THE TRANSMISSION LINE FOR THE SPIDER EXPERIMENT

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The 100 keV Ion Source Test facility, identified as **S**ource for the **P**roduction of **I**ons of **D**euterium **E**xtracted from **R**F plasma (SPIDER) is aimed to test the full scale prototype of the Ion Source for the ITER 1 MeV Neutral Beam Injector (NBI).

The SPIDER facility, whose construction will start in Padova, Italy, in the current year, requires the construction of a High Voltage insulated Deck (HVD) and of a High Voltage Transmission Line (TL) necessary respectively to host the Ion Source and the Extraction Grid Power Supplies (ISEPS) system polarized at 100 kV and to transmit the power and signal conductors from ISEPS to the beam accelerator.
In already existing NBI systems with beam energy above 100keV, the TL is realized with the Gas Insulated Line technology, using pressurized gas (usually Sulphur Hexafluoride SF_6) as insulation medium. In the case of the SPIDER TL, the presence of a large inner conductor (half meter diameter), would make the pressurized TL a complex and costly component. For this reason, a different approach in the SPIDER realization has been followed, consisting in the design of a free air insulated TL.

The paper focuses on the design of this High Voltage Transmission Line, which has to host the complex High Potential (100 kV) inner electrode, which carries inside power and measuring conductors and cables (multi-kiloamps busbars, RF coaxial lines, multi-wire cables, fiber optics etc.) and has to minimize the Electromagnetic Interferences (EMI) produced by the frequent grids breakdowns, a typical phenomenon of the Neutral Beam Injectors.
The details of the interfaces with the Beam Accelerator Vessel and with the High Voltage Deck are also described, especially as far the EMI aspects are concerned.

Finite Element (FE) analyses have been performed on one hand to verify the configuration from the electrostatic point of view and, on the other hand, to evaluate EMI screening effectiveness of the double layer panels employed to build the Transmission Line external – ground potential – electrode. In addition, FE thermal simulations have been performed to assess the potential impact of the relatively high thermal dissipation of power conductors located inside the high potential electrode, highlighting the necessity to provide the TL inner conductor with active cooling.

Moreover, an experimental test campaign has been carried out on a TL mockup to validate the TL electrostatic configuration under DC voltage.

Finally, the paper will report on the status of procurement activities for the Transmission Line, including procurement strategy and progress in execution.