**Diagnostics For Fusion Reactors**

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With ITER’s design and construction entering final stages, and with a renewed effort in designing and constructing the next step fusion devices, a new emphasis on the role of diagnostics is emerging. The next steps, being demonstration fusion reactors or full-scale power plants, will require a dedicated set of diagnostics and monitors serving primarily in control loops. This stands in contrast to the current role as both control and physics measurements in present-day devices. Design of these diagnostic systems will encounter many challenges, such as radiation effects (prompt and accumulated), surface degradation (deposition and erosion), reduced access and maintenance, very high required reliability, availability and inspectability, as well as long pulse operation. In addition, they will experience complications due to relativistic effects and lack of neutral beam-based measurements. Many of these challenges have been addressed for ITER and will be experienced during its operation, which will provide valuable knowledge for overcoming these issues. In some cases, however, the conditions expected in a reactor will require further developments beyond those achieved for ITER. New approaches such as RF/microwave-based techniques and the use of proxy measurements are showing excellent promise in fulfilling the needs of a reactor. A review of these needs, the impacts of the expected harsh conditions, and prospects for new approaches will be discussed and illustrated.