First experience with the W7-X Fast Interlock System

Reinhard Vilbrandt on behalf of the W7-X-Team
Max Planck Institute for Plasma Physics, Greifswald, Germany
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Motivation

• The first practical experiences with the central Fast Interlock system (cFIS) have been gained during the operation phase 1.2b in summer 2018
  • initial cooled divertor, max. 200 MJ heating input, max. pulse length 100 s
   • proof of
     • a satisfactory reaction, scalability, operability
  • assessment of
    • the response times resulting from various safety-relevant plasma diagnostics.
  • definition of
    • improvement and upgrade of the FIS to protect components in the plasma vessel in the future (active cooled divertor, max. heating power up to 14 MW)
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Main results

- The response time of the cFIS is sufficient.
- The fast shut-off of the heating systems within 5 µs worked reliably.
- All interventions by the cFIS were justified. False alarms were not observed.
- Diagnostics for ECRH stray radiation, diamagnetic energy, and plasma density worked very reliable.

example

radiation from the plasma gets too high at 6 sec.
→ the electron temperature drops (but ECE was not available)
→ fast drop of diamagnetic energy
→ ECRH shut-off by cFIS
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Improvements

• Implementation of the ECE-diagnostic to the cFIS. (worked stand-alone properly)

• Elimination of some temperature drift and signal artefacts of the diamagnetic loops.

• Add real-time recording of data and events in the cFIS for analysis purposes. (e.g. to detect jitters in signal generation)

• Removal of some timing constraints in the cFIS (implemented as a precaution into the first version)

→ aiming at a strict focus on safety-relevant parameters
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Upgrade

- Implementation of Divertor Thermography to avoid overload of plasma facing components.
- Implementation of the new Ion Cyclotron Resonance Heating (ICRH) system into the cFIS.
- The increasing number of heating systems and safety-relevant diagnostics demands enhancement of the high speed core-system and communication.
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Thank you for your attention

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This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 and 2019-2020 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.