

Bringing state of the art diagnostics to a nuclear machine

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The ITER project stands on the crossroad between a Scientific Facility and a Fusion Power Plant. Its diagnostic suite is inspired by diagnostic techniques that have been successfully demonstrated and perfected on previous and existing fusion experiments. However, the implementation of each technique on ITER comes with added challenges due to the fact ITER is registered as a full nuclear facility – “Installation Nucléaire de Base” INB 174 – under French and International nuclear regulations. This brings extra requirements related to both the harsh nuclear environment and to the regulations that need to be respected.

In a first part of this presentation some of the technical design challenges that result directly from the harsh environment will be addressed. This includes effects such as transmutation, activation, radiation damage, thermo-electric effects, high nuclear heating loads et cetera. The use of novel materials and components (e.g. development of radiation hard electronics) as well as innovative design and integration choices (e.g. developing the system architecture such that the more vulnerable part of the diagnostic can be located further away from the reactor itself) to cope with these challenges will be presented.

In a second part the safety and qualification requirements will be presented. These have in particular an impact on design, manufacture, installation, operation and maintenance of Protection Important Components (PIC) such as feedthroughs and windows. But also non-PIC (parts of) diagnostics are affected, specifically in relation to limited access – both in space and time – for commissioning, alignment, calibration and maintenance. Typically foreseeing the possibility for remote operation and maintenance should be included early in the design and, where this is not possible, hands-on activities should be designed to be as simple, quick and ergonomic as possible.

The above challenges and solutions will be illustrated by examples of diagnostics currently being designed, manufactured and installed for and at ITER.

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