INSTRUMENTATION AND DIAGNOSTICS FOR THE ITER NEUTRAL BEAM SYSTEM

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The ITER Neutral Beam System consists of two 1 MeV Heating and Current Drive (H&CD) Injectors and one 100 keV Diagnostic Neutral Beam (DNB) Injector. Each H&CD injector will deliver 16.5 MW of power to the ITER plasma with a pulse length of up to 3600 seconds during the different phases of the experimental programme, ranging from low activation operation with hydrogen and helium plasmas, deuterium plasmas, and finally full performance operation with deuterium-tritium mixtures. This broad range of requirements imposes a high flexibility, a high availability and reliability of the instrumentation and on the diagnostics that will be used.

The following issues are the most demanding for the instrumentation: the nuclear environment, the high voltage causing transients on the measurements during breakdowns, the ultra high vacuum requirements and the limited access to the instrumentation once installed.

The power from the residual ions (40 % of the ion beam) that are found after the neutralisation stage is intercepted on an electrostatic ion dump and the voltage of this ion dump must match the acceleration voltage. Also the stray magnetic field that is found in this region will shift the power loading on the ion dump. These parameters therefore require a fast control system and an interlock system to protect the beamline components.

The neutral beam vessel is directly connected to the Tokamak vacuum vessel and will therefore be contaminated with tritium. The NB vessel is for this reason classified as a Safety Importance Component (SIC). All instrumentation feedthroughs are also classified SIC. Since the feedthroughs are fragile components they have to be manufactured with double vacuum barriers and the interspace must be monitored. Any instrumentation connector inside the vacuum must be compatible for remote handling.

Mineral insulated instrumentation cabling must be used to reduce the degradation with time due to the neutron and gamma radiation. Also the high magnetic field require the usage of twisted mineral insulated cables.

The paper will highlight the design solutions that have been chosen to obtain a robust and high performing instrumentation and diagnostics system.