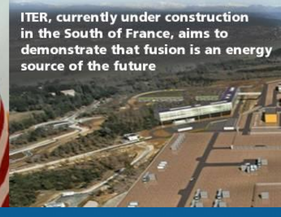

A huge global increase in energy use is inevitable


There is an urgent need to seek cleaner ways of producing energy on a large scale


Fusion offers important advantages: no carbon emissions, no air pollution, unlimited fuel, intrinsically safe


A global collaboration has been formed to test the feasibility of fusion


ITER, currently under construction in the South of France, aims to demonstrate that fusion is an energy source of the future

ITER Contribution to Control System Studio (CSS) Development Effort*

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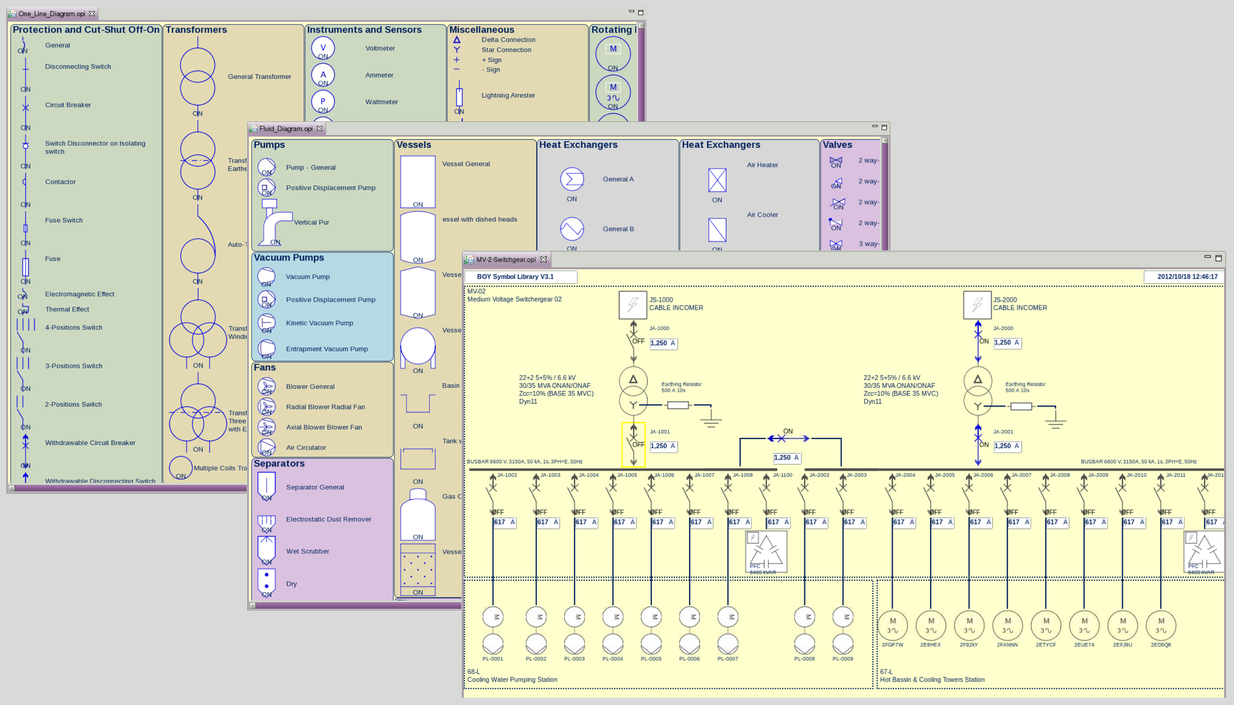
** The views and opinions expressed herein do not necessarily reflect those of the ITER Organization*

Introduction

- The ITER project aims to demonstrate the feasibility of commercial production of fusion energy. It is an international project that involves seven members (China, Europe, India, Japan, Korea, Russia and USA) who provide all plant systems (magnet, vacuum vessel, divertor, cryostat, diagnostics…) in-kind through so called procurement arrangements. The majority of them include local control systems that need to be integrated into CODAC – the central control system of ITER.
- To mitigate the risks during integration, a major effort has been invested to provide not only guidelines and standards applicable to all local control systems but also a framework that implements these standards and guarantees that the local control systems can be integrated into the central one.
- This framework is based on EPICS – Experimental Physics and Industrial Control System, and includes Control System Studio to provide the operator interface, the alarm system, engineering archival and the electronic logbook.

Operator Interface – Industrial Symbol Library

- The Operator Interface connects to the local control system, animates graphical widgets according to an EPICS PV value, alarm status/severity and connection/read-write status, shows PV's range and alarm limits and allows the operator to interact with the process by providing input data and sending commands. Working on a real use case, it was soon necessary to introduce an industrial symbol library of objects such as electrical circuit breaker, pump or valve.
- Based on CAD symbols, a library of more than 250 industrial symbols was setup in svg and png format and published to the CSS source repository as a new plugin.
- Subsequently, it was necessary to develop a new graphical widget to handle these industrial symbols and display them in their On/Off position according to an EPICS Boolean PV value and redraw the black and white original image in the preconfigured On/Off color.
- This industrial symbol library and symbol widgets were the first main ITER contribution to CSS development effort and found a direct application in the site electrical power distribution use case.
- This was also the opportunity to collaborate on existing widgets by adding new functions such as the image rotation and flip.



Alarm Automated Action

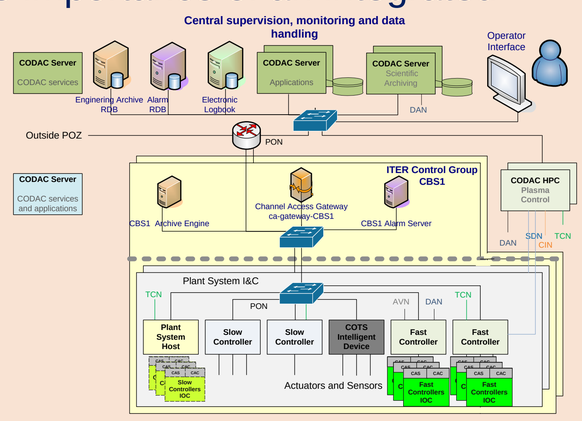
- The Alarm System monitors alarms in the control system and provides essential support to the operator by warning him of situations that need his attention, showing guidance, allowing him to open dedicated displays, execute commands and acknowledge alarms. When the operator is offsite or unavailable, it is important to be able to trigger after a delay an automated action in case of alarms – these actions being sending an email, an SMS or just executing a script. The extension point of the new plugin allows any contributor to develop his/her own automated action, ITER being in charge of the plugin itself, the automated action API and its first implementation - the automatic sending of an email with alarm information.

PV Name Auto-complete & Co…

- Every laboratory has its own naming convention and ITER is no exception. To minimise typing errors, it was decided to develop a CSS core plugin for the auto-completion and allow any contributor to implement his/her own PV configuration database interface, ITER being in charge of the plugin, the auto-complete API and the history name lookup. ITER has also provided an EPICS database source file parsing for the project imported in the user CSS workspace.
- In addition, ITER contributed to CSS development effort by adapting the plot tool and alarm user interface in order for them to be run via a web-browser-equipped device such as a PC, laptop, tablet or smart phone.

Conclusion

- CSS distributed architecture has been setup for the site electrical power distribution. This real use case gives us confidence in our technical choices and shows the importance of an integrated solution.



- *The next challenge for ITER is to propose tools in its CODAC framework for factory and site acceptance tests to automate sequences of commands, track actions and events, and produce reports.*