

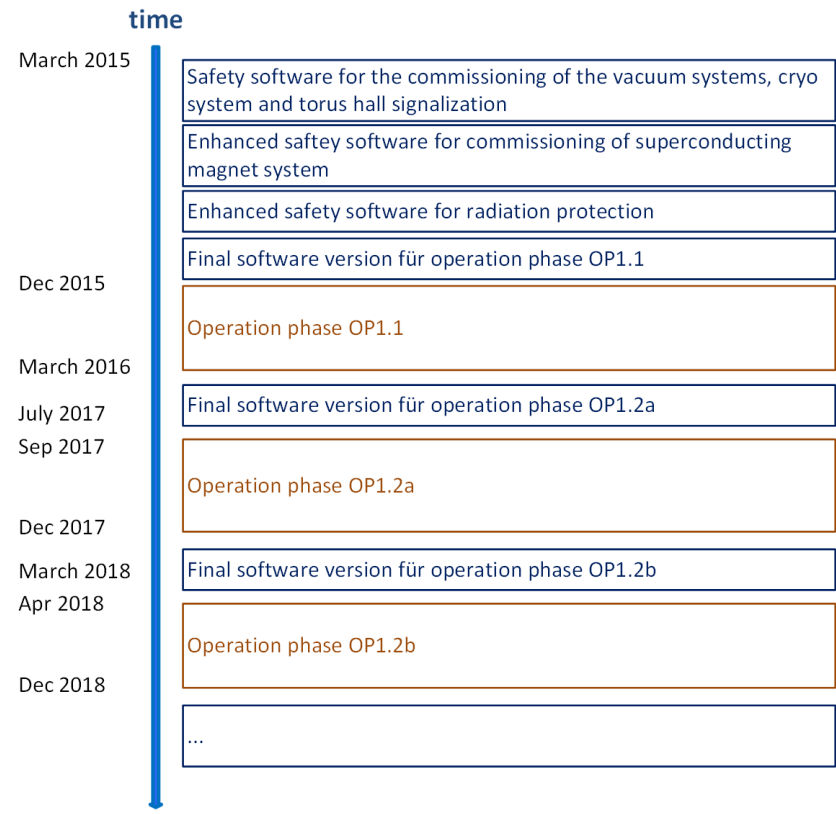
Simulation System for the Wendelstein 7-X Safety Control System

. Schacht¹, A. Wölk¹, S. Pingel¹, U. Herbst¹, D. Naujoks¹, and the W7-X Team

¹Max-Planck-Institute for Plasma Physics, EURATOM Association, Greifswald, Germany

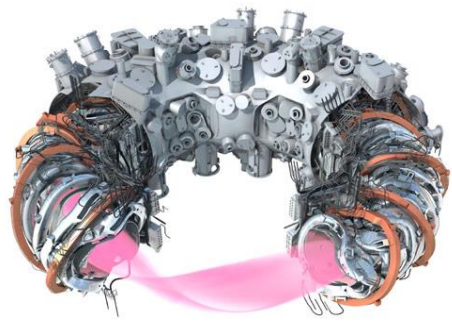
Real Time conference 2018, Williamsburg

W7-X operation Phases



- For every new operation phase an enhanced version of the central safety system (cSS) is necessary!
- The effort for integration tests and validation of the software for cSS is very high.

W7-X in operation



CAD model of W7-X



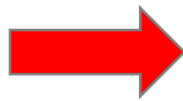
View on W7-X in the torus hall



German chancellor Dr. Merkel started the first H2-plasma discharge



Picture of the first H2-plasma (3. February 2016)



A simulation platform for the cSS was introduced for integration tests and validation of the cSS software for the operation phase OP1.2b.



HELMHOLTZ
GEMEINSCHAFT

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Motivation

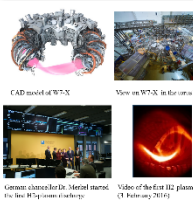
Software versions for safety system

Time	Event
March 2012	Initial software for the commissioning of the vacuum systems, cryo systems and the central operation.
July 2012	Enhancement of the software for commissioning of the central cooling system.
September 2012	Enhancement of the software for radiation protection.
December 2012	End of the commissioning phase OP1.1.
February 2013	Operation phase OP1.2.
July 2013	End of the commissioning phase OP1.2a.
September 2013	Operation phase OP1.2b.
December 2013	End of the commissioning phase OP1.2b.
February 2014	Operation phase OP1.2c.
April 2014	End of the commissioning phase OP1.2c.
September 2014	Operation phase OP1.2d.

The superconducting stellarator W7-X needs for a safe operation a well defined and tested safety system:

- I. The W7-X control system allows a safe and flexible control of preparation and conducting of discharges.
- II. For every new operation phase an enhanced version of the central safety system (cSS) is necessary.
- III. The effort for integration tests and validation of the software for cSS is very high.
- IV. A simulation system allows developing and testing the safety software before commissioning and helps to meet the high quality requirements.

W7-X in operation



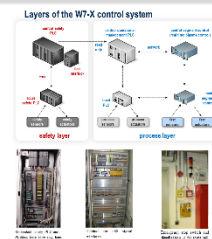
A simulation platform for the cSS was introduced for integration tests and validation of the cSS software for the operation phase OP1.2b.

Safety-System Overview

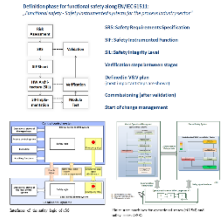
Safety system architecture

Functions of the safety system:

- I. Ensures personal safety and investment protection.
- II. Supervision of access control into the different zones of the radiation protection area.
- III. Emergency stop system.
- IV. Control of the safety states of W7-X.
- V. Signalization (warnings and alarms).
- VI. Realization of safety functions:
 - personnel safety,
 - device protection,
- VII. Communication interfaces:
 - Central Operation Management (cOPM) (Ethernet),
 - Fast Interlock System (Ethernet),
 - Control components (safety signal interface),
 - Data archive (Ethernet),



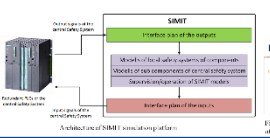
Development process



SIMIT based simulation platform for the W7-X safety system

Architecture of SIMIT (Fa. Siemens):

- **Modelling system:** The simulation models are created and the interfaces to the coupled partners are configured in the modelling system.
- **Control system:** The simulation model runs in the control system. The simulation model communicates with the coupled safety program of redundant PLCs of the cSS simulation platform.



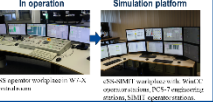
Realization:

- Installation of a simulation system, consisting of:
 - 2x PLC S7-417,
 - Profibus safe network and profibus coupling device,
 - Windows PC equipped with SIMIT V9.0
- Processing of about 2000 safety Input/Output signals.
- Implementation of simulation models for:
 - 21 technical components,
 - 5 operation diagnostics (e.g. laser systems),
 - 12 diagnostics,
 - Signalization, access control, gas warning system, ...



Results:

- W7-X operation and safety software development are possible at the same time.
- Early detection and correction of configuration and software errors.
- Shorter commissioning period due to:
 - a tested configuration,
 - extensively tested software.
- Significantly reduced on site debugging.
- Education of the cSS operators.



Motivation

Information about safety system of W7-X

Simulation platform for safety system

JÖRG SCHACHT, MAX PLANCK INSTITUT FÜR PLASMAPHYSIK, GREIFSWALD, GERMANY

Contact: joerg.schacht@ipp.mpg.de

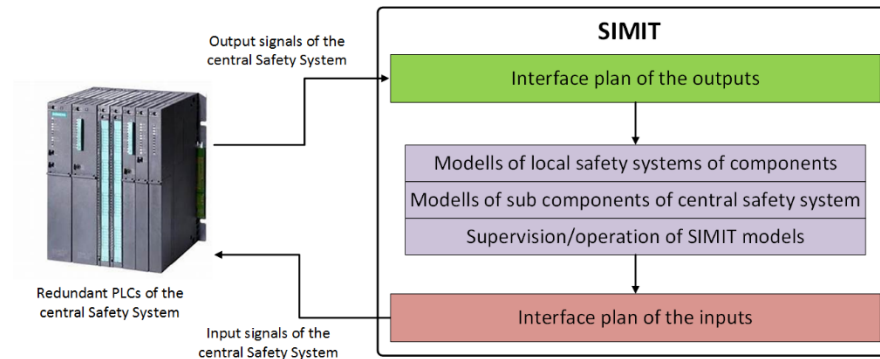
Jörg Schacht

Thanks for attention!

Please contact me during the poster session!
Poster session 2, Poster ID # 370

SIMIT based simulation platform

SIMIT test platform architecture

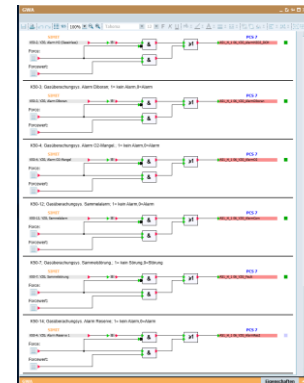


Results:

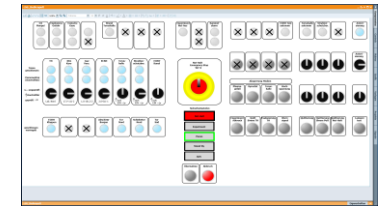
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Realization

SIMIT implementation



SIMIT graphical program chart



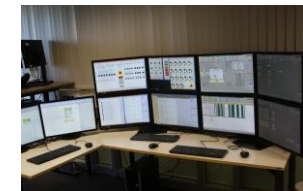
Simulation of the cSS panel

In operation



cSS operator workplace in W7-X control room

Simulation platform



cSS-SIMIT workplace with: WinCC operator stations, PCS-7 engineering stations, SIMIT operator stations.