Overview on R&D and Design Activities for the ITER core CXRS Diagnostic System

W. Biel[1], T. Baross[7], P. Bourauel[1], D. Dunai[7], M. Durkut[3], G. Erdei[8], N. Hawkes[6], M.v.Hellermann[2], A. Hogenbirk[5], R. Jaspers[4], G. Kiss[1], F. Klinkhamer[3], J.F. Koning[2], V. Kotov[1], Y. Krasikov[1], A. Krimmer[1], O. Lischtschenko[2], A. Litnovsky[1], O. Marchuk[1], O. Neubauer[1], G. Offermanns[1], A. Panin[1], K. Patel[6], G. Pokol[8], M. Schrader[1], B. Snijders[3], V. Szabo[8], N. van der Valk[3], R. Voinchet[1], J. Wolters[1], S. Zoletnik[7]

[1]Institut für Energieforschung - Plasmaphysik, Forschungszentrum Jülich Gmbh, Association EURATOM-FZJ, member of Trilateral Euregio Cluster, 52425 Jülich, Germany
[2]FOM-Institute for Plasma Physics Rijnhuizen, Association EURATOM-FOM, partner in the Trilateral Euregio Cluster and ITER-NL, P.O. Box 1207, 3430 BE Nieuwegein, The Netherlands
[3]TNO Science & Industry, Partner in ITER-NL, P.O. Box 155, 2600 AD Delft, The Netherlands
[4]Department of Applied Physics, Eindhoven University of Technology, The Netherlands
[5]Nuclear Research and Consultancy Group V.o.F., Petten, The Netherlands
[6]Association EURATOM/CCFE, OX14 3DB, Abingdon, UK
[7]KFKI RMKI, EURATOM Association, PO Box 49, H-1521, Budapest, Hungary
[8]BME, EURATOM Association, PO Box 91, H-1521, Budapest, Hungary

Corresponding author: w.biel@fz-juelich.de

The ITER core CXRS diagnostic system is designed to provide experimental access to more than one quarter of the about 40 quantities listed in the ITER measurement requirements table. It collects the light emitted from the interaction of the Diagnostic Neutral Beam with the core plasma and guides it via a mirror labyrinth through the Upper Port Plug #3 towards a fibre bundle, which then transmits the light towards a set of spectrometers for spectral analysis. The requested measurement accuracy and stability for the CXRS system go far beyond the level commonly achieved in todays fusion experiments, while the hostile technical environment on ITER provides an extreme challenge for the design, integration and operation of the diagnostic system.

The most vulnerable component of the CXRS system is the first mirror, which is subject to erosion due to fast particle bombardment and deposition of plasma impurities. Additional challenges for the design activities are the low expected CXRS signal intensity in the plasma centre caused by the attenuation of the neutral beam together with a high Bremsstrahlung continuum level, the high neutron loads, generating thermal loads and hence stresses, electro-magnetic loads generated from transient plasma events, seismic events and the limited access for any kind of system maintenance.

Within this paper, we provide a summarizing overview on the status of ongoing design activities for the CXRS system, while the details are described within several additional special contributions. Specifically, we address the system engineering studies on comparison of CXRS design concepts and estimations of CXRS lifetime and availability, the design activities on Port Plug components (shutter, retractable tube, mirrors and mirror mounts, shielding cassette and mirror cleaning system), erosion and deposition modeling related to the first mirror, neutronics calculations, engineering analysis on thermal, electro-magnetic and structural mechanical issues, remote handling aspects, optical design, CXRS spectrometer and fluctuation BES system prototype development, improvement of atomic data and overall CXRS performance assessment.