

Instructions for CMS EB/EE Detector Safety Shift

File:

<http://kwb.home.cern.ch/kwb/cms/ecal/procedures/safetyshift.html>

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It is essential to ensure at all times at IP5 the safe operation of CMS ECAL, and the safety of personnel and equipment. **This document considers only the Barrel (EB) and Endcap (EE) calorimeters of ECAL.** **NEW August 2009: ECAL Safety Shifter instructions for the PreShower (ES) can be found [here](#).**

At present we need to have a dedicated "*ECAL Detector Safety Shifter*" at IP5 (in/around the *Surface Control Room (SCR)*) whenever Low Voltage (LV) or High Voltage (HV) is applied to the front-ends of EB or EE (although HV alone can be applied as long as the relevant experts are present at IP5). This document details the EB/EE duties of this ECAL Detector Safety Shifter.

Formally within ECAL, at IP5 the responsibility for ECAL Detector Integrity rests with the *ECAL Field Technical Coordinators (ECAL-FTC)*, **16-5504**, presently [Ken Bell 16-0746](#) and [Wolfgang Funk 16-3125](#), supported by the *ECAL Safety Link-Person (ECAL-SLP)*, presently [Anna Elliott-Peisert 16-5791](#). Unless otherwise stated, the ECAL Detector Safety Shifter should direct their ECAL Detector Safety Shifter questions to

1. [Ken Bell 16-0746](#) or
2. [Wolfgang Funk 16-3125](#).

Comments on this document are welcome, and should in the first instance be directed to [Ken Bell 16-0746](#). Since this document concerns Detector Integrity/Safety, for the moment I prefer to have it NOT on a Twiki, where it might be too easily edited erroneously.

Shift-Training

- The ECAL Detector Safety Shifter should be trained before they undertake their first shift.
- For the moment the *ECAL DCS On-Call Expert*, **x72606**, (usually [Diogo Di Calafiori 16-3808](#) else [Serguei Zelepoukine 16-5133](#) [e.g. 24-Jul-09 - 09-Aug-09]) should provide this, until we have better documentation in place.
- Some old (and slightly out-of-date) EB/EE DCS documentation is available [here](#).
- For ES, if it's not now part of the ECAL DCS Shift training, then please see the [ES Shifter DCS Instructions](#).

Shift-Duties

For the moment the shift duties are known to be extremely tedious, but they are also extremely important... Your patience and understanding is appreciated...

The ECAL Crystal Calorimeter presently has a dedicated "*ECAL*" *Safety System (ESS)*, which is more-or-less the "last-line" of protection preventing EB/EE being in an unsafe state. The goal of the ECAL Detector Safety Shifter is to provide some real-time human back-up, in case ESS fails to ensure EB/EE is in a safe state.

Since June 2009, these duties have become less crucial, since EB/EE has evolved to have the *Detector Control System (DCS)* take automated safety actions before things get so serious that ESS needs to act, and now that there is additional independent

Detector Safety System (DSS) emergency back-up of the actions of ESS.

The basic concept is that the biggest risk to EB/EE is to have Low Voltage power on the detector front-ends, without cooling of those front-ends (they are cooled via water at 18°C. Mild overheating of the front-ends will result in accelerated ageing of the electronics. More substantial overheating could directly result in catastrophic failure of the front-ends. This would be extremely serious for the hermeticity of EB/EE. Empirically, the most likely reason to lose cooling on some detector front-ends is to lose cooling on **all** EB/EE front-ends, because of **global failure** of the chilled water from the "CV Zone/Room" in USC (i.e. lower level of Service Cavern, extreme +ve Z end) to the EB/EE cooling distribution plants on the Near and Far Balconies on "Level X2" in the UXC cavern. Empirically, we believe the EB/EE front-ends may survive up to 10 minutes with LV but no cooling.

The basic philosophy (agreed with CMS Technical Coordination, who is overall responsible for Safety at IP5) is that at present **the ECAL Detector Safety Shifter should:**

- **check the temperature of at least one Barrel Supermodule or Endcap Dee every 10 minutes (and check temperatures are updating)**
- **check carefully the temperature of all Barrel Supermodules and Endcap Dees every 30 minutes**

To make this straightforward, the ECAL DCS team has made the *Air Temp(ESS)* Tab of the ECAL DCS Main Supervisor Panel **display the highest temperature of the eight ESS thermistors of each Barrel Supermodule and Endcap Quadrant.** [These ESS thermistors measure the temperature of the AIR, close to the readout electronics.] Thus there are $36+8=44$ temperatures to watch. The display should update about every 27 seconds. We do not yet have a "heartbeat" on this display, although it's under development (and is displayed on the sub-panels showing detailed ESS Air Temperatures inside Supermodules or Dees). However, the least-significant decimal place of at least some of the 44 temperatures should change on

each update, so you can use this to check your screen is updating.

- **If the temperatures appear not to update for more than 2 minutes, please immediately call the ECAL DCS On-Call Expert, x72606, likely [Diogo Di Calafiori 16-3808](mailto:Diogo.Di.Calafiori@cern.ch), or [Serguei Zelepoukine 16-5133](mailto:Serguei.Zelepoukine@cern.ch) [24-Jul - 09-Aug], or [Georgi Leshev 16-5935](mailto:Georgi.Leshev@cern.ch) as back-up.**
- **If the temperatures continue not to update for more than 10 minutes, and you can't get hold of an ECAL DCS On-Call Expert, x72606, then you must Emergency Power-Down ECAL (see below). Then please contact the ECAL Field Technical Coordinator (ECAL-FTC), 16-5504.**

In the short term, one easy way for many people to be reminded of something every 10 minutes, is via the standard CERN Nokia 6021 mobile phone:

Menu/Organiser/Alarm_Clock/Snooze_time-out/10_minutes, and set your alarm time for almost immediately!

Shift-Help

1. **If the ECAL DCS Main Supervisor Panel (*Vision_1: CMSfw_Console/CMSfwFSM.pnl*) is not already present:** Get the ECAL DCS Main Supervisor Panel up and running:
 1. Open a terminal from the *ecalshift* account
 2. *cd /opt/pvss/pvss2_v3.6/bin*
 3. Type *startPAA* After a bit a little window opens up:
 - Click once on the line *ECAL_DCS_Remote_UI*
 - Click on the semaphore (=green traffic light on the top row of icons) to make it start
2. **If you want to turn ECAL (=EB/EE) LV or HV on, but Sub-System *ECAL HV* or *ECAL LV* are in State *ERROR* or *INTERLOCK*,** then phone the ECAL DCS On-Call Expert, x72606, (likely [Diogo Di Calafiori 16-3808](mailto:Diogo.Di.Calafiori@cern.ch), or [Serguei Zelepoukine 16-5133](mailto:Serguei.Zelepoukine@cern.ch) [24-Jul - 09-Aug]) else

[Pedja Milenovic \(16-2526\)](#) else [Ken Bell \(16-0746\)](#), to get the interlock removed.

3. **If you want to turn ECAL (=EB/EE) LV and HV on:** (e.g. at the start of the day)
 1. If the surround-colour of any padlock within *Partition* on the Main Supervisor Panel is Orange, first phone the ECAL DCS On-Call Expert, x72606, likely [Diogo Di Calafiori 16-3808](#), or [Serguei Zelepoukine 16-5133](#) [24-Jul - 09-Aug] to fix it (Orange means something is excluded).
 2. Log-In: Left-Click the Key at top right of the display window, and log-in in the sub-window (NICE username/password).
 3. If the Log-In sub-window doesn't appear anywhere obvious, look at the bottom row/panel of the left-most screen, and one icon should say *LOGIN: Log in*. Right-Click on this, release on *Move* and drag the sub-window to somewhere visible on one of your screens.
 4. If you don't immediately appear with *Supervisor* privileges, Right-Click on the line below your username, and select *ECAL_Supervisor_Operator*.
 5. Next check that the PreShower is excluded from your actions: within *Partition* on the Main Supervisor Panel, check the *ES_PLUS* and *ES_MINUS* padlocks are open and have a diagonal line through them (*Mode: LockedOut* if you hover the mouse over those padlocks).
 6. Next check that the Cooling is OK: Left-Click on the *Cooling* Tab, and make sure all Supermodules and Dees are Green = OK.
 7. Then check that what's displayed at the *HV, LV, Air Temp (ESS)* and *PTHM* Tabs looks plausible and OK. (**DCU Tab presently has a known "feature" in EB+12.**) Then Left-Click back on the *Supervisor* Tab.
 8. To take control, Left-Click on the top *Sub-detector*

padlock next to State, and *Take*.(Ignore any error messages about *ECAL_Pressure_Near* and *ECAL_Pressure_Far*. These are an artifact of system development...) **Keep *ECAL_Supervisor_Operator* privileges, and Control, permanently, so that you can do a controlled Power-Down of ECAL from DCS at any time.**

9. To turn LV on, from *Sub-detector State* OFF, Left-Click on the *State* and release on STANDBY. The top four *Partitions* (EB+, EB-, EE+, EE-) should soon go to STANDBY. ("Standby" for EB/EE is LV=ON, HV=OFF)
10. To turn HV on, from *Sub-detector State* STANDBY, Left-Click on the *State* and release on ON. The top four *Partitions* (EB+, EB-, EE+, EE-) should soon go to PARTLY_ON [Yellow], then to ON [Green]. It's normal that Endcap HV takes longer than Barrel HV to ramp up or down.
11. **Now look at the ECAL temperatures!** just to make sure the Cooling is still OK.
12. If you've just powered on EB+EE for their first time today, and you know how to do it: write an ECAL ELOG to inform the community that EB+EE is now on.
4. **If at any time you see some status in the panels that you don't trust:** go to extreme Top-Left corner *CMS ECAL* and Right-Click on this to force a Refresh of the display. (It's known that such a Refresh is occasionally necessary; it's now done automatically ever 80 seconds!)
5. **To look at the ECAL ESS Air Temperatures:** Left-Click on the *Air Temp (ESS)* Tab. The maximum ESS Air Temperature for each Barrel Supermodule or Endcap Quadrant is displayed adjacent to it. (KWB Aside: we haven't actually checked the Mapping, AFAIK...)
 1. For the Barrel, more details can be obtained by Left-Clicking on each Supermodule
 2. For the Endcaps, for more details:

- Left-Click one Dee, which should launch an intermediate window
 - Within this, then Double-Left-Click on the 2 panels under *Sub-System*, to launch 2 displays corresponding to the 2 Quadrants (then you can close that intermediate window).
3. Normal Air temperature, LV OFF, is typically $\sim 18^{\circ}\text{C}$, if cooling is running correctly. The *Air Temp (ESS)* display of maximum air temperature per group of 8 sensors, should show $18\text{-}20^{\circ}\text{C}$.
 4. Normal Air temperature, LV ON, is typically 29°C for EB and 23°C for EE, if cooling is running correctly. The *Air Temp (ESS)* display of maximum air temperature per group of 8 sensors, should show $27\text{-}31^{\circ}\text{C}$ for EB and $22\text{-}23^{\circ}\text{C}$ for EE.
 6. **To look at the temperature of the ECAL Cooling Water as it leaves the distribution plants on the UXC Balconies:** Left-Click on the *Cooling* Tab Left-Click on a Barrel Supermodule or Endcap Dee will display (bottom right) the Temperature and Flow of the water as it leaves the distribution plants on the UXC Balconies to the Supermodule or Endcap.
 1. If all working perfectly, water Temperature should be $18.0^{\circ}\text{C} \pm 0.2^{\circ}\text{C}$.
 2. If all working perfectly, water Flow for EB SMs should be $1.39 \text{ litres/second} \pm 0.1 \text{ l/s}$ (XXX margin = KWB guess).
 3. If all working perfectly, water Flow for each EE endcap (both Dees are on the same circuit) should be $5.3 \text{ l/s} \pm 0.2 \text{ l/s}$ (XXX margin = KWB guess).
 7. **If you think you see a cooling problem, while LV still seems to be on, and the temperatures are OK but rising, please phone for help: first the ECAL DCS On-Call Expert, x72606, else the ECAL Field Technical Coordinator, 16-5504/16-0746/16-3125, else Georgi Leshev, 16-5935, and start watching carefully the relevant temperatures, remembering the Warning limit**

of 37'C and the Alarm limit of 40'C!

8. **To do a SLOW controlled power-down of ECAL** (may take 10 minutes!):
 1. First ramp down HV:
 - Top of Main Supervisor Panel from *Sub-detector State ON*, Left-Click on the *State* and release on STANDBY.
 - This should initiate ramp-down of HV.
 - The top four *Partitions* (EB+, EB-, EE+, EE-) should soon go to PARTLY_ON [Yellow], then to STANDBY [Blue].
 - It's normal that Endcap HV takes significantly longer than Barrel HV to ramp down.
 2. Then ramp down LV:
 - Top of Main Supervisor Panel from *Sub-detector State STANDBY*, Left-Click on the *State* and release on OFF.
 - This should initiate ramp-down of LV.
 - The top four *Partitions* (EB+, EB-, EE+, EE-) should soon go to PARTLY_ON [Yellow], then to OFF [Blue].
9. **To do a FAST controlled power-down of ECAL** (should power down LV in less than 1 minute):
 1. Just ramp down HV and LV simultaneously:
 - Top of Main Supervisor Panel Left-Click on the *State* and release on OFF.
 - This should immediately initiate ramp-down of both LV and HV. (XXX July 2009: STILL TRUE???)
 - Go to the *LV* Tab: all EB and EE should soon go Blue (signifying LV is off)(ramp-down of HV should also have been initiated, but takes much longer to finish).
10. **At the end of your shift:**
 1. **If your shift is the last one of the day, and no-one is scheduled to take over:**
 - First tell anyone still working with EB/EE that you

are about to power off for the night(they may request the familiar "Just another 5 minutes" ...!):

- Some workers you should should know of directly.
 - Others may have reserved a Supermodule or Dee Sector [here](#): phone them to check they're actually finished.
 - Then do a Slow controlled power-down of ECAL, as above.
 - If you know how to do it:write an ECAL ELOG to inform the community that EB+EE is now off.
 - Then phone the ECAL DCS On-Call Expert, x72606,likely [Diogo Di Calafiori 16-3808](#), else [Serguei Zelepoukine 16-5133](#) [24-Jul - 09-Aug],so that they can set the ESS interlocks for the night (which avoids anyone inadvertently turning EB/EE back on).
2. **Release Control:**To release control, Left-Click on the top *Sub-detector* padlock next to State, and release on RELEASE [****NOT** RELEASEALL**].
 3. **Log Out:**Right-Click the Key at top right of the display window, and release on LOG OUT.
 11. **NEVER leave IP5 with HV or LV on EB or EE, without someone taking over the ECAL Detector Safety Shift**
 1. If the shifter who is supposed to take over from you doesn't appear, and can't be contacted(shift-list is [here](#) *Shift type: "ECAL - Safety shifter" or "ECAL - EB+EE+ES shifter"*; Click *Show*)and you can't continue yourself or find a "volunteer" to take over,then contact Ken Bell, 16-0746, else Wolfgang Funk, 16-3125, else [Cristina Biino, 16-4792](#)else do a Slow controlled power-down of ECAL, as above.
 2. **If some safety alarm obliges you to leave the Surface Control Room (SCR)**, you don't know how soon you'll be able to return, so

- Preferably do a FAST controlled power-down of ECAL, as above.
 - Else switch off ECAL by the Red Button in the SCR (Item 2 of the *Emergency Power-Down ECAL* section below).
3. To Be Continued, when more things I can't imagine nevertheless go wrong...

The ECAL Detector Safety Shifter must

- **every 10 minutes**
 - **check the *Air Temp (ESS)* temperature of at least one Barrel Supermodule or Endcap Dee**
 - **watch the *Air Temp (ESS)* temperatures to ensure the 27-second updating is still functional**
- **every 30 minutes**
 - **check carefully the *Air Temp (ESS)* temperature of all Barrel Supermodules and Endcap Dees**
- **If many temperatures show unexpected serious rise above 33'C:**
 - Call (any time of day or night) ECAL Field Technical Coordinator: 16-5504, else 16-0746, else 16-3125; else the ECAL DCS On-Call Expert, x72606.
- **If any temperature exceeds 37'C [Warning] (relevant box should go Yellow, but don't care if it doesn't!):**
 - Call (any time of day or night) ECAL Field Technical Coordinator: 16-5504, else 16-0746, else 16-3125; else the ECAL DCS On-Call Expert, x72606.
- **If any temperature exceeds 40'C [Alarm] (relevant box should go Red, but don't care if it doesn't!):**
 - **First Emergency Power-Down ECAL** (see below).
 - Then call (any time of day or night) ECAL Field Technical Coordinator: 16-5504, else 16-0746, else 16-3125.
- **If *ECAL_Cooling State* goes to ERROR:**
 - First phone the ECAL DCS On-Call Expert, x72606 (may be spurious alarm from *Water Leak Detection*)

(WLD) system).

- Else phone the EB/EE Cooling Expert, [Xavier Pons, 16-4723](tel:16-4723).
- Then start watching even more carefully the display of ESS temperatures, remembering the Warning limit of 37'C and the Alarm limit of 40'C!
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- **If the temperatures appear not to update for more than 2 minutes:**
 - Immediately call the ECAL DCS On-Call Expert, x72606 likely [Diogo Di Calafiori 16-3808](tel:16-3808) or [Serguei Zelepoukine 16-5133](tel:16-5133) [24-Jul - 09-Aug], else [Georgi Leshev 16-5935](tel:16-5935) as back-up.
- **If the temperatures continue not to update for more than 10 minutes:** and you can't get hold of an ECAL DCS Expert, x72606
 - **First Emergency Power-Down ECAL** (see below).
 - Then call (any time of day or night) ECAL Field Technical Coordinator: 16-5504, else 16-0746, else 16-3125.
 - Then call (any time of day or night) the ECAL DCS On-Call Expert, x72606 likely [Diogo Di Calafiori 16-3808](tel:16-3808) or [Serguei Zelepoukine 16-5133](tel:16-5133) [24-Jul - 09-Aug].
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Emergency Power-Down ECAL

To power down ECAL in emergency:

1. **If you have Control via DSS, and believe you can power EB/EE down rapidly using DSS:**
 - Top of Main Supervisor Panel from *Sub-detector State* ON or STANDBY: **Left-Click on the State and release on OFF**. This should immediately initiate a controlled ramp-down of **both LV and HV** .
- 2.
3. **Else switch off EB/EE by hardware in Surface Control Room (SCR):**

- Go to *RACK SYNOPTIQUE DSS* panel in "coffee-machine" corner of Surface Control Room.
 - *MANUAL Trigger* column on right-hand-side: **Push the 3rd big red button from the top, labelled *EB+EE***. After a brief (10-second) ramp-down of EB/EE LV and HV, this should trigger a DSS shutdown of all EB/EE HV Racks, and should shut off power to the OPFCs which power the Maratons LV power supplies (Button last tested 20-Apr-09).
- 4.
5. **Else switch off EB/EE manually underground (if you think there's any chance the above method may have failed):**
- You don't need a Dosimeter or Token, just your CERN Access Card, plus CMS_U access rights.
 - **First turn off the LV:**
 - Take the Big Elevator, or stairs, to the S2 (=1=upper) level underground.
 - Walk through the heavy fire-door in front of the elevator, and walk straight ahead.
 - Go down the flight of 8 stairs on your right, into the "S4" zone.
 - Ignore the first 3 racks on your left, containing red CAEN crates.
 - Ignore the next rack, containing Wiener OPFCs for the CSC system.
 - For the next 3 racks (S4F05, S4F06, S4F07) containing Wiener OPFCs for EE+/EE-, EB- and EB+ LV system: **Turn Off the green On/Off rocker switches on:**
 - **All 14 EE+ OPFCs**
 - **All 14 EE- OPFCs**
 - **All 54 EB- OPFCs**
 - **All 54 EB+ OPFCs**
 - (You can ignore the top crate in S4F05 = EE rack: this is Totem)
 - **Now turn off the HV:** (less urgent than LV)

- Go back up that flight of 8 stairs and continue into the S2 zone.
 - Row B Rack S2B09 contains the 1 EE+ CAEN HV crate
 - Row B Racks S2B08, S2B07 and S2B06 each contain 3 x EB+ CAEN HV crates
 - Row G Rack S2G09 contains the 1 EE- CAEN HV crate
 - Row G Racks S2G08, S2G07 and S2G06 each contain 3 x EB- CAEN HV crates
 - **EITHER Turn Off all 10+10 CAEN HV crates by hand**
 - **by using the Key on the right-hand-side of the front panel ("Local" -> "OFF")(all Keys are the same, if some are missing!)**
 - **or by using the Mains Switch/Contact-Breaker at the REAR-bottom-left of the crate ("1" -> "0")**
 - **OR Turn Off the 220V power going into these CAEN crates,by switching off the 5 contact-breakers at the TOP of the REAR of all 8 racks (assuming you can reach that high!).**
- 6.
7. **Then call (any time of day or night) ECAL Field Technical Coordinator: 16-5504, else 16-0746, else 16-3125.**
8. **Then call (any time of day or night) the ECAL DCS On-Call Expert, x72606likely [Diogo Di Calafiori 16-3808](tel:16-3808) or [Serguei Zelepoukine 16-5133](tel:16-5133) [24-Jul - 09-Aug].**

Additional Information

The purpose of the ESS thermistors is to monitor the AIR Temperature near the electronics of the front-end electronics. Eight thermistors dedicated for ESS have been

positioned in redundant pairs at the centre of each Module of the Barrel Supermodules, and at four locations inside each Quadrant of the Endcap Dees. The ESS temperature sensors have been calibrated to a relative precision of 0.1°C. With stable cooling running, and no LV present for 48 hours, the temperatures within each group of eight thermistors typically agree to better than 1°C, and the individual pairs agree to significantly better than that. With LV and cooling stable for 24 hours, the temperatures within the individual pairs again agree to much better than 1°C. Note that **this is not the temperature of the lead-tungstate crystals, nor is it the temperature of the cooling water or grid/backplate.**

With Cooling on and LV powered, the temperatures of the four pairs of ESS temperature sensors within a Supermodule or Quadrant show significant differences:

- For the Barrel Supermodules, typically the minimum is 24-25°C and the maximum 28-29°C (usually Module 1 is the coolest, then Module 2, then Module 4, with Module 3 the hottest).
- For the Quadrants of the Endcap Dees, EE+ has typical minimum and maximum temperatures of 21°C and 23°C, while EE- has typical minimum and maximum temperatures of 22°C and 23°C.
- (No, Ken Bell does NOT yet understand why such differences, or those below, are observed...)

The maximum ESS Air Temperature of each Supermodule or Quadrant varies significantly. Typical "plateau" values are (CMS Closed, August 2009):

- EBP_01: 27.4°C
- EBP_02: 29.0°C
- EBP_03: 30.6°C [~hottest EBP]
- EBP_04: 29.3°C
- EBP_05: 29.5°C
- EBP_06: 30.5°C [~hottest EBP]
- EBP_07: 29.5°C

- EBP_08: 28.9'C
- EBP_09: 29.9'C
- EBP_10: 28.9'C
- EBP_11: 28.8'C
- EBP_12: 29.3'C
- EBP_13: 29.6'C
- EBP_14: 29.3'C
- EBP_15: 28.8'C
- EBP_16: 29.2'C
- EBP_17: 26.9'C
- EBP_18: 29.5'C
- EBM_01: 26.9'C
- EBM_02: 28.0'C
- EBM_03: 26.0'C
- EBM_04: 29.9'C
- EBM_05: 29.8'C
- EBM_06: 30.6'C [hottest EBM]
- EBM_07: 29.5'C
- EBM_08: 28.4'C
- EBM_09: 30.0'C
- EBM_10: 31.0'C
- EBM_11: 29.0'C
- EBM_12: 29.1'C
- EBM_13: 30.4'C
- EBM_14: 28.5'C
- EBM_15: 29.4'C
- EBM_16: 29.6'C
- EBM_17: 28.4'C
- EBM_18: 27.8'C
- EEP_Near_lower: 23.1'C
- EEP_Near_upper: 23.7'C
- EEP_Far_lower: 23.2'C
- EEP_Far_upper: 22.8'C
- EEM_Far_lower: 22.7'C
- EEM_Far_upper: 22.9'C
- EEM_Near_lower: 22.3'C
- EEM_Near_upper: 22.7'C

There is also a set of ECAL "precision" (nominal 0.01'C) temperature probes measuring more directly the temperature of the water and grid/backplate of the Barrel Supermodules and Endcap Dees. These will soon be able to be displayed via the *PTHM* Tab (still under development).

And the temperature of the Cooling Water (nominally 18'C) as it leaves the distribution plants on the UXC balconies to each Supermodule or Endcap can be displayed via the *Cooling* Tab.

LV=ON: Today "LV=ON" actually means that the outputs of the Maraton LV supplies in the racks in UXC are enabled. There are LV regulator cards inside the SuperModules and Dees, which ensure a stabilised LV reaches the front-end electronics. These regulator cards incorporate an external "Inhibit" of the output of each regulator. The state of the inhibits can be set by the LV DCS application. Before turning on LV, the inhibits are set to settings read from the database. However, should the setting of an inhibit inside a Supermodule or Dee subsequently change, this is detected, but there is presently no automatic action or alarm.