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P3.027 SPIDER Gas Injection and Vacuum System: from Design to Commissioning

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The ITER project requires at least two Heating Neutral Beam Injectors (NBIs), each accelerating up to 1MV a 40A beam of negative H-/D-ions, to deliver to the plasma a total power of about 33 MW for one hour. Since these requirements have never been experimentally met, it was recognized necessary to build-up a test facility, named PRIMA including both a full-size negative ion source (SPIDER - Source for Production of Ion of Deuterium Extracted from Rf plasma) and a full prototype of the ITER injector (MITICA - Megavolt ITER Injector & Concept Advancement). This realization is made with the main contribution of the European Union, through the Joint Undertaking for ITER (F4E), the ITER Organization and Consorzio RFX (CRFX) that hosts the Test Facility in Padova, Italy. SPIDER is a Radio Frequency ion source that has the same characteristics foreseen for the ITER NBI but with beam energy limited to 100 keV. The mission of SPIDER is to increase the understanding of the source operation and to optimize the source performance in terms of extracted current density, uniformity and pulse duration.

The paper describes the Gas injection and Vacuum System (GVS), from the analysis of requirements to the system detailed design, procurement, site acceptance tests and commissioning. In particular, it presents the rationale behind the main design choices and specific manufacturing details of the gas injection plant feeding the RF source. Furthermore, the paper describes the sensor system to measure the vacuum level, gas pressure and flow, and residual gas analysis considering the interface with the SPIDER/MITICA central interlock and safety systems. Reference is also made to safety aspects concerning the presence of H₂/D₂ in a closed environment as the SPIDER biological shield. Finally, the main results of the GVS commissioning with the control and interlock systems are presented.

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