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ITR/2-1: ITER Diagnostics - Technology and Integration Challenges

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Diagnostics play a vital role in controlling the plasma and optimizing its behavior. The higher temperatures and densities of the burning plasma drive the need for advances in diagnostic technology. Discussion of such needs is part of a conceptual design review activity in progress at ITER, and supported by experts from the ITER parties. The front-ends of most of these diagnostics will be housed in massive port plugs, which also shield the machine from radiation, and supply cooling to the first wall. Many diagnostics are housed in a single equatorial port plug, presenting new and interesting technical and organizational challenges for developers. Front-end components must tolerate thermally-induced stresses, disruption-induced mechanical loads, stray ECH radiation, radiation damage, and degradation due to plasma-induced coatings. Challenges are amplified due to the difficulty in performing maintenance on these large structures, particularly once they are activated. In the active phase, port plug removal and maintenance will be performed robotically. Such activities benefit from a standardized approach to diagnostic packaging. Motivated by needs to minimize disruption loads on the plugs, to standardize the handling of diagnostic shield modules, and to decouple the parallel design efforts of the many parties developing ITER diagnostics, the packaging of diagnostics has recently focused on 3 vertical shield modules inserted from the plasma side into each equatorial port plug structure. The dimensions and attachment features of these modules are standardized. At the front of each is a detachable first wall element with customized apertures. Examples of developmental needs identified in the conceptual design phase will be given. Progress on front-end integration into port plugs will be described, including qualification test plans. Also discussed will be measures for coping with the neutron loads, the thermal and electromagnetic loads, the ECH loads, and the first-mirror vulnerabilities.

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