

Pixel Detector Control System

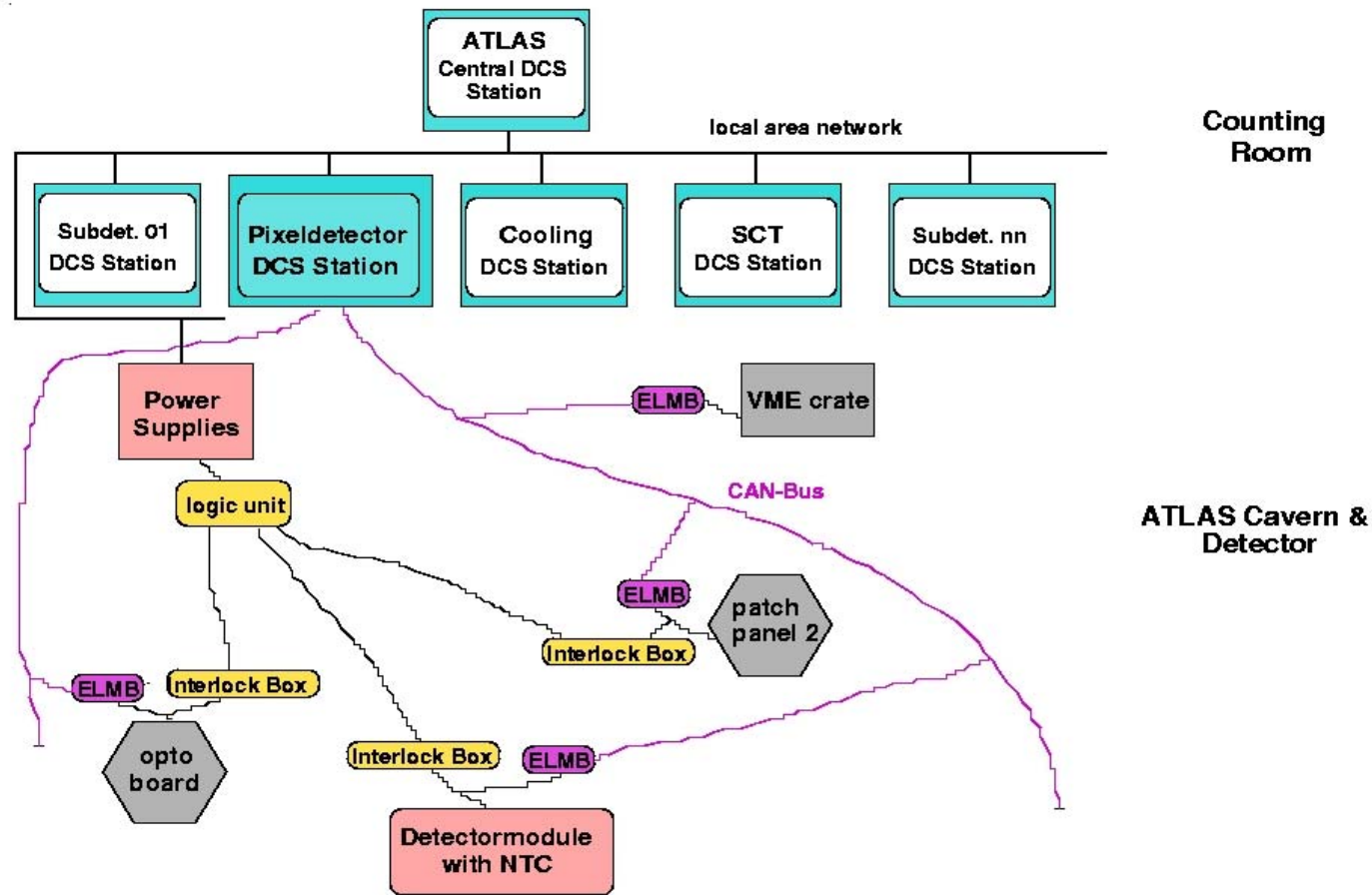
DCS Workshop

October 2001, Amsterdam

- **Overview on the Pixel DCS**
- **Interlock Box**
- **Pixel DCS Hierachy**
- **First Experience with PVSS**
- **Outlook to work in 2002**
- **Wishes for PVSS**
- **Estimated Numbers of ELMBs for the final system**

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Pixel DCS Overview



DCS building blocks

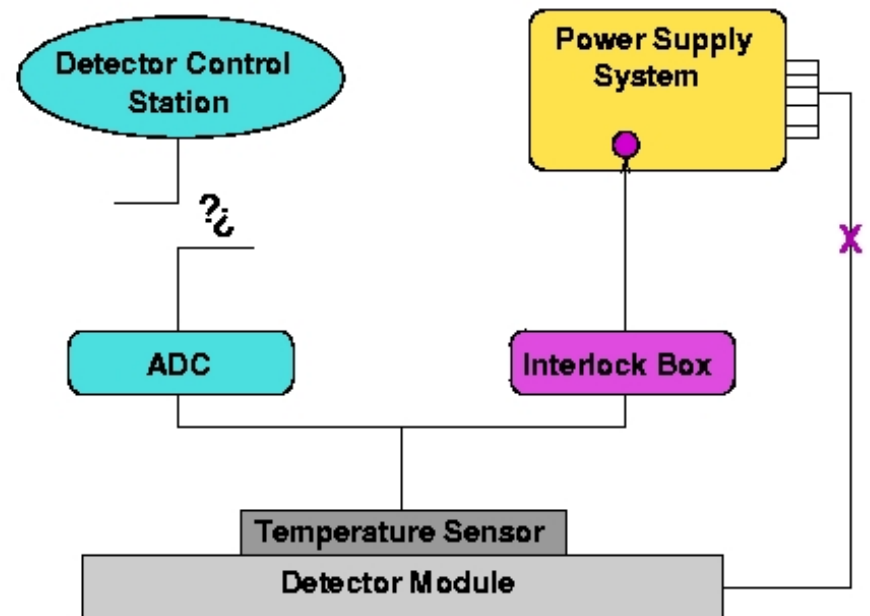
- **Cooling system:** separate PVSS system,
- Inside Pixel SCADA system status info only needed
- **Power supplies:** „high local intelligence“,
- performing monitoring by its own,
- able to execute control function
- reduces network traffic and increases safety,
- communication via OPC-server
- **Hardware Interlocks** acting on the power supplies
- **Logic unit:** supplementation to the Interlock System, taking into account different modularities
- **ELMB:** temperature monitoring (NTCs),
- monitoring currents and voltages of the regulators, VME crates, digital outputs for test signal, (DAC channels in the cooling partition)

Interlock Box: Idea

- Idea: If DCS software fails, emergency exit
- Pure hardware based solution
- A 2-bit logic:

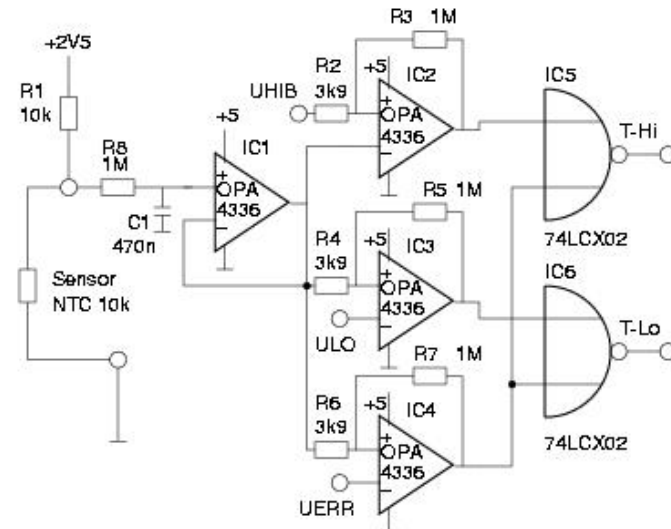
<i>okay</i>	<i>1</i>	<i>1</i>
<i>Temp high or short circuit</i>	<i>1</i>	<i>0</i>
<i>Temp low</i>	<i>0</i>	<i>1</i>
<i>error</i>	<i>0</i>	<i>0</i>

- Compatible with ELMB but also able to operate in stand alone

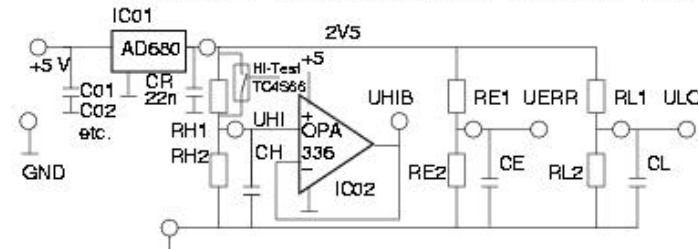


Interlock Box: Circuit

- **Temperature sensor: 10 k Ω NTC resistor,**
- **modification for the use of other NTC resistors is possible**
- **Clean reference voltage**
- **Signal from NTC is compared to different thresholds, op-amps acting as discriminators**
- **Nor gates combine information**
- **Neg. TTL compatible logic (active low)**
- **Shooting point adaptable by resistor network**



Discriminator section, one for each channel



Reference section, common for all channels

Interlock Box: electrical results

NTC:

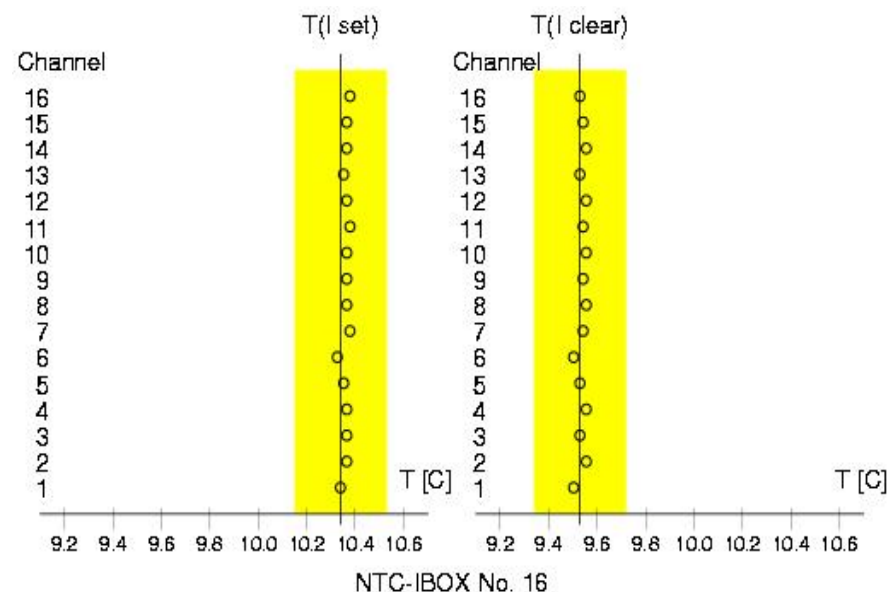
from Ishituka, SMD 0603, 10 k Ω @ 25°C \pm 1%
and B-value: 3435 K \pm 1%

R(T) non linear function, spread f(T)

- Theoretical spread confirmed (ca. 0.3 K) ✓
- Accelerated ageing @ 100 °C for 1 week ✓
- Irradiation with 24 GeV/c protons
up to 2.05 10¹⁵ p/cm² ✓

Accuracy of the Interlock Box:

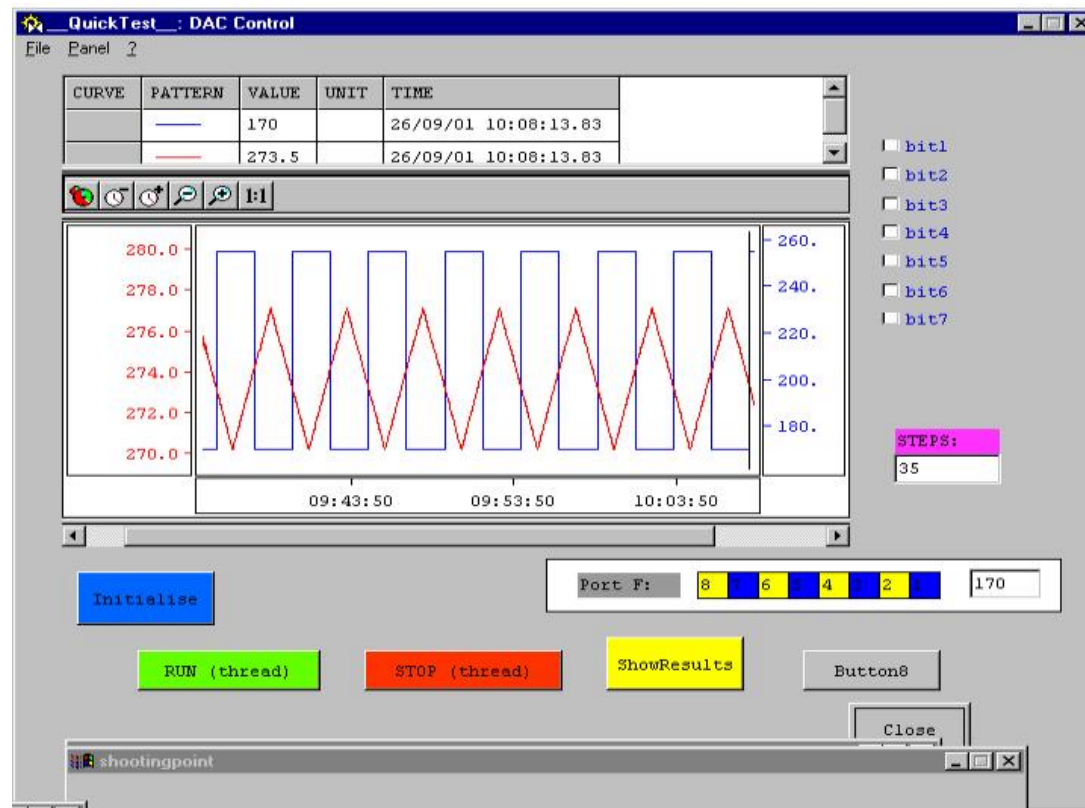
- theoretical value < 0.2 K
- Max value due to tolerances of components:
< 0.2 K (offset voltage of op-amp, high
precision resistors 0.1 %)
- measured and confirmed for 3 Boxes
- Hysteresis: ca. 1K



Interlock Box: Hysteresis

Measurements at CERN in the DCS group

Amongst other things, test in magnetic field (1.5 T) ✓



Interlock Box: Irradiation

Values according to M. Dentan:

ATLAS Policy on Radiation tolerant Electronics, ATC-TE-QA-001

Radiation tolerance criteria (MDT Barrel3) incl. several safety factors for 10 years operation of ATLAS

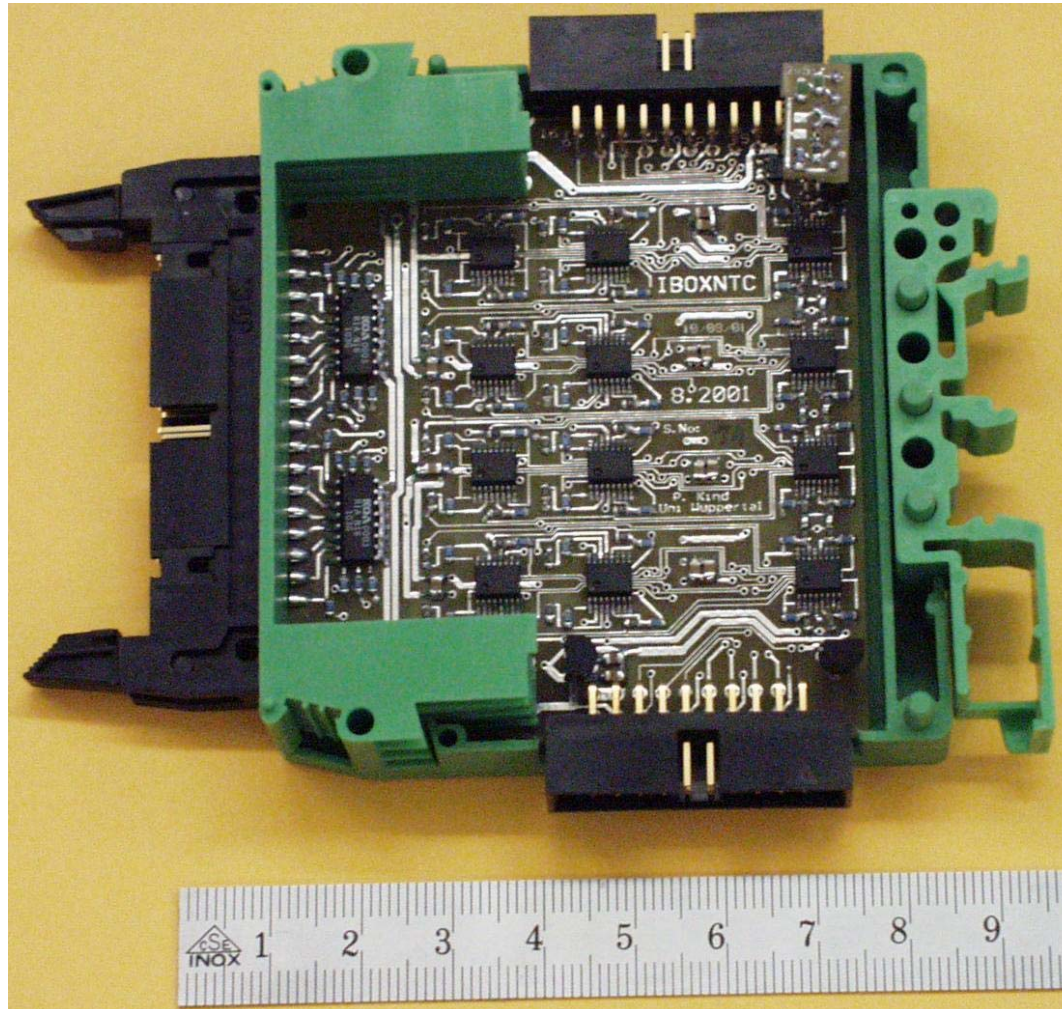
RTC_{TID}	93 Gy	Co-60 source @ CIS, Saclay
RTC_{NIEL}	4.8 10E11 n/cm² (1MeV)	Reactor @ CEA, Valduc
RTC_{SEE}	9.210E10 h/cm² (> 20 MeV)	60 MeV protons @ UCL, Belgium

individual test boards,

additionally special program for Interlock Box during SEE tests

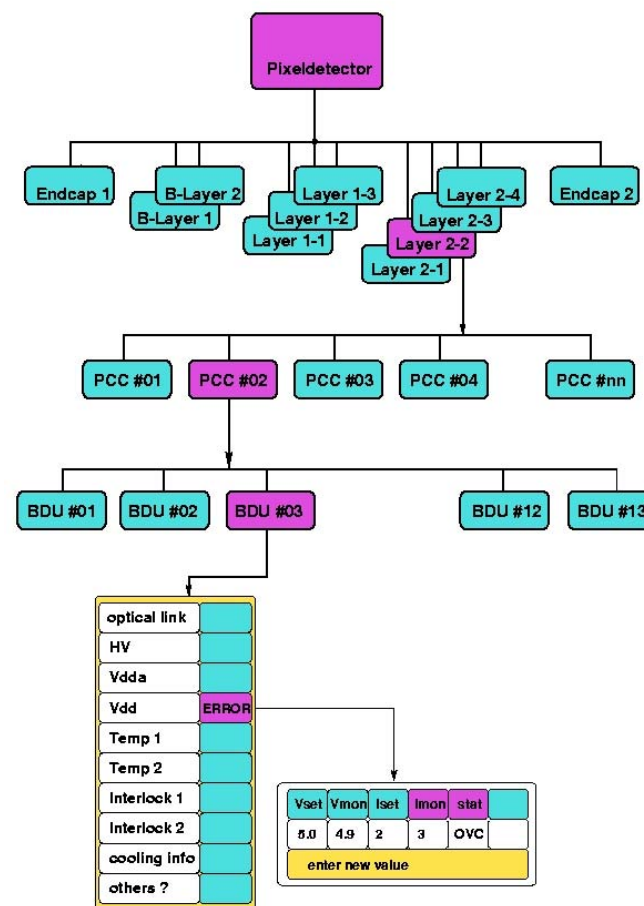
set of components to build the Interlock Box pre-selected

Interlock Box



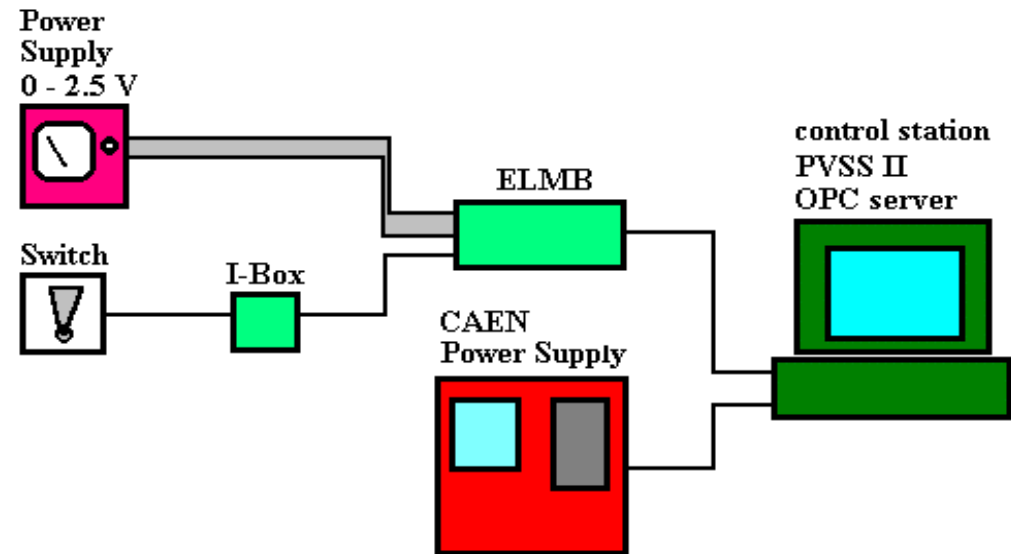
Pixel DCS Hierarchy

- Apparatus or Geographically oriented?
- Geographical approach simplifies error tracing for shifter
- **Top:** pixel detector
 - Makes connection to outer world
 - Receives commands from ATLAS DCS
 - passes commands to the lower levels
- **Level 1 + 2:** barrel layer 1 & 2, B-layer, disks
- (segmentation according to mechanical structures)
- **Base level:** base detector unit (13/bi-stave)
- 2 real detector modules with voltages, temperatures, etc.



First Experience with PVSS

- Performed by Martin Imhäuser in collaboration with ATLAS DCS group
- Test Setup →
- Windows NT platform with NI-CAN card and NI-CAN software (v1.4.2)
- PVSSII v2.11.1
- CANopen OPC server v1.0
- CAEN OPC server v1.0
- Adjustable power supply to simulate voltages coming from the NTCs
- Switch used to force an interlock signal



Control Panel

The screenshot displays a multi-windowed control panel for the ATLAS-Pixel detector system. The windows include:

- Unregistered HyperSnap:** Shows a 3D model of the ATLAS-Pixel detector with a red central cylinder and green end caps. A "Go back" button is present.
- DCS Log Viewer:** Displays a log of events:
 - RampingUp done...
 - 2001.08.02 09:45:41.940
 - Detector status OK
 - 2001.08.02 09:45:42.007
 - Detector status OK
 - 2001.08.02 09:45:45.672
 A timestamp "09:47:14 AM 08/02/01" is shown at the bottom.
- DCSStave Overview Level2:** Shows a circular arrangement of 12 green rectangular segments. One segment is highlighted in red. The text "Error occurred in Stave07 - BDU01" is displayed. A "Go back" button is at the bottom.
- DCSBDU Base Detector Unit BDU01 / Stave07:** This is the main control window, divided into several sections:
 - Left Panel:** A vertical list of status indicators with colored squares:
 - Init OL,MCC,FE (Green)
 - optical link (Red)
 - ATLAS On/Off (Green)
 - HV (Green)
 - Vdda (Green)
 - Vdd (Green)
 - Temp sensor 1 (Green)
 - Temp sensor 2 (Green)
 - Interlock 1 (Green)
 - Interlock 2 (Red)
 - cooling info (Green)
 - other? (Pink)
 - Top Right Section (VDETO):** Controls for V0Set (12.000 Volt), IOSet (2.0000 Amp), Vmon (12.000 Volt), and Imon (0.0000 Amp). Includes "On/Off" buttons and "Go to PS ..." and "Hide this ..." options.
 - Bottom Right Section (VDD0):** Controls for V0Set (2.000 Volt), IOSet (1.0000 Amp), Vmon (1.990 Volt), and Imon (0.0010 Amp). Includes "On/Off" buttons and "Go to PS ..." and "Hide this ..." options.
 - Temperature Section:** Shows "Temperature 1" at 1.028 C and "Temperature 33" at 1.025 C, each with a "Hide" button.
 - Bottom Left:** "close all", "go back...", and "automatic" buttons.
- Demo Simulation Dataflow:** A window titled "Simulate Dataflow upper DCS" showing a list of interlocks and their status:
 - Reset Interlock from optical link: Value is TRUE (Red checkmark)
 - Set Interlock from Cooling: Value is FALSE (Green X)
 - Set Interlock1 from IBox: Value is FALSE (Green X)
 - Reset Interlock2 from IBox: Value is TRUE (Red checkmark)
 - Not Init optolink, MCC and FE registers: Value is TRUE (Green checkmark)
 - Ramp Dwn Voltage sequence: Value is TRUE (Green checkmark)

DCS Tests: results

- **First experience in handling the program**
- **As a starting point the base detector unit is defined**
- **For developing, configuration etc. an additional apparatus oriented approach is useful**
- **Compatibility of ELMB and Interlock Box okay**
- **Running in the limit for some data structures (home made problem?)**

- **CANopen OPC server running stable and reliable**
- **CAEN OPC server running for limited periods**
- **CAEN and CAN OPC server together, CAEN servers crashes in 1 minute**

Outlook Work in 2002

Interlock Box:

test with real detector module, crosstalk?

qualification tests concerning irradiation

set up a test system for production and its qualification (using PVSS)

hopefully start production

→ need numbers of required boxes from other interested groups by Feb. 2002

PVSS:

solve „data structure“ problem

participation in testbeam activities

make base detector unit more realistic

build up a greater detector part with it

Constructive Criticism, Wishes

- **CAEN OPC server needs improvements**
- **Automatic tool for calibration**
- **Speed for exchange of information between 2 PVSS systems?**
- **Driver for GPIB**

Number of ELMBs for final system

Channel type	Number of channels – number of ELMBs	
DAC channels	258	5
ADC channels	14000	218
Digital output lines	160	
Sum of ELMs		ca. 250
ELMBs required in 2002		ca. 5