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Advancing fusion energy: Meeting the challenges of diagnostics and electronics for the ITER project

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In the pursuit of clean and sustainable energy, the International Thermonuclear Experimental Reactor (ITER) project has emerged as a beacon of hope. As the world's largest experimental fusion reactor, ITER aims to demonstrate the feasibility of fusion as a viable energy source. However, operating in a challenging nuclear environment presents numerous technical and engineering obstacles that must be overcome to ensure safe and reliable operation.
The diagnostic systems are critical to the successful and safe operation of ITER. They provide the means to observe, monitor and maintain plasma performance over extended periods of time. They provide accurate measurements of plasma behaviour and performance, including those required for protection of the machine and its control, as well as measurements required for physics studies. In total, about 50 diagnostic systems will be installed on ITER.
This presentation focuses on the development of diagnostics systems and the utilization of electronics within the ITER project. The harsh environment, characterized by high temperatures, intense neutron fluxes, and strong magnetic fields, poses significant challenges for electronics and instrumentation.
The first part of the presentation discusses the design and development of diagnostic systems for ITER. These systems encompass a wide range of measurements, including plasma temperature, density, and impurity content.
The second part of the presentation delves into the unique requirements and challenges associated with electronics used in the nuclear environment of ITER. The radiation effects, including total ionizing dose, displacement damage, and single-event effects, pose serious reliability concerns for electronic components. Radiation-hardened designs, materials, and techniques are discussed, along with strategies for mitigating radiation-induced failures and ensuring the longevity of electronic systems.
Finally, this presentation provides an overview of the research and development efforts underway in the field of diagnostics and electronics as part of the ITER project. By addressing the technical challenges and presenting the progress made, it aims to encourage the exchange of knowledge, collaboration and innovation in the field of electronics for nuclear fusion. The knowledge gained from this research will not only contribute to the success of ITER, but will also pave the way for future advances in fusion energy technologies.

Disclaimer: The views and opinions expressed herein do not necessarily reflect those of the ITER Organization

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