

The Compact Muon Solenoid Detector Control System

ICALEPCS 2009 – Kobe, Japan
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Outline

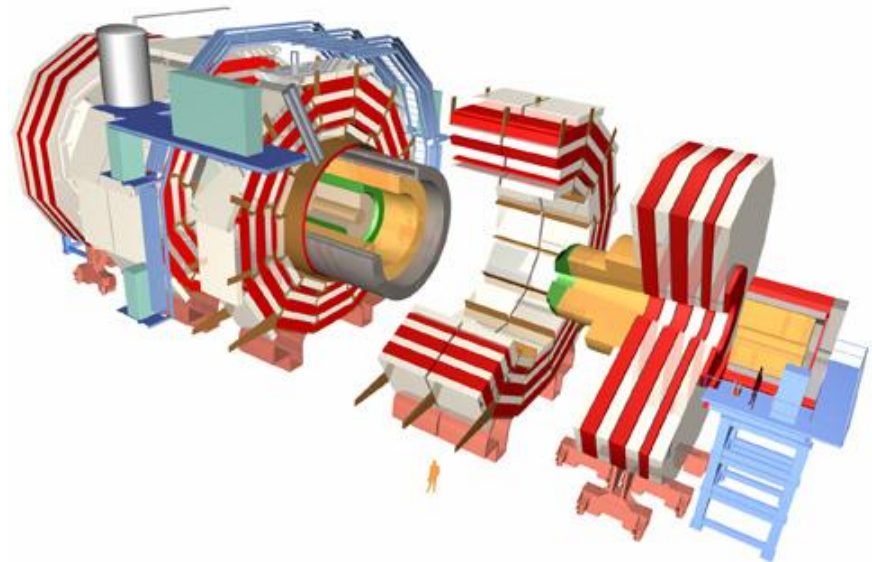


- ◉ Overview and requirements
- ◉ Deployment Strategy
- ◉ Status



- The Compact Muon Solenoid (CMS) is one of the Large Hadron Collider general purpose particle detectors

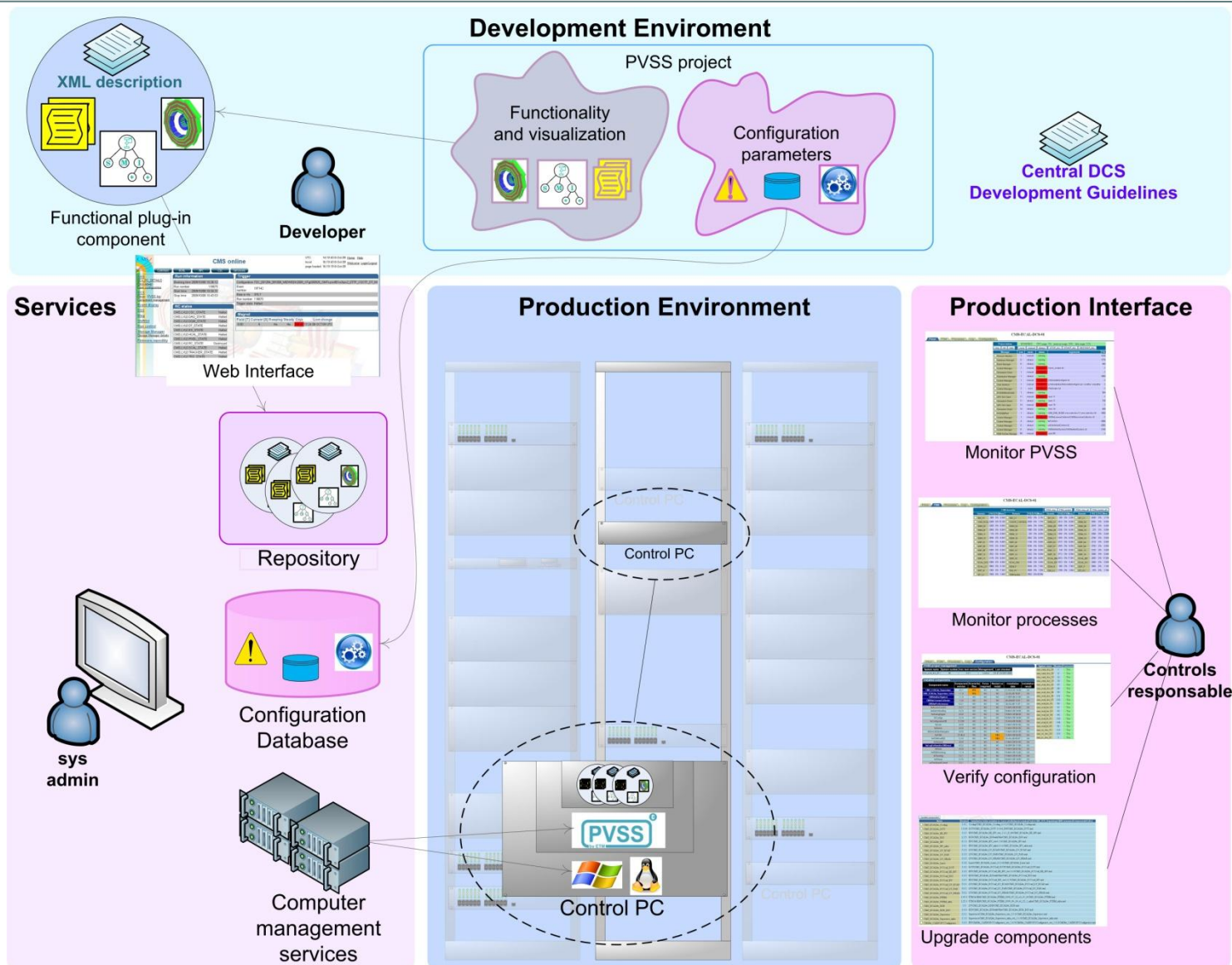
System Name	Number of PCs	Monitored Parameters
Tracker	14	350k
Calorimeter	14	115k
Muon	30	435k
Trigger DCS	2	1k
Alignment	3	3k
Services	35	20k
Total	98	934k



$\sim 10^6$ control system parameters



Deployment Strategy





- ◉ Running 24h/d
- ◉ Deployment strategy easing maintenance
 - Recovering nodes
 - Updating packages
- ◉ A hierarchy of Finite State Machines based nodes summarize states and propagates commands. The most top layer:
 - Provides control over CMS DCS trigger partitions
 - Communicates with experiment Run Control
 - Handle the handshake with the LHC



Main DCS Operator Screen



USER: root
ROLE: SystemOverview

Sub-detector

Trigger Partition

Place your CERN card on the card reader and select your operator role
If you don't have DCS operator role go have fun with Run Control :)

Ready for physics
Preparing for physics
Standby
Going to Standby
Off
Switching off
Error

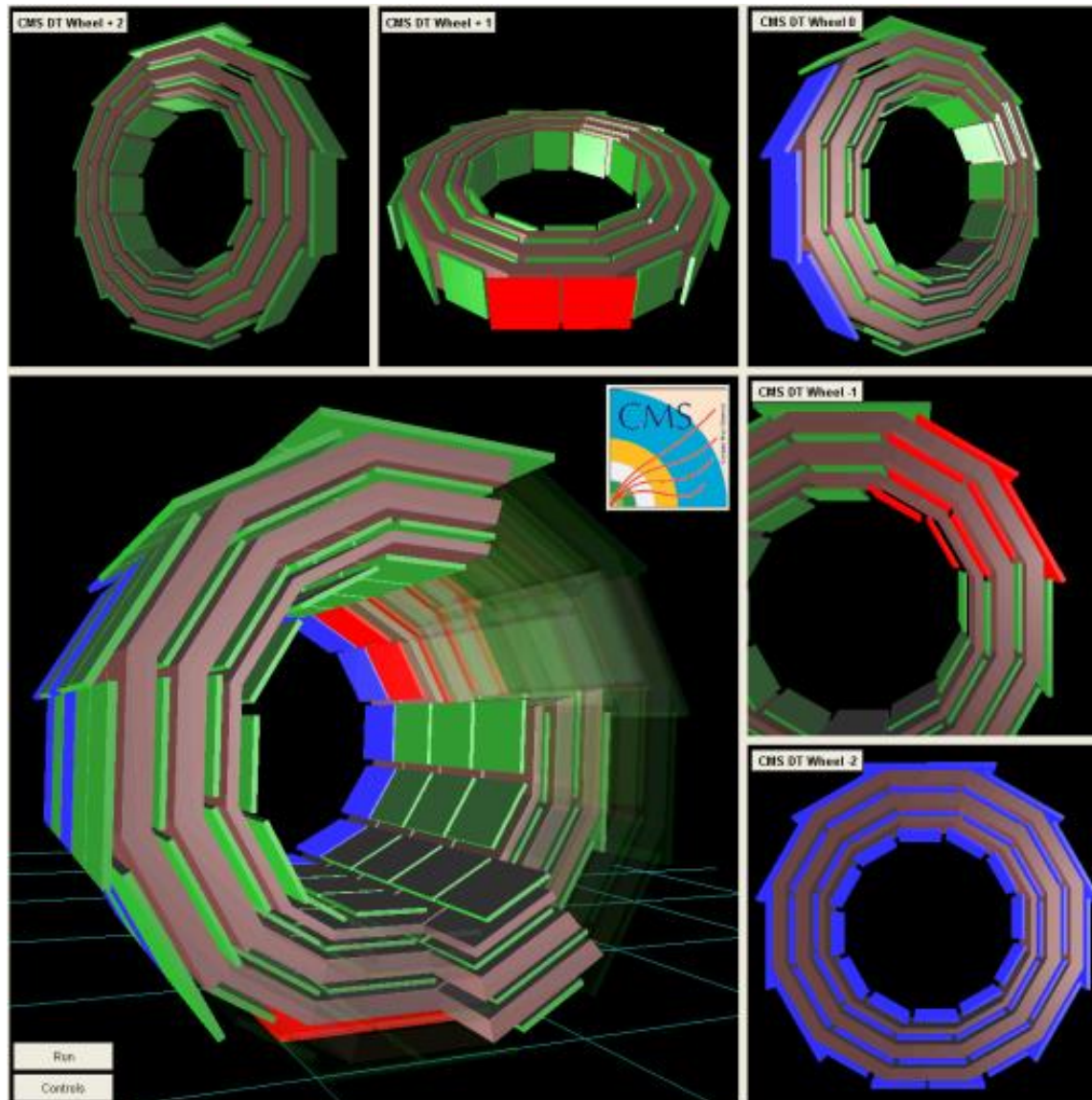
Sub-detector	Component	Status	Component	Status	Owner
TRACKER	B PIX	IN LOCAL	PixelBarrel	OFF	No Owner
	F PIX	IN LOCAL	PixelEndCap	OFF	No Owner
	TIB/TID	IN LOCAL	TIB	OFF	
	TOB	IN LOCAL	TOB	OFF	
	TEC+	IN LOCAL	TEC plus	OFF	
	TEC-	IN LOCAL	TEC minus	OFF	
	EE-	IN LOCAL	Endcap Minus	ERROR	No Owner
	EB-	IN LOCAL	Barrel Minus	ERROR	No Owner
	EB+	IN LOCAL	Barrel Plus	ERROR	No Owner
	EE+	IN LOCAL	Endcap Plus	ERROR	No Owner
	ES-	IN LOCAL	ES MINUS	OFF	No Owner
	ES+	IN LOCAL	ES PLUS	OFF	No Owner
HCAL	HF	IN LOCAL	HF	ERROR	German Ruben Martinez
	HO	IN LOCAL	HO	ERROR	German Ruben Martinez
	HEHBa	IN LOCAL	HEHBa	ERROR	German Ruben Martinez
	HEHBb	IN LOCAL	HEHBb	ERROR	German Ruben Martinez
	HEHBc	IN LOCAL	HEHBc	ERROR	German Ruben Martinez
	DT+	IN LOCAL	Wheel YB1	OFF	Marina Ciunta
	DT0	IN LOCAL	Wheel YB2	OFF	Marina Ciunta
	DT0	IN LOCAL	Wheel YB0	OFF	Marina Ciunta
	DT-	IN LOCAL	Wheel YB-1	OFF	Marina Ciunta
	DT-	IN LOCAL	Wheel YB-2	OFF	Marina Ciunta
	RPC	IN LOCAL	CMS RPC	ERROR	cms_rpc_dcs_04:Manager5
	CSC-	IN LOCAL			
CSC+	IN LOCAL				



- ◉ Aimed for an intuitive HMI for operators
 - No need for courses
 - No need for extensive documentation
 - Software helpers guiding operator
- ◉ Touch screen operation panels in underground cavern
 - Card reader authentication
 - Functionality enabled depending on user privileges
- ◉ 3D technology for geometrical error correlation



3D DCS View





Rack Control Touch Screens



DEVICE_MODULE: fwRack/fwRackOperation.pnl cms_cent_dcs_01:RCA/Zones/S1 in MODE_NAVIGATOR (cms_cent_dcs_01 - ServiceProject; #6)

Rack zone: S1 [9.7m x 10m]

S1A		S1B		S1C		S1D		S1E		S1F		S1G		S1H	
S1A02	OFF	S1B02	ON	S1C00	ON	S1D00	ON	S1E00	ON	S1F00	ON	S1G00	ON	S1H02	ON
S1A03	ON	S1B03	ON	S1C01	ON	S1D01	ON	S1E01	ON	S1F01	ON	S1G01	ON	S1H03	ON
S1A04	ON	S1B04	ON	S1C02	ON	S1D02	ON	S1E02	ON	S1F02	ON	S1G02	ON	S1H04	ON
S1A05	ON	S1B05	ON	S1C03	ON	S1D03	ON	S1E03	ON	S1F03	ON	S1G03	ON	S1H05	ON
S1A06	ON	S1B06	ON	S1C04	ON	S1D04	ON	S1E04	ON	S1F04	ON	S1G04	ON	S1H06	ON
S1A07	ON	S1B07	ON	S1C05	ON	S1D05	ON	S1E05	ON	S1F05	ON	S1G05	ON	S1H07	ON
S1A08	ON	S1B08	ON	S1C06	ON	S1D06	OFF	S1E06	ON	S1F06	ON	S1G06	ON	S1H08	ON
S1A09	ON	S1B09	ON	S1C07	ON	S1D07	ON	S1E07	ON	S1F07	ON	S1G07	ON	S1H09	ON
S1A10	ON	S1B10	ON	S1C08	ON	S1D08	ON	S1E08	ON	S1F08	ON	S1G08	ON	S1H10	ON
S1A11	ON	S1B11	ON	S1C09	ON	S1D09	ON	S1E09	ON	S1F09	ON	S1G09	ON	S1H11	ON
S1A12	ON	S1B12	ON	S1C10	ON	S1D10	ON	S1E10	ON	S1F10	n/a	S1G10	ON	S1H12	ON
S1A13	ON	S1B13	ON	S1C11	ON	S1D11	ON	S1E11	n/a	S1F11	n/a	S1G11	n/a	S1H13	ON
S1A14	ON	S1B14	ON	S1C12	ON	S1D12	ON	S1E12	ON	S1F12	ON	S1G12	ON	S1H14	ON
S1A15	ON	S1B15	ON	S1C13	ON	S1D13	ON	S1E13	ON	S1F13	ON	S1G13	ON	S1H15	ON
S1A16	ON	S1B16	ON	S1C14	ON	S1D14	ON	S1E14	ON	S1F14	ON	S1G14	ON	S1H16	ON

Choose property to display

Card reader authentication

Group Commands

Rack Overall Status

USER: NO USER
ROLE: NO USER
CHOOSE USER AND ROLE
Label
CHOOSE RACK TITLE
Status
CHOOSE DISPLAYED P
CLEAR GROUP SELECTION
SEND GROUP COMMANDS
EXPERT ACTIONS
HOW TO USE THIS PANEL



- ◉ PVSS users and privileges are synchronized with CMS LDAP server
- ◉ Web base applications allow control group responsible to provide privileges to users
- ◉ Synchronized with CMS Shift List tool



- ◉ Alarm screen summarizes all CMS DCS alerts
- ◉ Alert help engine
 - Web forms for DCS experts to add help content
 - Dynamic Web pages for Operators with incremental alert help



Alarm Screen



Alarm Screen

Print alarms:

Acknowledgement: Acknowledge Unacknowledged Individual/Group acknowledged

Mode: ☐ Current Alarms ☐ Historical Alarms Select Time Range...

Alarm Filters:

Systems: cms_cent_dcs_01, cms_cent_dcs_02, cms_cent_dcs_04, cms_rc_dcs_04

Logical Name: * Alarm Text: * Quick Filters:

Device Description: *

Sh	Device DP element	Logi	Alarm text	Dir.	Value	Ack	Time	Co
VV	cms_ecal_dcs_02:CMS_ECAL_DCS/ESS_SM_pos		Bad ESS connection!	WENT	FALSE		2009/10/07 15:48:58.850	
F	cms_ecal_dcs_02:CMS_ECAL_DCS/ESS_SM_pos		Overheating!	CAME	255		2009/10/09 19:50:47.457	
F	cms_ecal_dcs_02:CMS_ECAL_DCS/ESS_SM_pos		FSM Summary	CAME	TRUE		2009/08/24 14:16:57.933	
Y	cms_ecal_dcs_02:CMS_ECAL_DCS/ESS_SM_pos		Cooling problem!	CAME	TRUE		2009/10/10 09:38:46.415	
VV	cms_ecal_dcs_02:CMS_ECAL_DCS/ESS_SM_pos		LV Cool Alarm!	WENT	FALSE		2009/09/17 16:35:27.862	
VV	cms_ecal_dcs_02:CMS_ECAL_DCS/ESS_SM_pos		Bad ESS connection!	WENT	FALSE		2009/10/07 15:48:57.999	
F	cms_ecal_dcs_02:CMS_ECAL_DCS/ESS_SM_pos		Overheating!	CAME	255		2009/10/09 19:50:47.457	
F	cms_ecal_dcs_02:CMS_ECAL_DCS/ESS_SM_pos		FSM Summary	CAME	TRUE		2009/08/24 14:16:57.980	
Y	cms_ecal_dcs_02:CMS_ECAL_DCS/ESS_SM_pos		Cooling problem!	CAME	TRUE		2009/10/10 09:38:46.415	
VV	cms_ecal_dcs_02:CMS_ECAL_DCS/ESS_SM_pos		LV Cool Alarm!	WENT	FALSE		2009/09/17 16:35:28.894	
VV	cms_ecal_dcs_02:CMS_ECAL_DCS/ESS_SM_pos		Bad ESS connection!	WENT	FALSE		2009/10/07 15:48:58.952	
F	cms_ecal_dcs_02:CMS_ECAL_DCS/ESS_SM_pos		Overheating!	CAME	255		2009/10/09 19:50:47.457	
F	cms_ecal_dcs_02:CMSAlertSystem/SumAlerts/Sal		TRUE	CAME	TRUE		2009/09/04 16:18:41.106	
Y	cms_ecal_dcs_02:CMSAlertSystem/SumAlerts/Sal		TRUE	CAME	TRUE		2009/09/04 16:06:55.053	
VV	cms_ecal_dcs_02:CMSAlertSystem/SumAlerts/Sal		TRUE	WENT	TRUE		2009/08/27 09:25:27.950	
VV	cms_ecal_dcs_02:CMSAlertSystem/SumAlerts/Sal		TRUE	WENT	TRUE		2009/09/09 12:50:33.921	
F	cms_ecal_dcs_02:CMSAlertSystem/SumAlerts/Sal		TRUE	CAME	TRUE		2009/08/24 14:25:14.214	
F	cms_ecal_dcs_02:ECAL_ESS/ECAL_ESS		FSM Summary	CAME	TRUE		2009/10/06 19:44:12.554	
E	cms_ecal_dcs_06:Cooling_DU/EBM_01_Cooling		FSM Summary	CAME	TRUE		2009/08/25 14:55:08.212	
Y	cms_ecal_dcs_06:Cooling_DU/EBM_01_Cooling.FI		Low	CAME	0.6104795932		2009/10/10 09:39:21.950	
E	cms_ecal_dcs_06:Cooling_DU/EBM_01_Cooling.FI		Very Low	CAME	0.6104795932		2009/10/10 09:39:21.950	

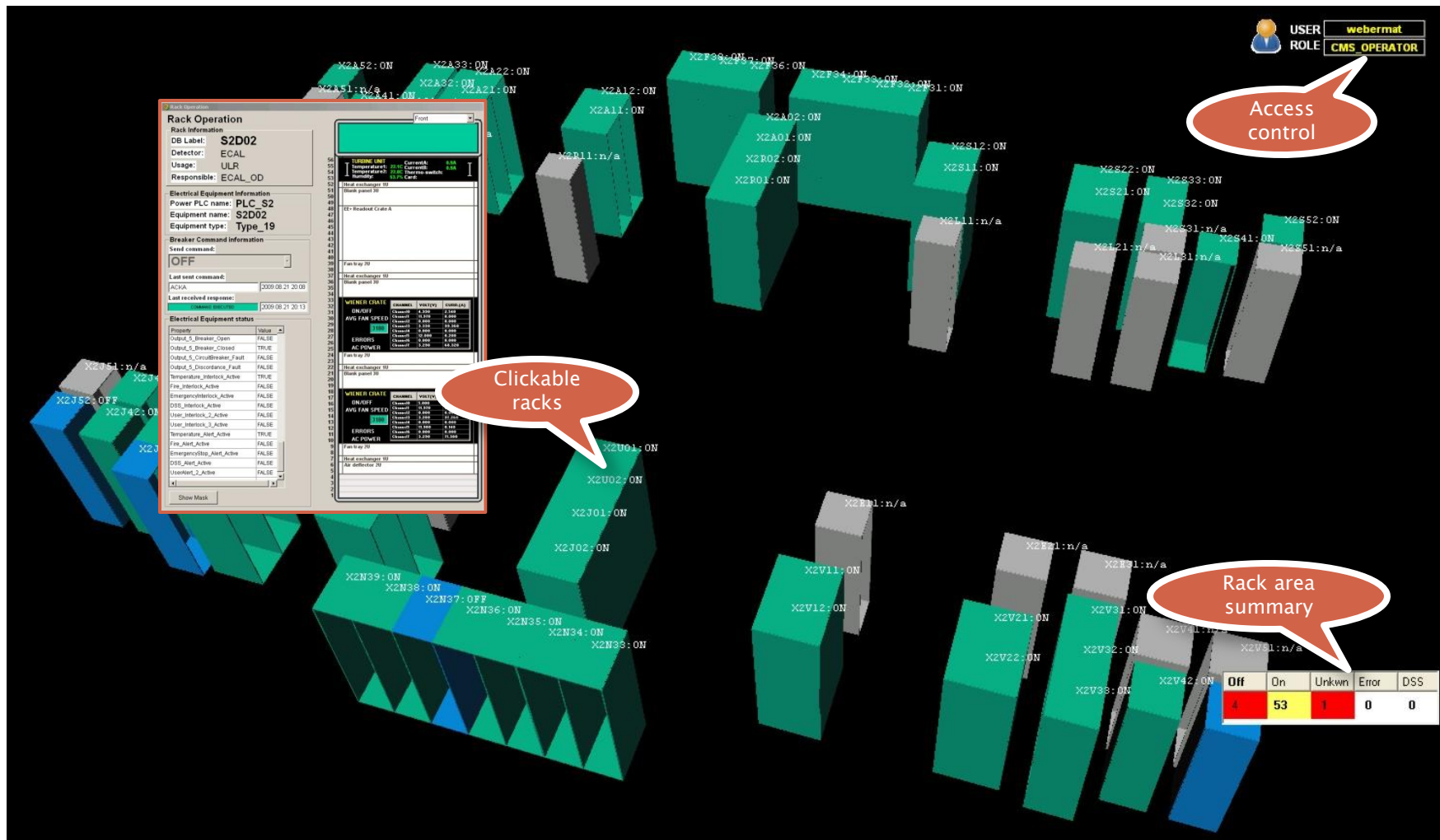
click for help



- ◉ Central DCS services integrated
 - Rack and crate control
 - Gas
 - Cooling
 - Ventilation
 - Magnet



Rack and Crate Control





Rack details



Rack Operation

Rack Operation

Rack Information

DB Label: **S2D02**

Detector: ECAL

Usage: ULR

Responsible: ECAL_OD

Electrical Equipment Information

Power PLC name: **PLC_S2**

Equipment name: **S2D02**

Equipment type: **Type_19**

Breaker Command information

Send command:

OFF

Last sent command:

ACKA 2009.08.21 20:08

Last received response:

COMMAND EXECUTED 2009.08.21 20:13

Electrical Equipment status

Property	Value
Output_5_Breaker_Open	FALSE
Output_5_Breaker_Closed	TRUE
Output_5_CircuitBreaker_Fault	FALSE
Output_5_Discordance_Fault	FALSE
Temperature_Interlock_Active	TRUE
Fire_Interlock_Active	FALSE
EmergencyInterlock_Active	FALSE
DSS_Interlock_Active	FALSE
User_Interlock_2_Active	FALSE
User_Interlock_3_Active	FALSE
Temperature_Alert_Active	TRUE
Fire_Alert_Active	FALSE
EmergencyStop_Alert_Active	FALSE
DSS_Alert_Active	FALSE
UserAlert_2_Active	FALSE

Show Mask

Front

TURBINE UNIT

Temperature1: 22.1C CurrentA: 0.9A

Temperature2: 22.9C CurrentB: 0.9A

Humidity: 83.7% Card:

Heat exchanger 1U

Blank panel 3U

EE+ Readout Crate A

Fan tray 2U

Heat exchanger 1U

Blank panel 3U

WIENER CRATE

CHANNEL	VOLT(V)	CURR.(A)
Channel0	4.930	2.540
Channel1	11.370	0.000
Channel2	0.000	0.000
Channel3	3.330	93.360
Channel4	0.000	0.000
Channel5	12.000	0.280
Channel6	0.000	0.000
Channel7	3.230	68.320

ON/OFF

AVG FAN SPEED

3180

ERRORS

AC POWER

Fan tray 2U

Heat exchanger 1U

Blank panel 3U

WIENER CRATE

CHANNEL	VOLT(V)	CURR.(A)
Channel0	5.000	2.420
Channel1	11.370	0.000
Channel2	0.000	0.000
Channel3	3.280	37.260
Channel4	0.000	0.000
Channel5	11.380	0.140
Channel6	0.000	0.000
Channel7	3.230	71.380

ON/OFF

AVG FAN SPEED

3180

ERRORS

AC POWER

Fan tray 2U

Heat exchanger 1U

Air deflector 2U

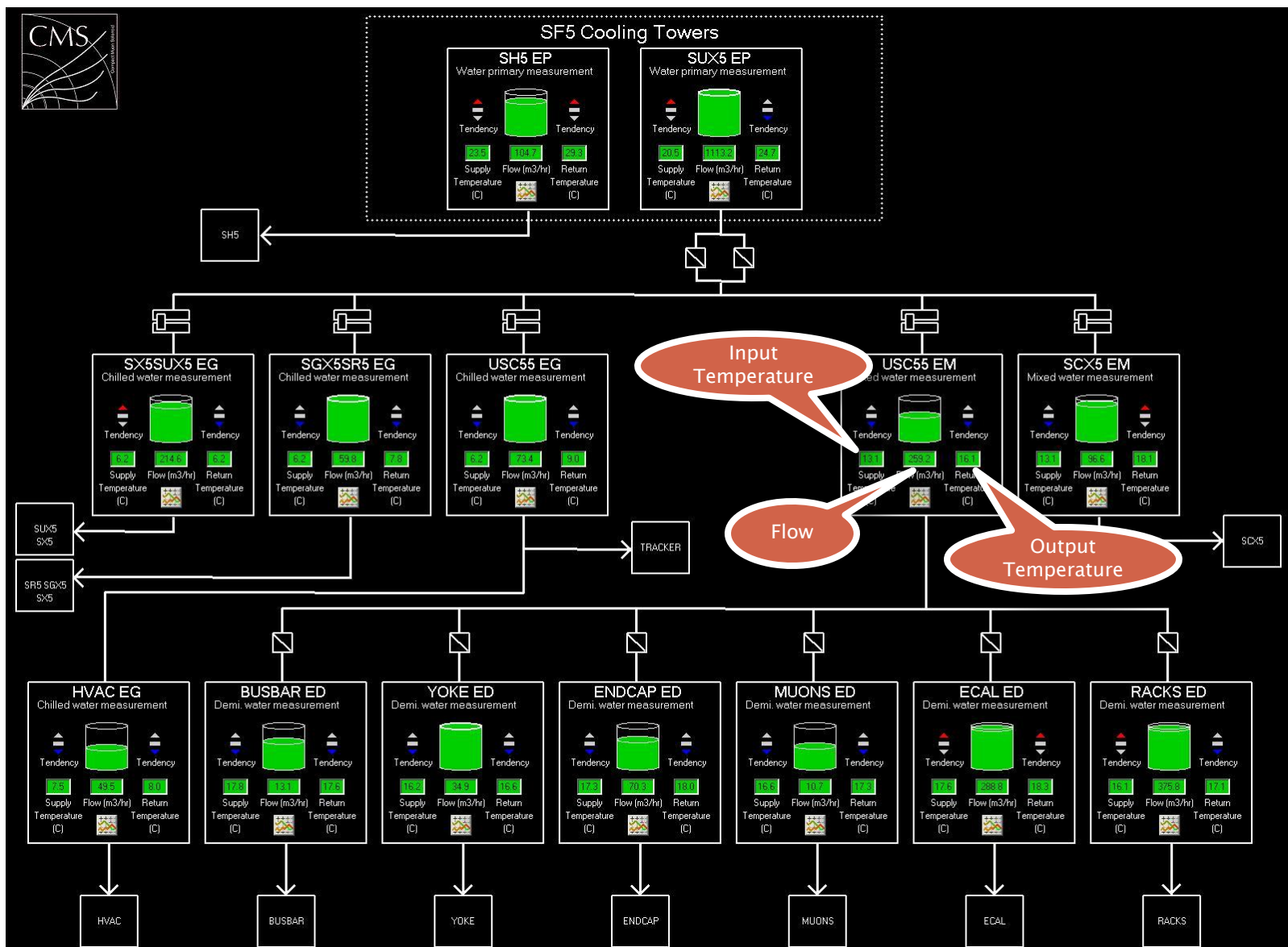
Electrical
information

Environment
monitoring

Crate Control



Cooling Monitoring





どうもありがとう
Thank you !