 (UPP3).

The core CXRS optical system requires protection, especially for the first mirror (M1), against degradation during plasma pulses, dwell time, time between plasma burns, wall conditioning, and maintenance. Implementing protective shutter mechanisms is one of the ways to reduce degradation effects.

Two conceptual solutions are proposed and compared as possible candidates for the new core CXRS UPP layout. Both conceptual solutions make use of the same shutter mechanism (actuator) with different locations of the driving component (actuator). The fast shutters are planned to operate within fractions of seconds.

**CONCEPT-1** uses a pneumatic (helium) actuator in the primary vacuum side, attached to the Diagnostic Shielding Module (DSM). Concept-1 can implement any generic solution adopted by ITER, reducing the overall complexity of the alternative designs, not only for the core CXRS UPP but as well for other ITER systems. Additionally, Concept-1 is more suitable for ITER systems due to the conditions in the DSM region (ultra-high vacuum, magnetic fields, neutron fluxes, high temperatures), the actuator type is restricted mainly to pneumatic actuators among others. This will determine the best choice for the core CXRS UPP layout.

**CONCEPT-2** uses two parallel hydraulic actuators located outside of the primary vacuum, attached to the UPP back flange.

The two fast shutter concepts showed to be suitable candidates for the new core CXRS baseline layout, and it is recommended to continue a design optimization process for both concepts. In particular, for Concept-2, further efforts are encouraged to be performed; using other kinds of actuators may provide alternative designs, not only for the core CXRS UPP but as well for other ITER systems. Additionally, Concept-2 can implement any generic solution adopted by ITER, reducing the overall complexity of the machine.

In future studies other comparison topics are foreseen to be covered, such as a detail design of components, a complete RAMI (Reliability, Availability, Maintainability, and Inspectability) analysis, among others. This will determine the best choice for the core CXRS UPP layout.