Metrology for integration and installation activities at the PRIMA Test Facility

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The ITER project requires, for plasma heating and current drive, at least two Neutral Beam Injectors (NBIs), each accelerating up to 1MV a 40A beam of negative deuterium ions, so as to deliver to the plasma a 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 (Padova Research on ITER Megavolt Accelerator), which includes both a full-size negative ion source (SPIDER - Source for Production of Ion of Deuterium Extracted from RF plasma) and a prototype of the whole 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 (Italy) which hosts the Test Facility.

The paper describes the main metrology activities performed in the last three years devoted to the integration and installation of the large number of items and plant units composing the PRIMA facility. Particular emphasis is given to the propaedeutic activities consisting mainly in the definition of the metrology network (the so called Unified Spatial Metrology Network - USMN). The USMN is a feature of the Spatial Analyzer software (SA) compliant with the ISO standard that using the Montecarlo method is capable to reduce the global measurement uncertainty. The method is based on the installation and measurement of a large number of fiducial points (approximately one hundred targets, properly designed and installed on the PRIMA building pillars and floors). For PRIMA, some local USMN networks have been built up at different locations (for example inside both the SPIDER and MITICA bio-shields and inside each building) combined eventually in the definition of the PRIMA USMN network. This approach allowed the definition of the global reference frame (absolute coordinate system) to be used for the positioning of all items, while respecting the uncertainty requirements of each component by means of technologically advanced laser trackers.

In the paper some instances will be given like the positioning of the transmission line and the high voltage bushing support structure for MITICA, the vacuum vessel and the beam source for SPIDER.