

EPICS

Spring Meeting 2016

Overview

Adam Stephen, UKAEA



CCFE is the fusion research arm of the **United Kingdom Atomic Energy Authority**. This work was part-funded by the RCUK Energy Programme [grant number EP/I501045] and the European Union's Horizon 2020 research and innovation programme.

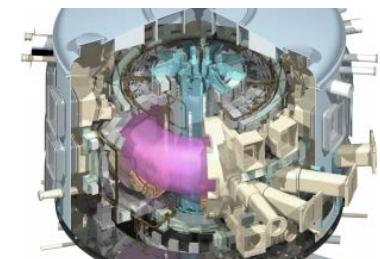


Welcome/Agenda

- 9:45 – 10:00 Arrival and coffee
- 10:00 – 10:20 Adam Stephen, UKAEA : Overview/Introduction + Data/Web services outlook
- 10:20 – 10:50 Freddie Akeroyd, ISIS : ISIS use of CS-Studio + Python script server
- 10:50 – 11:15 Will Rogers, Diamond: Role out to CS-Studio from MEDM.
- 11:15 – 11:35 Adam Stephen, UKAEA : From FPGA to HMI (Case Study : new protection system : how to integrate with operations).
- 11:35 – 11:55 Isa Uzun, Diamond : PandA, a 1U standalone system powered by a programmable Zynq FPGA-SoC.
- 11:55 – 12:00 Adam Stephen, UKAEA : Wrap up

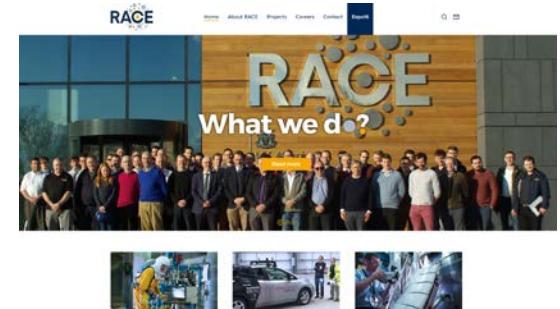
UKAEA EPICS Status

- UKAEA Capabilities
 - EPICS training April/Cosylab – 15 attendees
 - Tessella in-house training course
 - Anticipate ITER delivered EPICS training Q1 2017
- JET Facility
 - EPICS base configured and installed for Solaris
 - Interface between our data middleware (OMS) and CA
 - Outline management system and process
 - Windows IOCs + support developed for :
 - Vacuum pump controllers (Peter Heesterman)
 - Filter wheel controller (Mark Clarke)
 - Looking at Siemens PLC integration
 - HMI Integration currently to our legacy systems (XMIMIC)
- MAST-U Machine
 - Rich opportunities, current focus is engineering rebuild



UKAEA EPICS Status II

- RACE
 - Robotics/Remote Maintenance for ITER, ESS.
- ITER Technical Users Meeting
 - Lots of active progress
 - Systems coming on stream shortly
 - Integration period will be highly compressed
 - CS Studio presentation
- Control Room Tools
 - IT infrastructure enhancement funding
 - CS-Studio Pilot project for JET + MAST-U control rooms
 - Starting now – deployment by April
 - Candidate applications :



CS-Studio News 1 (BOB)

DisplayBuilder : better than BOY ? Kay Kasemir

- Performance of CSS asserted better than QT (TUMIB10 ICALEPCS13)
- But issues with the UI thread causing freezes
- BOY architecture based on GEF problematic
- Display builder has a multithreaded approach.
- Looks similar, but better. Performs better.
- .opi syntax cleaned up and made much more implementation agnostic
- Better colormaps
- Caveat : minimal script compatibility
- Deployed/tested on 200 SNS screens
- First full release scheduled for end-2016.
- Candidate name ? BOY, only better. Hence BOB.

CS-Studio News 2 : Collaboration Update

Collaboration Update

- Stats on issues/development (project remains very active)
- 4.3.x release end May adds a number of features, and is unit tested
 - Perspectives, Save/Restore, PVTable, Java8 Time,
 - BEAST datasource for Diirt, and prototype Display Builder.
- Code-at-thon April 16 at BNL
 - Quality improvements, unit tests, logging, feedback, java8
 - 600k loc *removed* !
- 4.4.x scheduled for December with full Display Builder, Cpython
- 10 registered sites (CSIRO, CSNS, DESY, DLS, FRIB, FANIL, ISIS, ITER, NSLSII, ORNL)
- Development+Governance processes outlined.
- More members welcome.

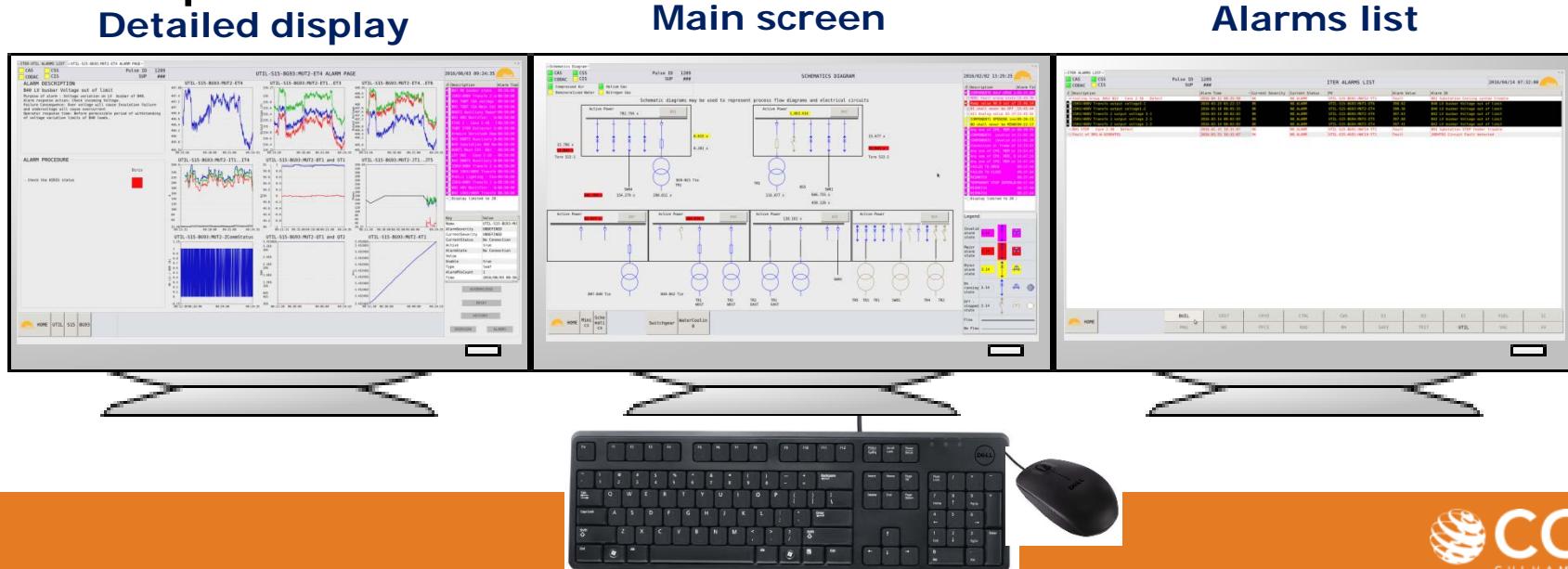
- Kay also pointed out that ORNL will host the next collaboration meeting in September 2016.

ITER Technical Users Meeting

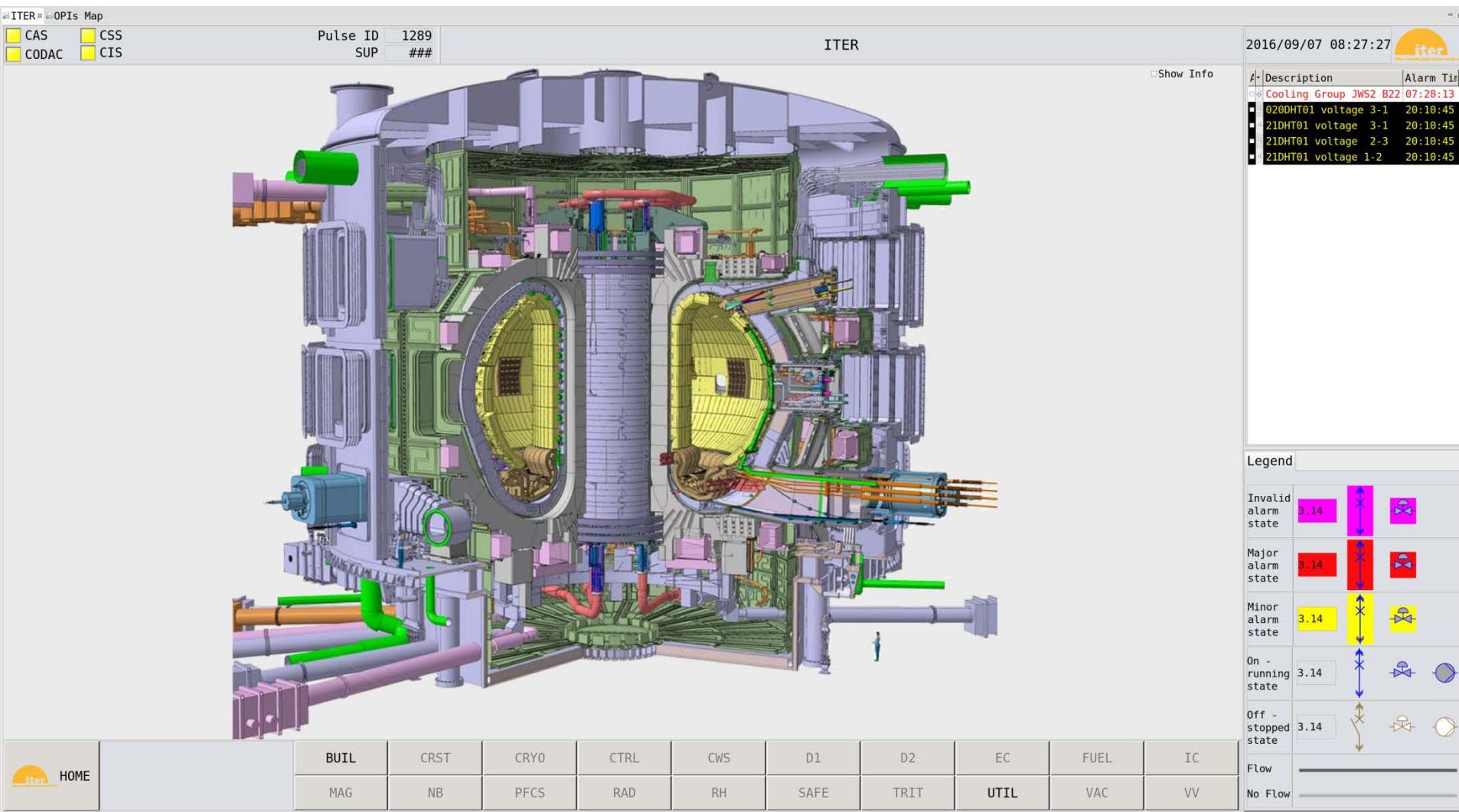


ITER HMI / CS-Studio 3 x 4K screens

- Plant System operator VDU workstation:
minimum 3 VDU (terminals)
 - Ultra HD resolution as a minimum
3840 x 2160 (simply 4K) at 60Hz
 - 24 inches
 - aspect ratio of 16:9



Zoom on the main screen



Alarm page layout

ITER OPIS Map UTIL-S15-BG93:MUT2-ET4 ALARM PAGE

Pulse ID 1289 SUP ###

ALARM DESCRIPTION

B40 LV busbar Voltage out of limit
 Purpose of alarm : Voltage variation on LV busbar of B40.
 Alarm response action: Check incoming Voltage.
 Failure Consequence: Over voltage will cause insulation failure and undervoltage will cause overcurrent
 Operator response time: Before permissible period of withstanding of voltage variation limits of B40 loads.

ALARM PROCEDURE

- Check the DIRIS status

Diris

UTIL-S15-BG93:MUT2-ET4 UTIL-S15-BG93:MUT2-ET1..ET3 UTIL-S15-BG93:MUT2-ET4..ET6

Output Voltage (V) Output Voltage (V) Output Voltage (V)

UTIL-S15-BG93:MUT2-IT1..IT4 UTIL-S15-BG93:MUT2-BT1 and ST1 UTIL-S15-BG93:MUT2-JT1..JT5

A Power Power

UTIL-S15-BG93:MUT2-ZCommStatus UTIL-S15-BG93:MUT2-QT1 and QT2 UTIL-S15-BG93:MUT2-KT1

OK (1) / NOK (0) KWh HES

UTIL-S15-BG93:MUT2-JT1 UTIL-S15-BG93:MUT2-JT2

2016/09/07 15:35:29 **ITER** International Thermonuclear Experimental Reactor

Description Alarm TIR

- Cooling Group JWS2 B2 07:28:13
- 020DHT01 voltage 3-1 20:10:45
- 21DHT01 voltage 3-1 20:10:45
- 21DHT01 voltage 2-3 20:10:45
- 21DHT01 voltage 1-2 20:10:45

UTIL-S15-BG93:MUT2 Status Trends Help Active and Reactive Power

KW Kvar

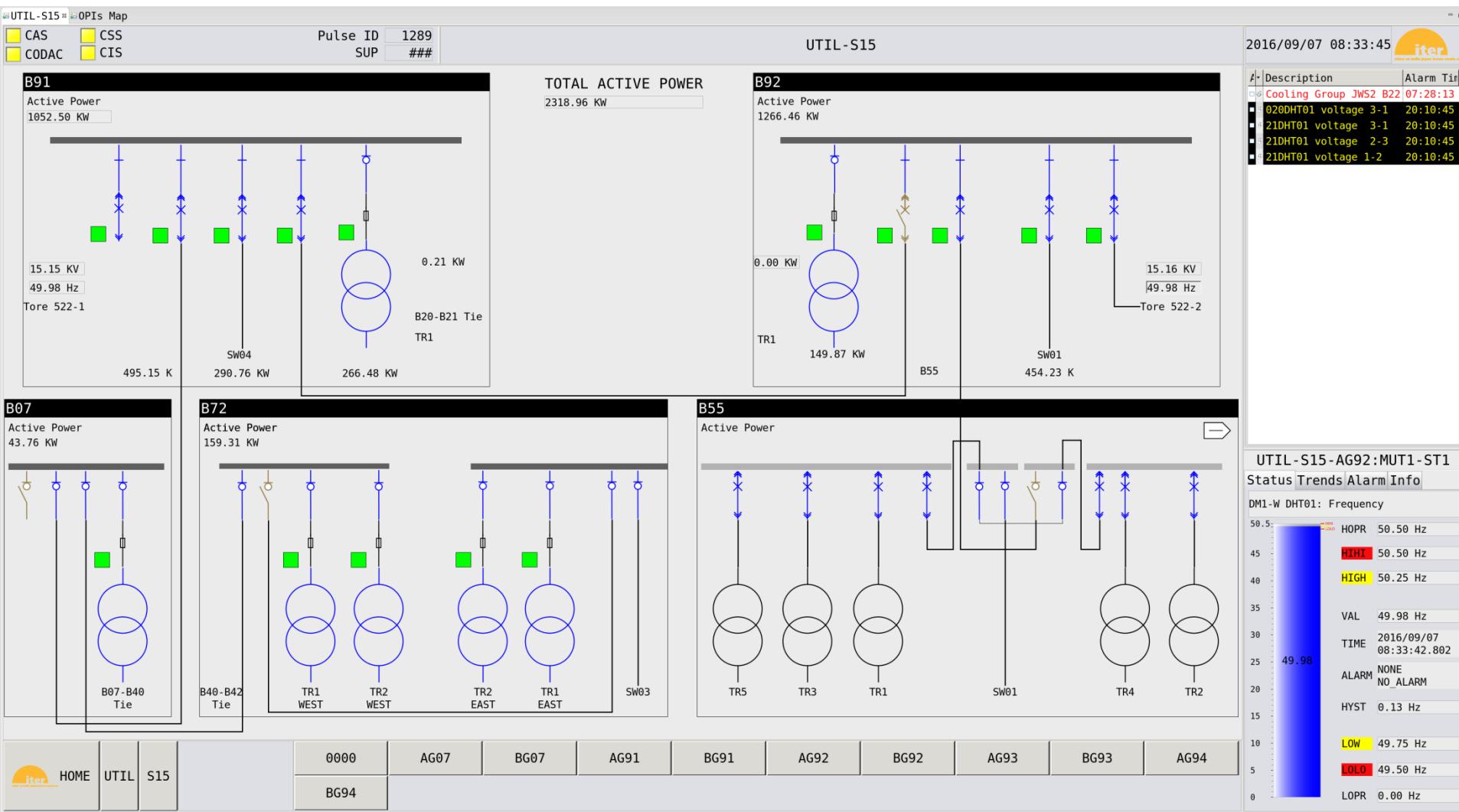
UTIL-S15-BG93:MUT2-JT1 UTIL-S15-BG93:MUT2-JT2

151.38 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230 -240 -250 -260 -270 -280 -290 -300 -310 -320 -330 -340 -350 -360 -370 -380 -390 -400 -410 -420 -430 -440 -450 -460 -470 -480 -490 -500 -510 -520 -530 -540 -550 -560 -570 -580 -590 -600 -610 -620 -630 -640 -650 -660 -670 -680 -690 -700 -710 -720 -730 -740 -750 -760 -770 -780 -790 -800 -810 -820 -830 -840 -850 -860 -870 -880 -890 -900 -910 -920 -930 -940 -950 -960 -970 -980 -990 -1000

14:09:39 14:27:00 14:44:00 15:01:00 15:18:00 15:35:00 14:08:35 14:42:00 15:35:10 14:08:35 14:42:00 15:35:10 14:09:39 14:27:00 14:44:00 15:01:00 15:18:00 15:35:00

15:24:47 15:30:00 15:35:30 15:24:47 15:30:00 15:35:30 15:24:47 15:30:00 15:35:30 15:24:47 15:30:00 15:35:30 15:24:47 15:30:00 15:35:30

UTIL-S15 CBS2 – Analog Faceplate

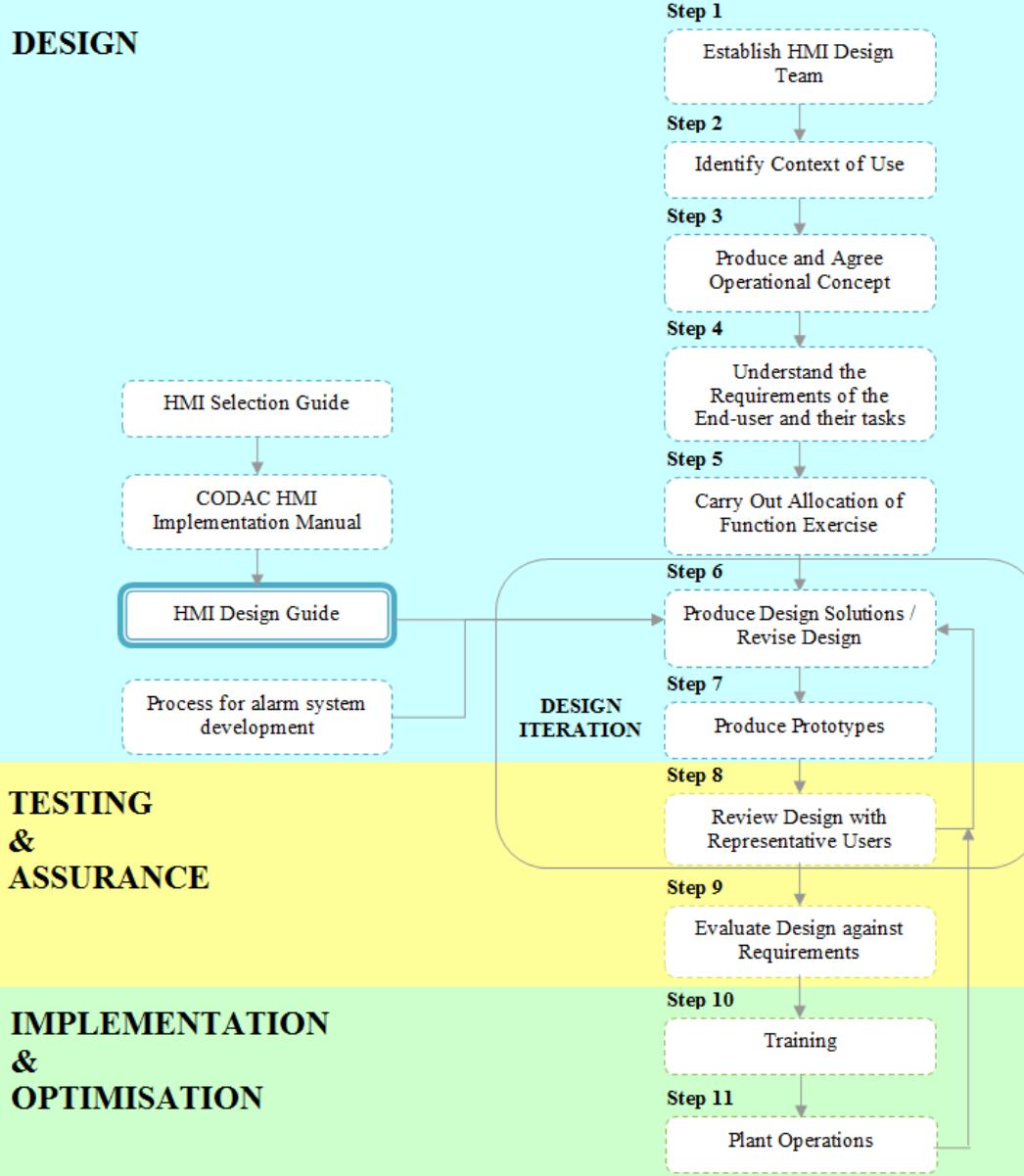


Not just about tools...

CODAC HMI Style Guide includes general design principles for the displays derived from HF. It describes the displays layout and organisation.

The toolkit provided by CODAC Core System (CCS) is based on CS-Studio set of tools that includes an operator interface (BOY), an alarm system (BEAST) and an archive system (BEAUTY)

DESIGN

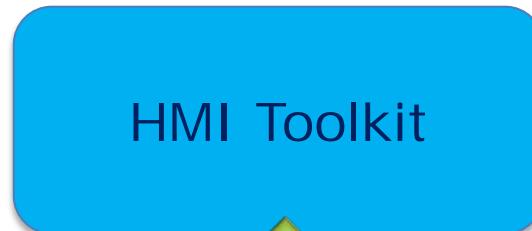


Which task is fully automated?

- QEDG6L
- 3XLESZ



HMI Style Guide and Toolkit (3XLESZ)



- standardised colours and fonts,
- collection of graphical objects – widgets – that the user can drag and drop from the palette to the display canvas, trend widgets,
- an industrial symbol library (electrical breaker, valve, pump...)
- many templates
- many tools

Hardwired panel

VDU-based system

Local front panel

QEDG6L

6.2 VDU-based system size and location

6.2.1 VDU size and resolution

The requirements provided in this section relate to the Plant System operator VDU workstations that will be located in the MCR. ITER is likely to have other roles that will have different display requirements e.g. the Session Leader, the Engineer in Charge, and maintainers. The specific VDU requirements for the other ITER roles will be identified through task analysis.

- 6.2.1.1 Analysis of operator tasks should be used to determine the number of VDUs for each Plant System operator *VDU workstation* in the Main Control Room: workstation designers shall assume a minimum of three VDUs per workstation.
- 6.2.1.2 The diagonally viewable size of each Plant System operator VDU shall be at least 605mm (24 inches).
- 6.2.1.3 The Plant System operator VDUs shall have an aspect ratio of 16:9.
- 6.2.1.4 The Plant System operator VDUs shall have Ultra HD resolution – 3840 x 2160 at 60Hz, as a minimum.

LN2 I&C development - Highlights

Start coding June 2016

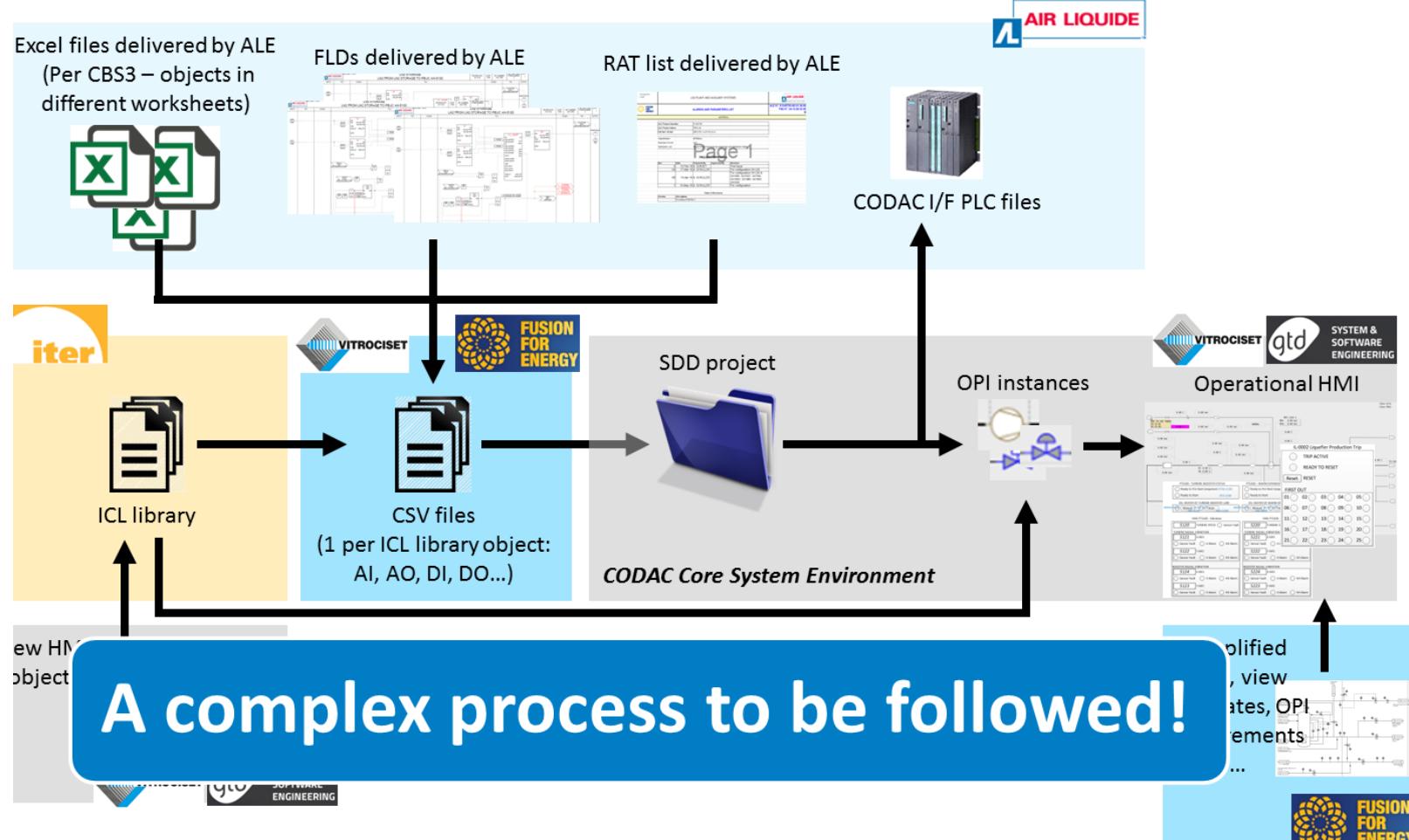
I&C FAT November 2016

- ❖ **100K-PVs 120-OPIs** – uses Industrial Cryo Library and CCS 5.2
- Multiple parties working in parallel and with inter-dependencies:
 - ALE: main LN2 plant supplier
 - ACTEMIUM: PLC programmer – subcontractor of ALE
 - F4E/GTD: PSH/HMI developer
 - IO Cryo: ICL library developer
 - IO CODAC: CODAC Core System tools
 - F4E/Vitrociset: Preparation of inputs for GTD

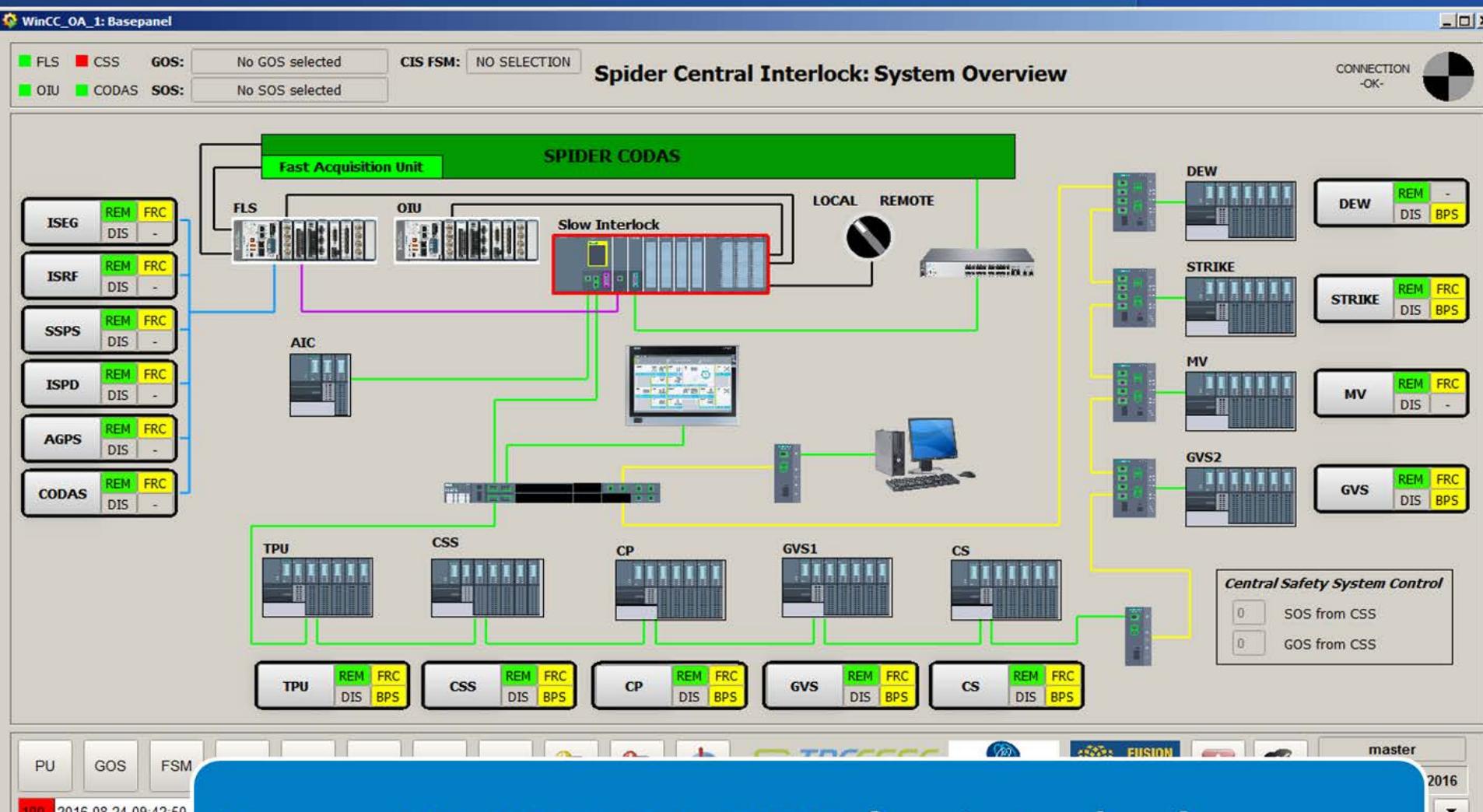
FIRST LARGE INDUSTRIAL SYSTEM!

LN2 I&C development - Highlights

Development process

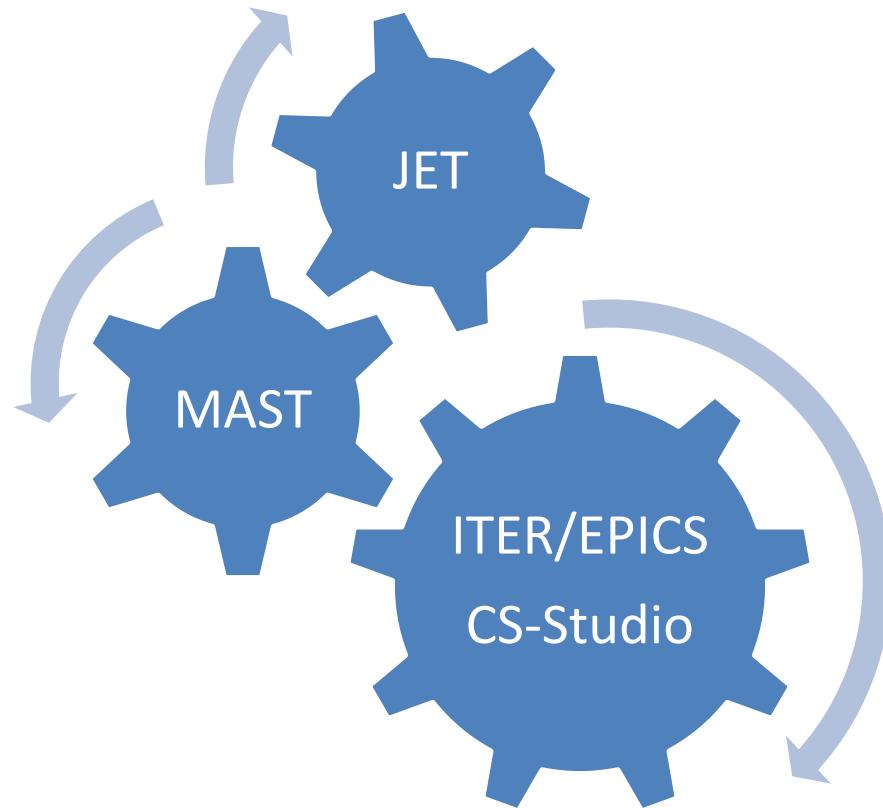


Spider WINCC-OA HMI



Some WINCC OA HMI for interlock

CS-Studio Pilot



Nuclear Control Rooms

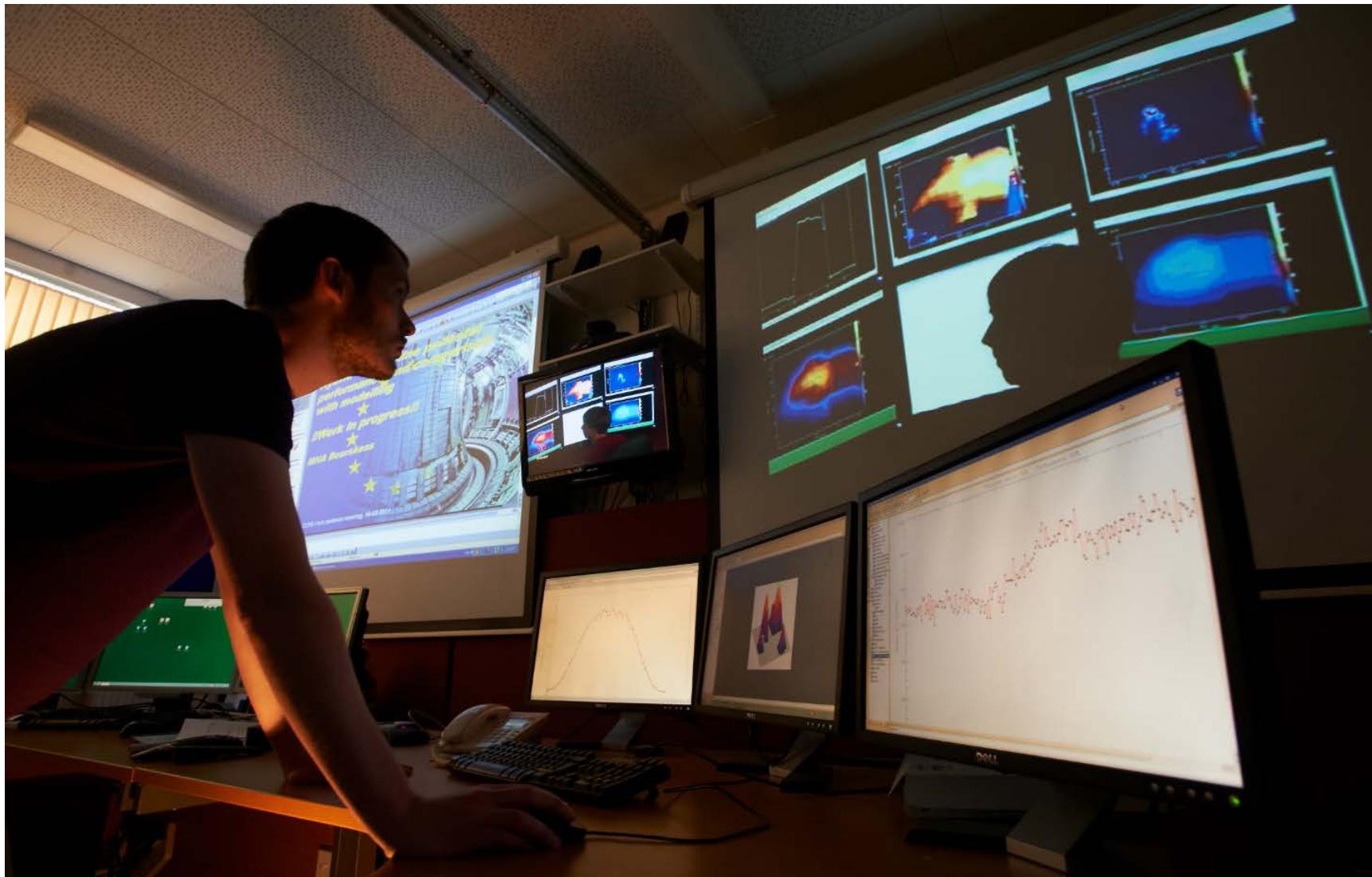


Foto: FOX

MAST Control Room HMI



MAST Remote Control Room



MAST New Control Room



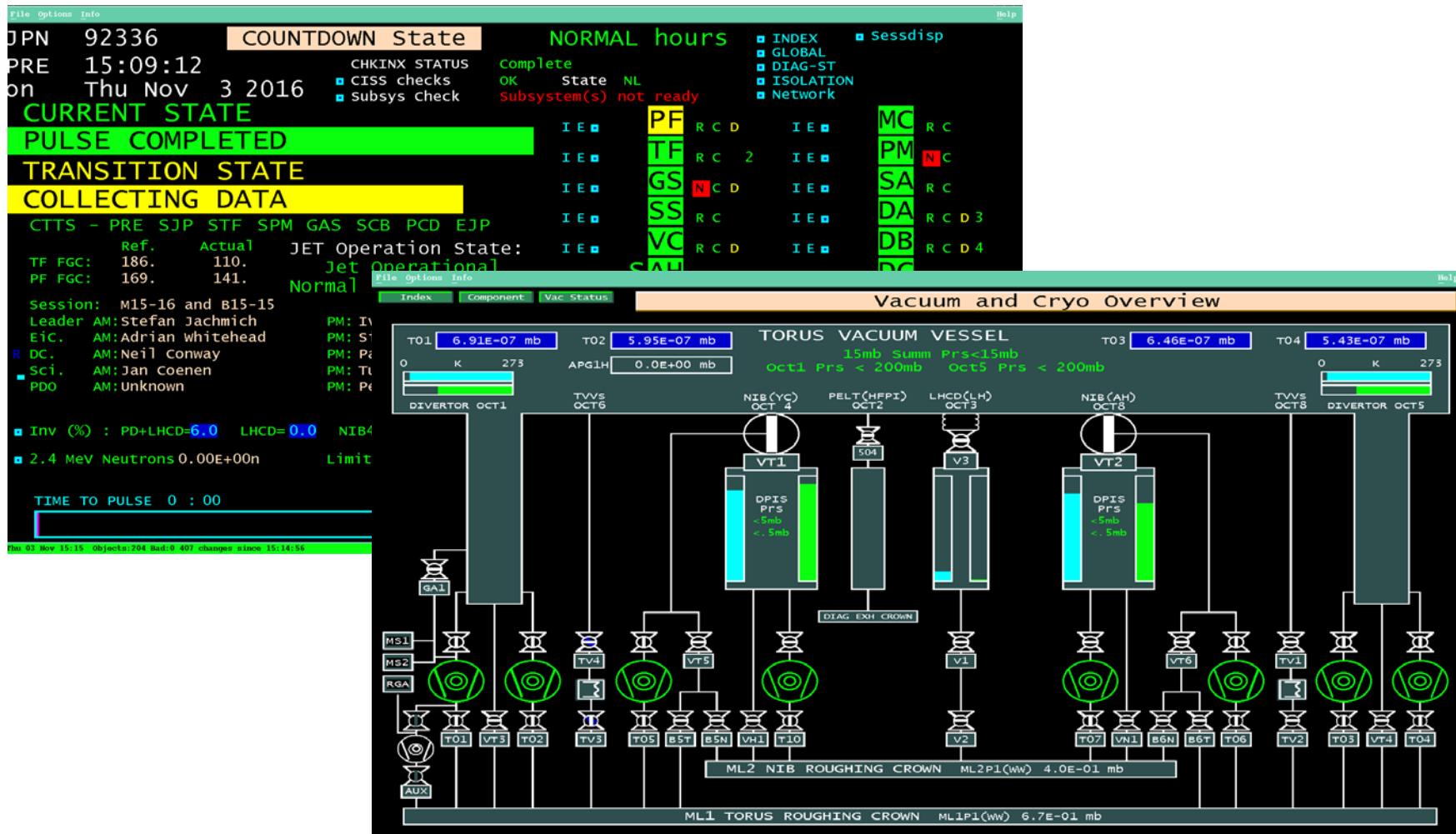
MAST New Control Room II



JET Control Room



JET HMI Tools



JET HMI Tools

File Options Info Help

Xcess Merriment Analysis System

- CODAS
- Christmas
- Work
- Roof Lab
- Wine chillers
- Baking
- Additional eating

■ NOT Operational	■ PRESENT	■ STOPPED
■ Reindeer detected	■ Active	■ Completed
■ In progress		

EIC: S. claus
Sleigh Leader: Dancer & Dasher
PIC: Prancer & Vixen
PDO: Comet & Cupid
CDO: Donner und Blitzen

■ INDEX
■ GLOBAL
■ GOODWILL

JET HMI Tools

gen-off-21 (astephen) JET alarm list from MC										
<u>File Edit View Options Programs Info Help</u>										
<u>F N P L Autos ACKPG ACK1 ACKB ACKO IS OS HIM TP CDO QHelp</u>										
16/03/24	START	DJ CODAS	pcmon5	3	H F N P L Desig	ACK				
PCMON for k11-p4da.pcdataonet.j reports an error										
16/03/24	START	DJ CODAS	pcmon13	3	H F N P L Desig	ACK				
PCMON for k112-p1wb.pcdataonet. reports an error										
16/03/24	START	DJ CODAS	pcmon17	3	H F N P L Desig	ACK				
PCMON for k114-p5wb.pcdataonet. reports an error										
16/03/24	START	DJ CODAS	pcmon19	3	H F N P L Desig	ACK				
PCMON for k12d-p8tb.pcdataonet. reports an error										
16/03/24	START	DJ CODAS	pcmon20	3	H F N P L Desig	ACK				
PCMON for k12d-pyro.pcdataonet. reports an error										
16/05/11	15:19:49	DJ CODAS	pcmon9	3	H F N P L Desig	ACK				
PCMON for k111-p1da.pcdataonet. reports an error										
16/05/11	15:22:49	DJ CODAS	pcmon18	3	H F N P L Desig	ACK				
PCMON for k12d-p8ta.pcdataonet. reports an error										
16/05/16	14:02:51	DJ CODAS	pcmon7	3	H F N P L Desig	ACK				
PCMON for k11-p4wa.pcdataonet.j reports an error										
Alarm #1 out of 58 in JET Criteria :										

JET 'AI'

Late Shift : EIC is Simon Hotchin SL is Ivo Carvalho - Next Pulse will be JPN 92337

EIC Control Panel

- Plant
- Shifts
- DryRuns
- PIW
- Grid
- Post-Pulse
- Checks
- Utilities
- Settings
- Reference

WebPages

CODAS essentialness	Set Pulse Result	VTM Protection	Modify Gas Inventory	Modify Neutron Budget
JOI 1.3	JOI 3.1	JOI 4.2	JOI 7.5	MO13s
DMV Prot Mix	Pressurise DMV1	Pressurise DMV2	Pressurise DMVR	Regen set-points
Set Reminder	Thinking Time	Mealbreak	JET Operating State	Handling the experts
reserved for T2	Set Overhead	Sparc, Gap	KY6 autoCal	TAE local pulse
reserved for T2				

JET Operations

JET Countdown Process Deal with tasks top-down (All tasks shown) Standby

You are not in Modify Plant mode

TFGC speed is too high Show Me

See close-out actions for inactive MO13s Show Me Checked

EIC Reminders OK

If you're logging a fault or delay against KG1 please take care to distinguish between KG1 diagnostic and KG1 CODAS
Message from Simon Hotchin

In the event that you hear any unusual noises in the torus hall and there are no alarms, trips or changes in the standard vessel monitoring traces, the first action should be to ask the PSOE to carry out the ERM tests on the coils, you should then call the Chief Engineer for guidance and inform Dragoslav or myself (S. Hotchin) before you run the next pulse.

SL handover was accepted Show Me Last handover was at Not received (*)

All pages have been loaded Show Me

TF, EFCC, TAE, Heating & Fuelling is OK Show Me

PSOE handover complete (no issues) Show Me

Pre-JOI Checks need running Run Checks took 0.0

General Readiness	OK
Power Supplies & PPCC	OK N OK OK OK OK OK OK OK N N N OK OK OK OK
Gas and PDV	N OK N OK N OK OK OK OK N OK OK N N OK OK
Plant and Protection	OK OK N N N N N N OK OK OK OK
Miscellaneous	OK OK OK

Some Plant Operators are not ready Show Me Handling the Experts ...

Pre-Pulse JET Operating Instructions Run JOIs Examine Issues Ack Issues took 0.0

gen-off-21 (astephens) xpsedit : Engineer-in-Charge Interface - PM/0000003 (Display Mode) (today is Nov 3 2016)

File Plant Shifts DryRuns PIN Grid PostPulse Checks Utilities Settings Reference

Main Page

Last Pulse: Thu Nov 3 15:08:47 2016 (92336)

Comments:

[2.56MA/3.4T VC_OS_LT, NBI 23 MW 48.5-55.5 with 2s PINI tail, ICRH 55.3-58 with RTCC on GIM7]

Toroidal Field	Included	RUN	Help	Oh Mode	D	PFR	40.8	PPS/max	3.50 M	A
Mode	Normal			PF/DMSS	105	ETF	55.101	TMS	PPCC	
				PF/FGC	170.006	PCD	64	Premag:	15kA premag	
				RPC	Unknown	EJP	83.101	P1 at SCB	15.00 k	A
						PreMag	Std 0000	P4 at SCB	180	
							<2013 0005			

NewFeatures

Adam ,

Some new features have been implemented since the last time you saw this dialog (08:06:49 Mar 16)

2nd November 2016

When MO69_0075 is active, Level 1 will automatically:

- automatically apply the required WALLS patch
- automatically set the Tile 5 limit to 1235 degC
- Set the specially designed P4DB ROI file for VTM

When the MO69 is inactive or expired, Level 1 will automatically:

- Clear the WALLS Patch
- Reset the Tile 5 limit to 975 degC
- Reset the normal P4DB ROI file.

This has NOT been tested! Please wait for Paul McCullen to confirm that all actions have taken place.

The EIC MUST assign MO69_0075 to JOI 2.4 and the correct experiment (M15-32)

25th October 2016

JOI 1.3 has been re-issued. Consecutive disruptions are no longer considered.

21st October 2016

The KY6 auto calibration has been simplified very slightly. This is what th

RF fb OFF

JET ‘AI’ – Ask “the Oracle”

wd/avs-utils/dot-files/.dot.bashrc.common: No such file
 wd/avs-utils/dot-files/.dot.bashrc.linux.common.pre: No
 wd/avs-utils/dot-files/.dot.bashrc.linux.common.post: N
 xpsedit

/jet/pm/level1/PulseTerminations/VTM/92336

VTM Termination Analysis for JPN 92336

Time	Alarm	DegC	VTM tile	Camera	ROI	Physical tiles showing pos
82.044	VtmMc	0	unknown	unknown	0	insufficient data

OK | Print | Save As

/jet/pm/level1/PulseTerminations/PTA/92336

Pulse Termination Analysis for JPN 92336 on

Systems

- YC : 48.50 to 57.01
- AH : 48.50 to 57.01

Summary of stops

No RTPS Primary Stops

Plant Enable Windows

- Enable : 48.5 NBshut NBtang NBnorm NB:
- Disable : 61.0250 | NBtang NBnorm
- Disable : 62.6790 NBshut NB:

NB terminated normally

BBI Trips

None detected

OK | Print | Save As

Type your question then move your mouse

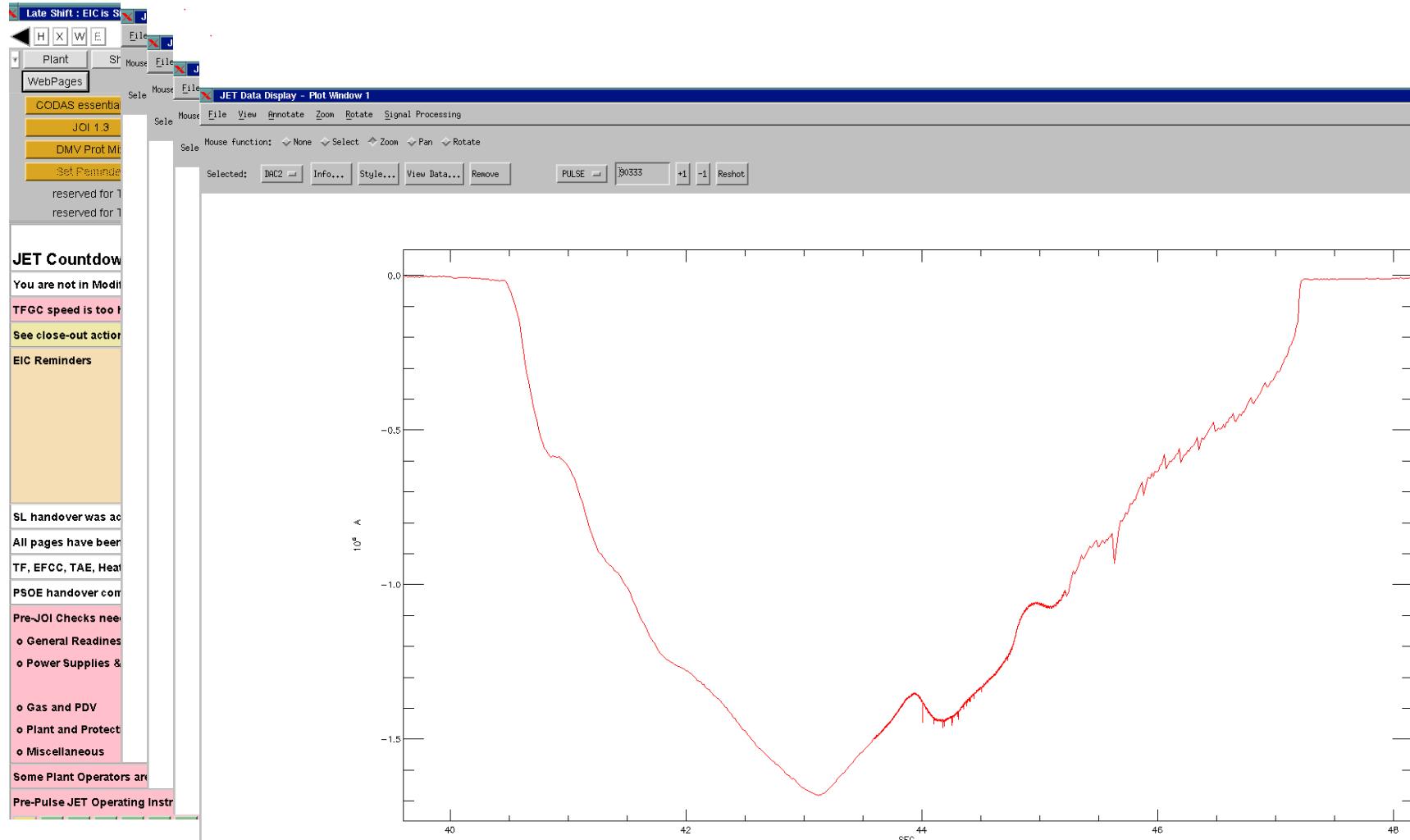
Why did 93101 terminate ?

Rem See Teach
Add Hide Exit

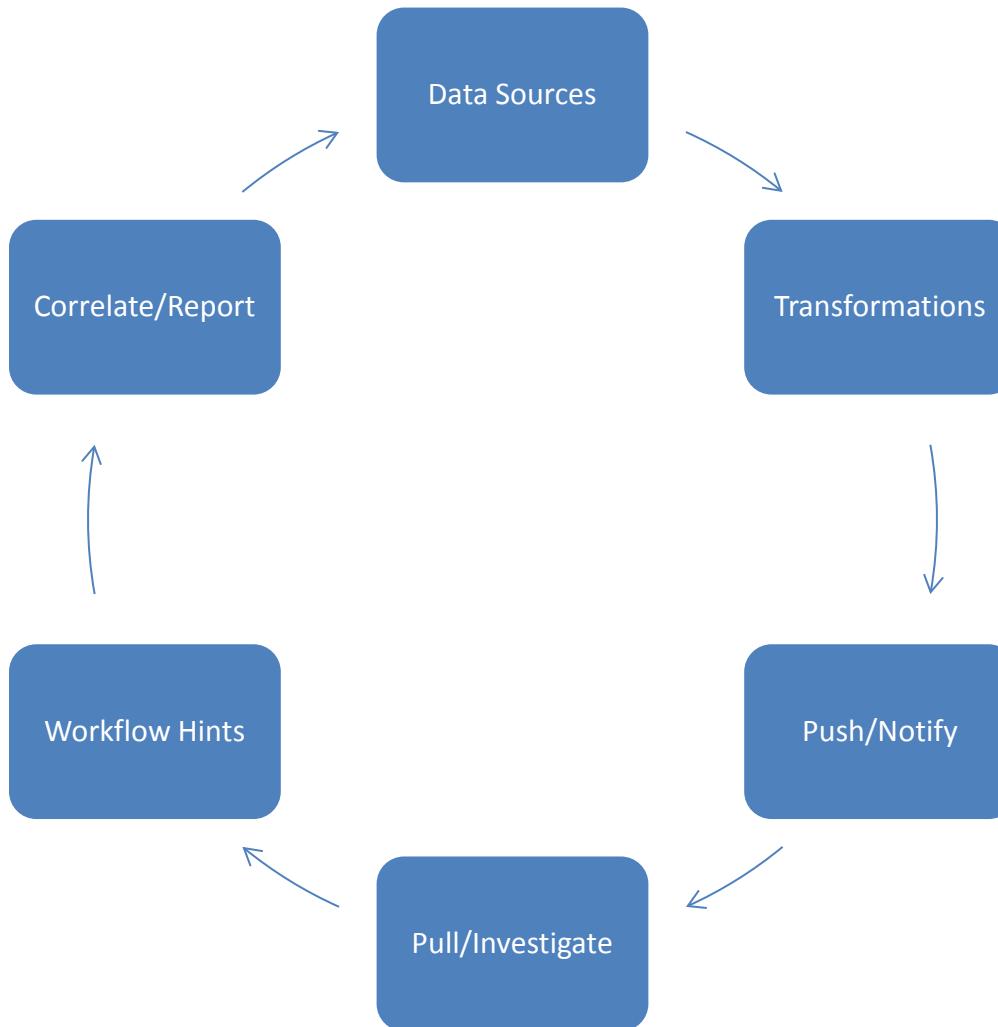
Pulse termination analysis for JPN 0

Pulse-Related search	When was pulse	PPCC log
Pulse Termination	go	go
Jotter	go	Dashboard
Chain 1	go	Pulse Summary
Level 1 parameter search		
Name match	Desc match	PPCC log
Howget match	Howset match	go
Miscellaneous search		
JOI	Person	JPNs in period
Level 1	Google	When was period
Colin's Meta search		
Signal	GAP Node	Mimic
Level 1	Cable	Functional position
BCN	Local Unit	go
CODAS Jv search		
Manual	JDN	JET Logging
Messages	Alarms	File
Drawing	CODAS Fault	Form 20
Immediate		

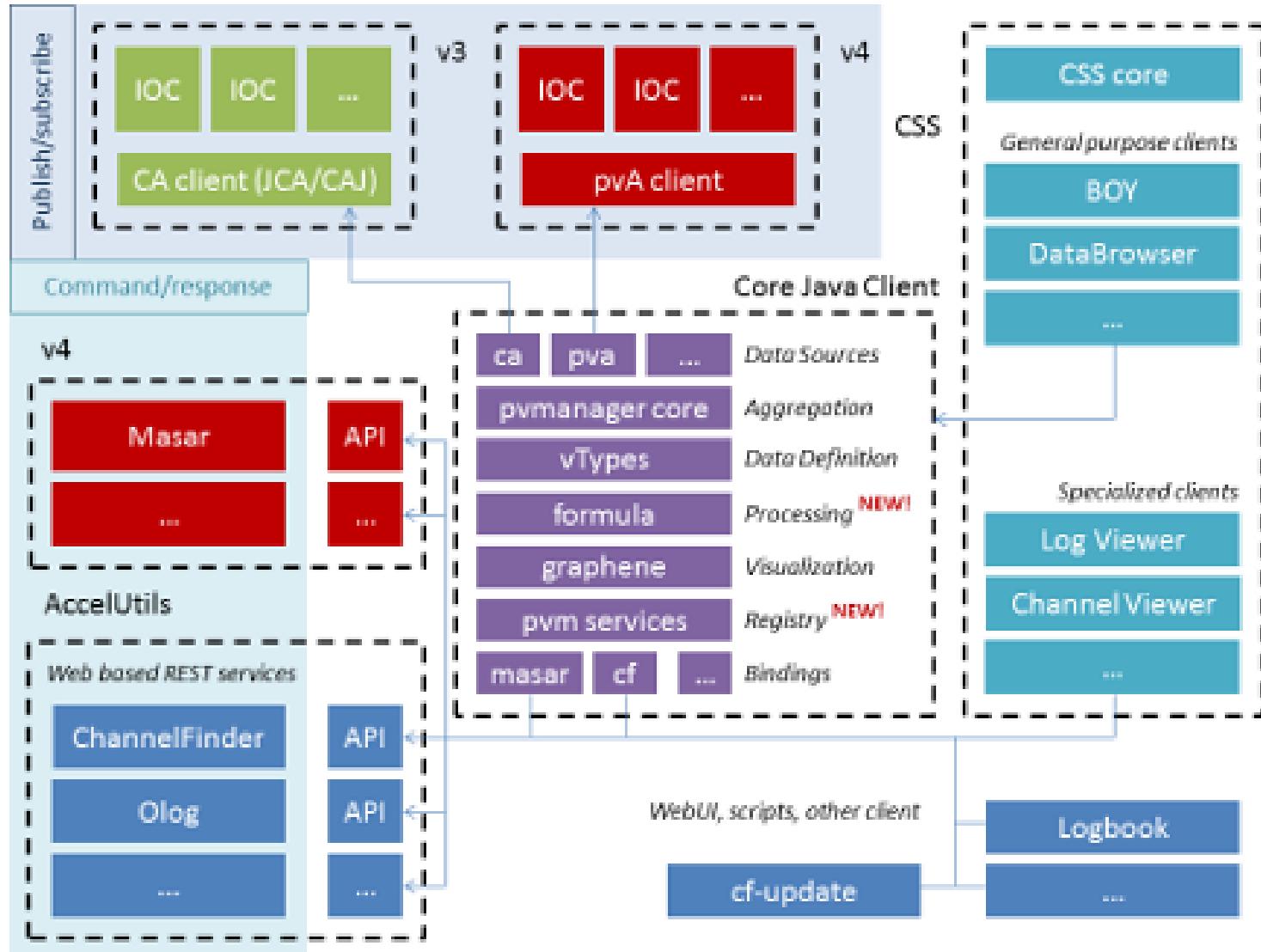
JET 'AI'



Workflows to support



V4 Architecture



Know what you're looking for? Here are some of the most popular things that users need.

[Dashboard](#)[Recommended Signals](#)[Data Handbook](#)[ReqCo](#)[JETDSP](#)[Physics Summary](#)[Jotter](#)[Chain](#)

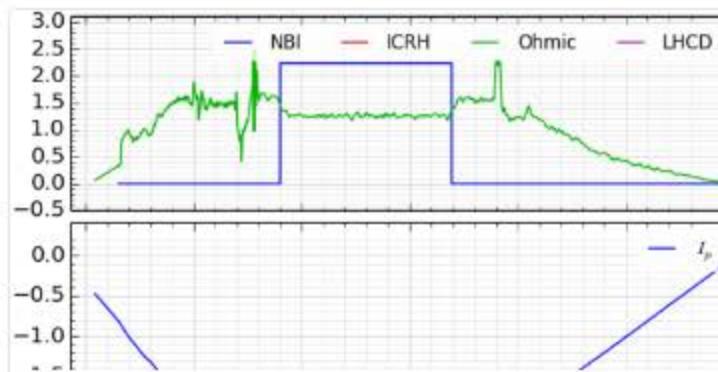
Data Access

[PDF](#) JET Data Overview - Explanation of the relationship between the three main JET data systems (JPF, PPF, CPF).



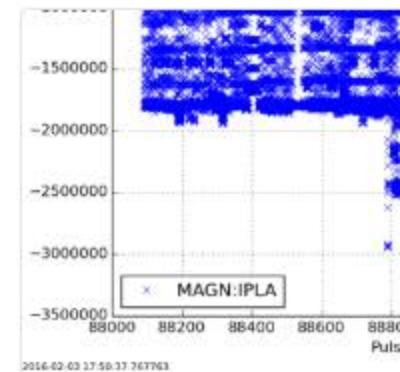
JPF - Raw data

The *JET Pulse File* system is a collection of raw, unprocessed data from JET pulses.

[Documentation](#)[Browser](#)

PPF - Processed data

The *Processed Pulse File* system is a centralised data storage and retrieval system for data derived from raw measurements within the JET Torus, and from other sources such as simulation programs.

[Documentation](#)[Browser](#)

CPF - High-level data

The *Central Physics File* database with extracts of JET plasma pulse, including signals and a few JPFS.

[Documentation](#)[Browser](#)

JET Dashboard

Home

92338

[« Earliest Pulse](#)[◀ Previous](#)[Next ▶](#)

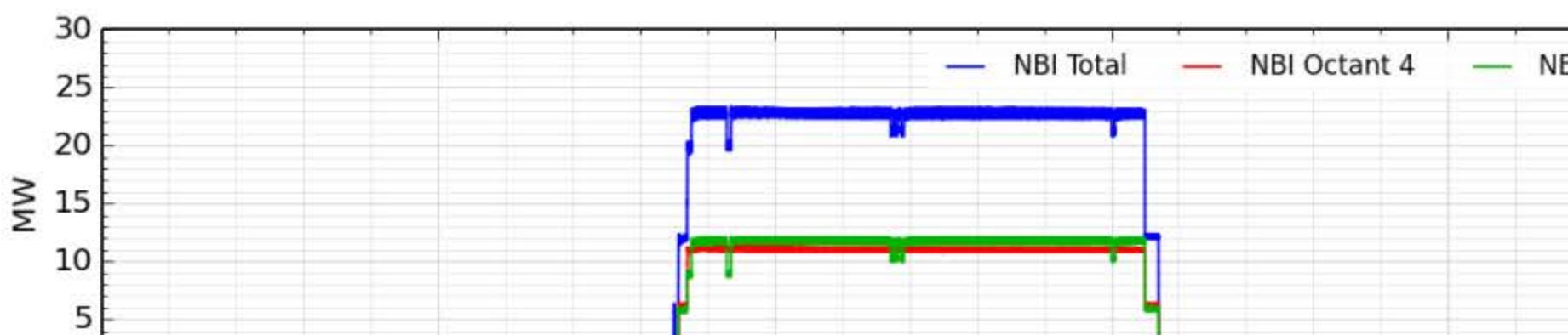
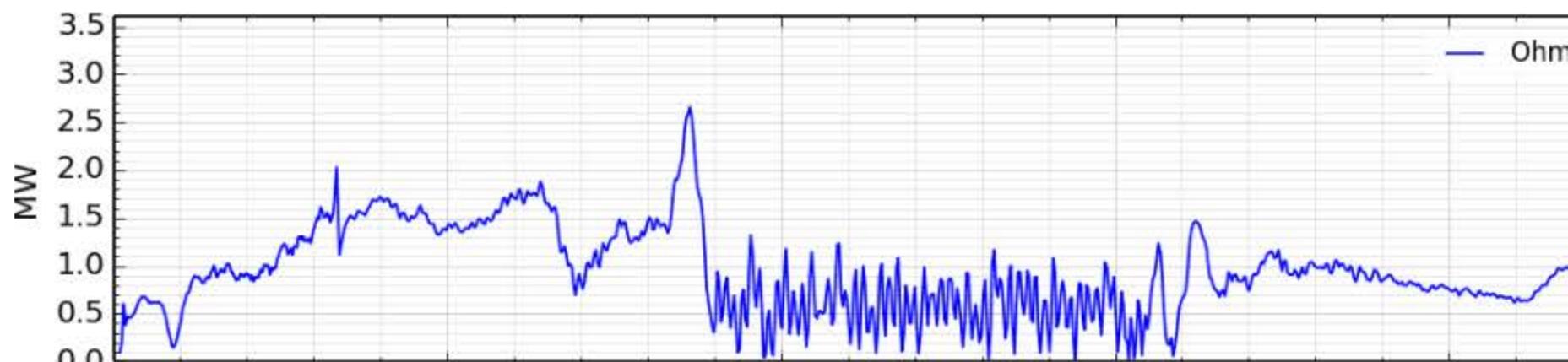
Overview

Plots

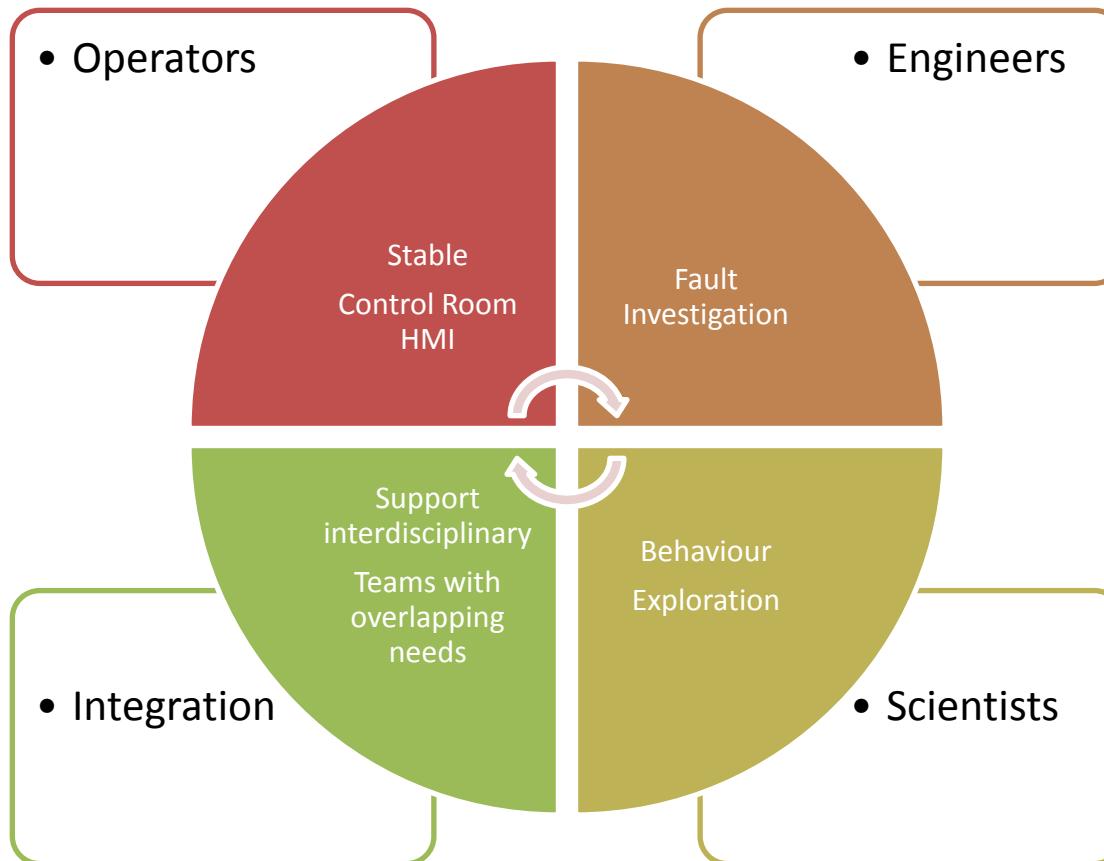
Stops

Data Browser

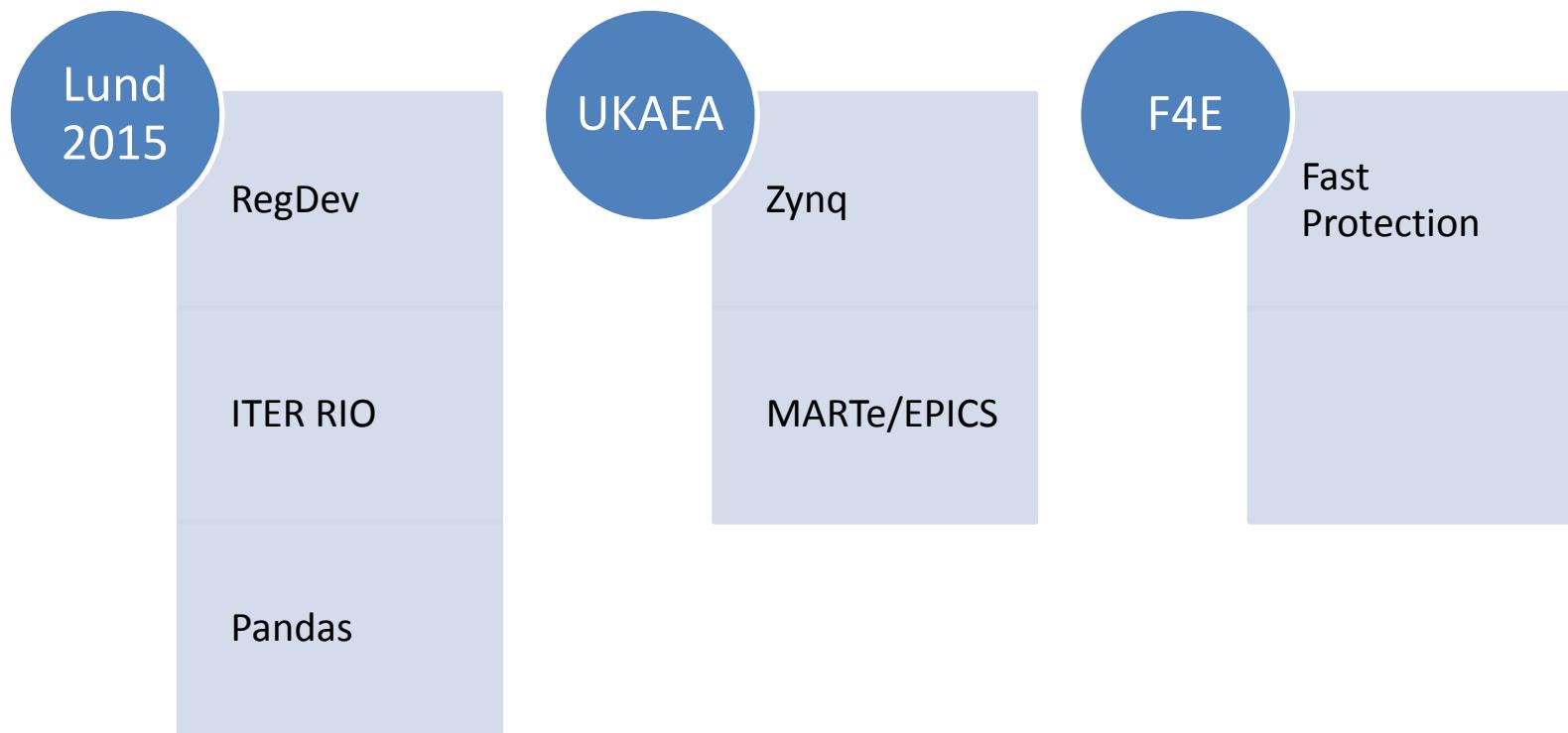
Power



Conclusions



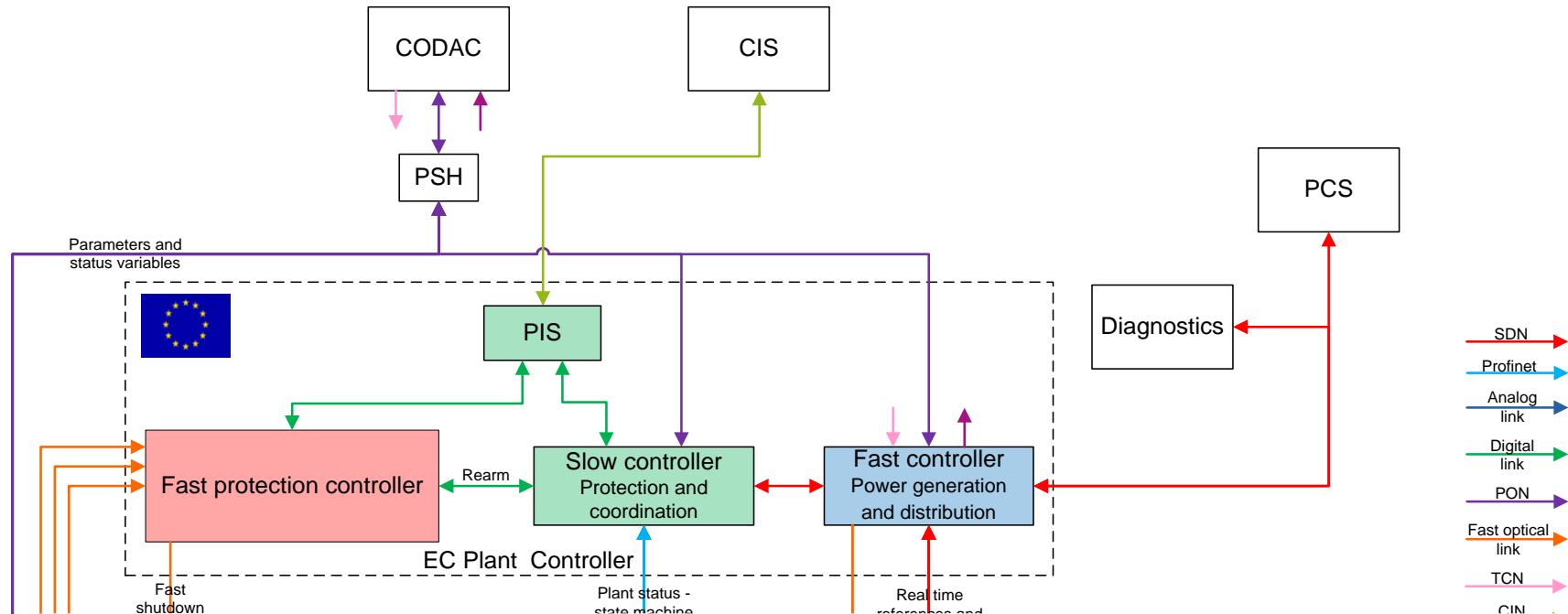
Part II : FPGA to EPICS Beyond Slow Control/ Protection Systems



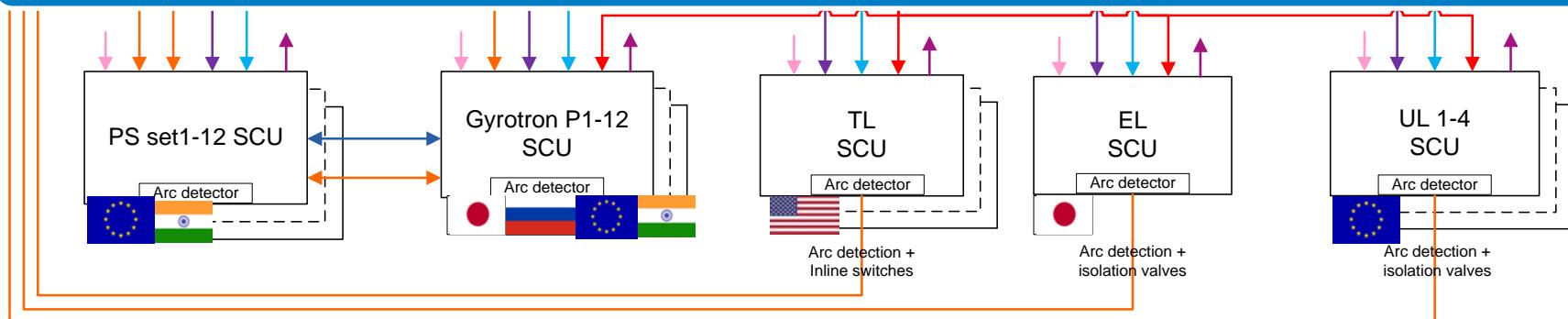
Neutral Beam Fast Interlock

- High power – must turn off in << ms
- FPGA to achieve speed / reliability
- SoC ARM/Linux for control/monitoring
- Balance between flexibility/reliability/cost/risk
- Embedded ARM/Linux/SW Stacks
 - Managing dependencies
 - Lightweight footprint
 - Simple
 - Reliable

ECCS Highlights



Coordination of SCUs from international development

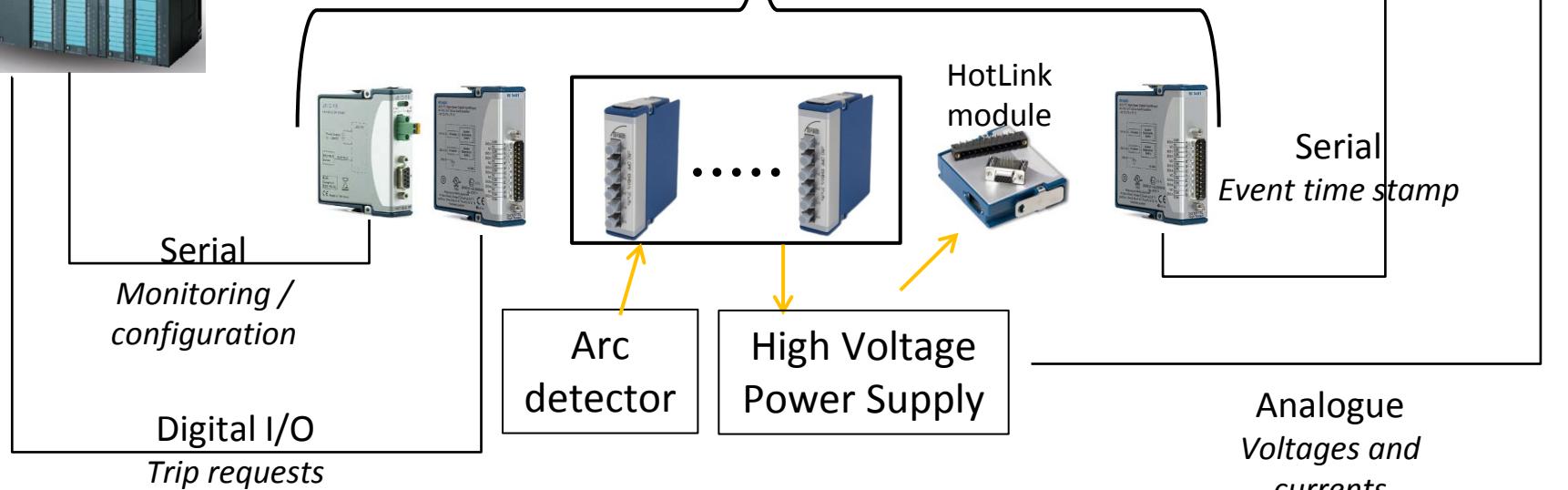


Ultra-Fast Interlock

Standalone system, no connection to LabView during operation



Fast protection system



- <1us reaction time
- Used in FALCON, ECCS, NBTf(similar)
- Pulse Train for critical communications
- Extra NI catalogue: IRS optical cards + HotLink module

Compact RIO Hot-Link modules

Two multi-function modules

1. Optical transmitter/receiver HOTLINK (compatible to EU power-supplies) – out/input on DAC and/or C-RIO. 10MS/s 14bit
2. C-RIO fast ADC – 2 channels @ 5MS/s
3. Fast comparator – 2 channels 100ns
4. Intelligent comparator – 2 channels 100us



Hours reliability tests using MDS+ and

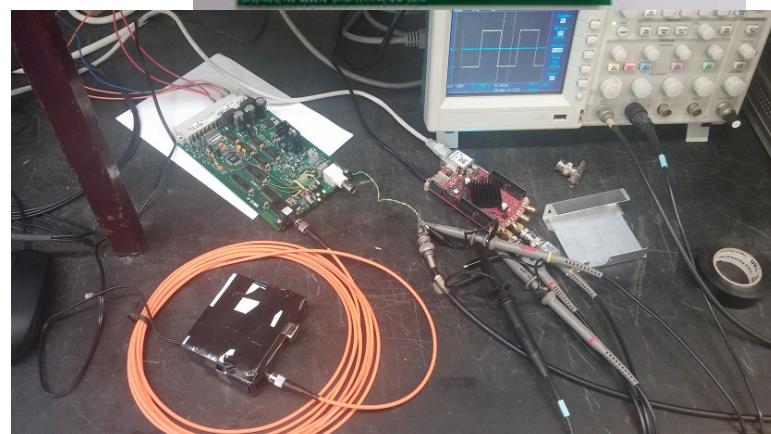
RedPitaya streaming on ethernet.

Quasi RT (scope like) visualization.

7MS/s @ 48hrslots of data

<1.3W power consumption

-- works! No errors – temperature good.



Challenges/Opportunities

Machine Control

Machine Protection

Machine Optimisation/Operation

Just do it better, faster, cheaper, more
flexibly, but with highest standards of
reliability and quality...

=> Common tools/apis/sharing/*industry*<=