# Questionnaire on requirements for COMPASS Detector Control System

## 1. Scope

The Detector Control System (DCS) should monitor and/or control all slowly varying parameters of all sub-detectors (SD) and sub-systems (SS) as well as all experimental infrastructure, such as cooling, ventilation, radiation, and so forth. This includes power switches, low and high-voltage power supplies, gas supplies, rack and crate temperatures, as well as experiment-wide infrastructure, such as cooling, electricity distribution and the interface to the SPS accelerator. The DCS does not include responsibility for safety, or any fast real-time feedback loops, although it will have interfaces to the safety and SPS systems.

The main goal of this questionnaire is to understand what each SD/ SS team expects from COMPASS DCS.

We emphasise that it is remembered that the advantages of a centralised DCS are numerous: some obvious and others more subtle:

a) A planned, centrally supported, DCS which satisfies well thought out and clearly expressed needs of the experimenters can make the difference between being left, at the end of the experiment, with a large fraction of the data being unreliable - or worse suspect but without proof - and having a large sample of good quality data augmented by a lesser sample of data where any existing problems can be understood and corrected for with confidence.

b) The DCS should reduce the manpower requirements for operation of the experiment by decreasing the number of people required to operate the detector. This translates into cost savings and improved productivity.

c) Set-up time (and recovery time after power or other service failures) can be drastically reduced, again reducing the number of experts-on-call.

However being part of the COMPASS DCS puts some constraint on the SD/SS control: e.g.: compromise with other groups, constraints on the hardware, software, etc.

It is the goal of the DCS Group to provide as comprehensive a system as possible, and it encourages as many groups as possible to participate fully. The development (to completion) should take place over the next two years, so time is indeed short. To properly estimate the resources required, the task must be well defined and in order to do this a URD (User Requirements Document) must be prepared very soon. Please remember that as time available before the first physics beam is limited the prompt help of all SD/SSs is both appreciated and indispensable.

It is understood that the SD/SS designs are in some cases far from being frozen. Nevertheless, it is essential that thought should be given to their requirements for controls in order that their needs may be met by the DCS. This questionnaire is a start in the direction of acquiring details about each of the sub detectors. It is hoped in this way that all generic functionality can be identified and that an appreciation can be made of any difficulties particular to a SD/SS. Please provide under each heading as much information as is known about your SD/SS.

In many cases, examples of typical answer are shown below the questions, in italic inside the brackets. When no input is intended you can response:

N/A - is not applicable or

D/C - is don't care.

If the space left for your answer is not enough, please put you answer on separate sheet of paper together with the question number.

All COMPASS SD/SS groups should answer to the questions of Sections 2 and 16 no matter will they use a local control system or the central one. The Sections 3-13 contain the questions to the groups, which plan to use the centrally supported DCS. If the Questionnaire does not cover your specific SD/SS requirements, please write them in Section 14. Any proposals and wishes to the central DCS should be collected in Section 15.

## 2. General questions. Part 1

2.1. Name of your sub-detector/sub-system (SD/SS). Name of the person responsible for your SD/SS? Who is your local "DCS responsible"?

2.2. What are the time scales/milestones for the construction of your SS/SD?

2.3. Participants whose SD/SS will be controlled within a general control scheme should continue now with Section 3. Otherwise if your SD/SS (or part of it) will be controlled by your own control system, please answer to the following questions:

2.3.1. Please describe the local DCS solution you have anticipated or already designed.

2.3.2. What long-term support is foreseen?

2.3.3. Would remote control of this local DCS be acceptable or possible, or only remote information gathering?

2.3.4. Would you like to have control over some DCS data or just obtain some information from the system? (DCS state, pressures, etc.)

# 3. Crate control

Standard remote crate control allows reading of crate state (ON/OFF), all available crate voltages and currents, fan speed, power supply and/or air temperatures. It also allows switching crate ON/OFF and bus resetting for a VME crate. Some crates may only have a sub-set of these parameters. The remote control is very useful when the crate is far from the control room (especially then it is in the zone not accessible during the data taking).

## 3.1. Hardware

**3.1.1.** How many crates would you like to control from the DCS? How they distributed over the crate type?

(*NIM – 10, CAMAC - 5, VME - 3; etc…*)

**3.1.2.** What are the types of the remote control access of your crates?

(*CAN bus; CAENET; home made control; etc…*)

3.1.3. How many crates will be installed in the zone not accessible during the data taking?

(*3 – NIM, 4 –CAMAC and 1-VME crates; etc…*)

3.1.4. Do you plan to use non-standard or legacy crates? If so, are formal specifications of control interfaces (or bus-systems) available? If so, is long term support for these devices planed (e.g. replacement parts, institute support, etc.)

## 3.2. Crate Control specification

3.2.1. Which operational parameters would you like to monitor?

*(all voltages and currents + crate temperature; Status of the crate ON/OFF etc…)*

3.2.2. How often do you need to read the crate parameters? With what precision?

*(each 30 seconds with 1% precision, etc.)*

3.2.3. Which crate actions would you like to do remotely?

*(Switch ON/OFF, reset communication, reset crate; etc…)*

3.2.4. Do you need some automatic crate actions?

*("yes", switching off in case of over-heating; "no"; etc…)*

*3.2.5.* Other crate requirements

## 4. HV control

4.1.1. How many HV channels in total do you like to monitor and/or control?

(*16; about 16; between 10 and 20; etc…*)

4.1.2. What type(s) of Power Supplies do you use? What type of remote control access do them support?

*(CAEN SY527 Mainframe with A734N cards, RS232 and CAENET; LeCroy4032; home made; etc…)*

4.1.3. Do you plan to use non-standard or legacy HV supplies?
If so: for how long?
Are the formal specifications of control interfaces (or bus system) available?
Is a long-term support for these devices planned?

4.1.4. What is your spare-channel policy. Do you plan to allocate spare channels (to be re-mapped in case of failure) or rather spare modules and pods in sufficient numbers that direct replacement will be possible at any time.

4.1.5. Which common and individual channel operational parameters would you like to read/set?

*(**READ**: Voltages, currents and STATUS(ON/OFF)*
***SET**: **Common parameters**: Vmax, Imax, Ramp-Up, Ramp-Down, Trip Time.*
***Individual parameters**: V0set, V1set (in case of two voltages); etc…)*

4.1.6. How often do you need to read operating parameters? Do you need to set/read the parameters synchronously?

*(each 30 seconds or synchronously with the beam;  etc…*

4.1.7. Do you need any automatic voltage setting?

*(yes, the individual channel voltage depends on the monitoring results, details will be discussed later; etc…)*

4.1.8. Other HV requirements

## 5. Low voltage control

A typical low voltage is a power supply for the preamplifiers, transceivers, etc.

5.1. How many voltage/current measurements in total do you have? What is the LV range? With what precision do you need to read/set the voltages/currents?

*(0-6V; from –6V to +6V; etc…)*

5.2. How often do you need to read/set the low voltages/currents? Do you need to set/read the voltages/currents synchronously?

*(each 30 seconds with 0.5% precision or synchronously with the beam; etc…)*

5.3. Do you need any automatic low voltage/current setting?

*(yes, the individual channel voltage depends on the monitoring results, details will be discussed later; etc…)*

5.4. What is your spare-channel policy? Do you plan to allocate spare channels (to be re-mapped in case of failure) or rather spare modules and pods in sufficient numbers that direct replacement will be possible at any time?

5.5. Other low voltage/current measurements requirements

## 6. Analogue monitoring

This section contains the questions about slowly varying analogue parameters of your SD/SS like temperature, pressure, humidity, etc. Please fill the following table:

| | How many channels in total do you have to monitor? | How often you need to read the value? | How precise the measurement should be? | Other this type of the parameter requirements |
|---|---|---|---|---|
| Temperature | | | | |
| Pressure | | | | |
| Gas/liquid (water) flow | | | | |
| Gas/liquid purity | | | | |

| | | | | |
|---|---|---|---|---|
| Humidity | | | | |
| Magnetic field | | | | |
| Position | | | | |
| Other analogue values | | | | |

## 7. Control of Boolean (bit) values

A lot of the information/commands is represented in boolean form. State of interlocks, ON/OFF information, micro-switch positions all are the boolean inputs to the DCS. A typical example of the boolean command is a request to switch ON/OFF some equipment (in doing so rather often the booleans ON/OFF are two independent signals to avoid hardware resetting when resetting controls equipment). Usually a boolean is an open or closed contact or NIM, TTL, etc level.

7.1. How many boolean input/output values in total do you have?

7.2. How often you need to read the boolean input values?

*(each 30 seconds; etc…)*

*7.3.* Other boolean input/output values requirements

## 8. Start-up

Different start-up sequences can be foreseen with the DCS. These start-ups will be applied when the COMPASS DCS is restarted after a shutdown period, after a global power off, etc. An example could be a COLD start and WARM start. A COLD start can be a start-up sequence where all the configuration parameters are downloaded to the hardware like for instance HV voltage, etc. A WARM start can be a start-up with a previously saved configuration (or a backup one) without any hardware downloaded.

8.1. After a long shutdown period, how do you want to restart your system?

*(Configuring of HV with start-up predefined values; by hand; etc.)*

8.2. During the run time, if the DCS is OFF (due to a power off, reset of the computers, you stop and start it again, etc.) how do you want to start?

*(Load a backup version; Load the latest running version; Restart like after a shutdown; etc.)*

8.3. If the DCS is ON, but the hardware power supply goes OFF and then ON again, how do you want to re-start?

*(Automatically download the previous configuration value; Download the previous configuration value on user request; etc.)*

## 9. Special procedures

A typical special procedure is a calibration. Usually it is a sequence of actions including variation of some parameters (position, HV, laser light intensity, etc) and data taking. Another example of the special procedure is a movement of the equipment from one place to another.

9.1. If such a procedures foreseen, please give details

## 10. Alarms

10.1. At the moment alarms are classified into three categories:

- **Warning**: A warning shall be made if a piece of equipment deviates from its normal operating behaviour (e.g. if a temperature is not within its nominal range), but there is no danger for data quality or no need for immediate intervention.
- **Fault**: A fault message should be sent when there is a potential risk of data quality damage because of equipment malfunction (e.g. HV is out of the pre-set limits).
- **Fatal**: A fatal alarm is sent when some important part of the control system itself has failed or there is a serious equipment failure and an immediate action should be taken (e.g. a HV channel is tripped, a crate is switched off, etc). In general, a fatal alarm should stop the data taking and a manual reset is required.

  Please describe the alarms relevant to your SD/SS categorising them according to the described categories

10.2. Do you have other alarm requirements

## 11. Trending

11.1. Please describe the data to be trended. How often the signal values should be stored? For how long do you want to keep them?

*(all currents, with 0.1% dead-band, for 1 week; etc…)*

11.2. Would it be permissible to trend a user-selectable sub-set to reduce the computing load?

## 12. Data Saving and Sending to DAQ

12.1. Would you like to save some values for an out of the DCS analysis? If so, which values, how often, in what format?

*(all voltages in ASCII file, adjustable time interval; all voltages and currents should be stored in sub-detector slow control data base (format will be discussed later) each 15 minutes; etc…)*

12.2. Would you like to send some data to DAQ? If so, which values, how often, in what format?

## 13. Sub-detector access limitation

13.1. Usually the access to the system is restricted to its declared user. The system distinguishes the user by appropriate password. At the moment the following user-levels are proposed:

- **Observer**: This is the default user-level when a new user connects to the system. The observer is able to monitor the operation of the system, but no control functions are accepted.
- **Local Expert**: A Local Expert shall have full access to operate on all aspects of a single SD/SS when the system is in maintenance mode. Only one Local Expert can have access to one single SD/SS at a time, but each sub-system may have its own Local Expert
- **Global Operator**: The Global Operator shall have access to operate all SD/SS when in the running mode. However, the level of access is restricted to items, which are not a security risk (so, for example, access would not be allowed to voltage trip thresholds). The Global Operator is furthermore at any time responsible for all equipment that is not assigned to a specific subsystem and for all subsystems for which there is no Local Expert.

- **Global Expert**: The Global Expertis equivalent to the Global Operator, but with complete access to all individual SD/SS.

  Please classify relevant to your SD/SS actions according to the described user categories

**13.2.** Does your SD/SS need another user type?

## 14. Other SD/SS requirements

If you have other sub-detector requirements, which were not be covered in the previous sections (for example TV monitoring, smoke detection, water leakage detection etc.), please describe them here.

## 15. Your proposals to central DCS

If you have proposals or suggestions to the central DCS, please express them here.

## 16. General questions. Part 2.

16.1. What constraints upon the DCS system does your subsystem impose? (e.g., the DAQ runs on Linux/PC, LynxOS/VME, CAMAC).

16.2. What need for special support is anticipated for your detector sub-system? (e.g., the DAQ must ascertain that the DCS is in a particular state before allowing run start.)

16.3. Is it intended to use the DCS to control (some part of) the DAQ read-out system for the sub-detector? For example for loading of the calibration data, etc.

16.4. Which systems require read/write access to the DCS data-bases? (e.g. DAQ ).

16.5. Is support for environmental (zone) measurements required (beam/SL/information, other). Are there some particular quantities (e.g., atmospheric pressure)? Are the operating points of your detector dependent on these (i.e., no HV when Beam is above some level of intensity)?

16.6. Is it foreseen that the configuration (the overall set of i/o channels in use) be changed dynamically or is it acceptable briefly to stop and restart the control system to change the configuration?

16.7. What additional hardware (VME/CAMAC, etc) do you have available for use within your lab/institute that could be added to the COMPASS SW/HW DCS pool?

16.8. Have you anticipated resources available to develop the DCS?

16.9. By which date will a control system be required, both for the complete SD/SS and any test beams?

16.10. Do you need to use the DCS in your home institute?

16.11. What acceptance tests will be defined for the sub-system?

16.12. Is your group willing to act as a proto-DCS data-server?