**DIRC N$_2$ system in a nutshell**

**Troubleshooting:** Do not touch ANY (yes, ANY...) piece of hardware which belongs to the N$_2$ system nor to the water plant. Any intervention either planified or triggered by unexpected events occurring in IR2 (like a power outage) requires first that the dump valve gets physically disabled. This task is mandatory and can only be performed by a DIRC water system experts.

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To avoid any water leak inside the detector (a spurious humidity could for instance damage the EMC crystals), Nitrogen (N$_2$) is permanently circulating inside the quartz bars in the 12 DIRC sectors and in the SOB(*). The corresponding hardware is located on top of the E.H. in rack B620B-38 which also contains the drc-gas IOC. The N$_2$ flows monitoring has two main components:

- rotameters located in the DIRC gas rack which monitor the flows upstream of BaBar;
- electronics flowmeters read in epics which monitor the flows downstream.

Therefore, the two monitoring systems are complementary: significant differences between them would likely trigger some leak. Rotameters are part of the DQM checklist and so they are checked three times a day. During the week, Matt McCulloch, 'our' tech. is checking them daily as well and the DIRC oncall person should also check their values when he/she goes to the IR2 ops. meeting. On the other hand, the epics monitoring is the only way to check the N$_2$ flows remotely.

(*) A N$_2$ blanket is maintained above the water to prevent carbonic acid to build up. [Jerry]

**The DIRC gas rack**
The picture above shows a front view of the DIRC gas rack. One can see the SOB flowmeter and the 12 sector flowmeters (the orange vertical bars) in the upper part of the picture. Below them, the round manometers which are used to adjust the N2 flow sector-by-sector are also clearly visible. The red digital screen displays the N2 pressure which should be in the range (6.30 +/- 0.75) PSI, as written on the white board below. The nominal position of the metallic bowl monitoring the flow in each channel is also written on the white board and is marked by a green dot on the glass wall of the corresponding flowmeter. The tolerance is +/- 25 on these values.
Zoom on the white board: this picture may be useful if the board gets erased one day...

Finally, the bottom part of the general front rack picture displays the alarm panel which shows the status of all the leak and humidity sensors: all diodes must be green!
Nitrogen flows are usually pretty stable. Seldom (and maybe never anymore since Bob Reif installed a second stage on the flow regulator in February 2005!), they may present significant and quick variations induced by some changes in the Nitrogen tank located outside IR2 (the big white tower with some ice at the bottom close to the Gas Hut). When this happens, all flows may go outside their nominal range. If that happens, the global $N_2$ flow must be adjusted manually by using the manometer which is located at the back side of the rack.

To operate this manometer, there is normally a 10c coin on the right of the rack: *don't forget to put it back after you finished tuning the flow!* The manometer is quite sensitive, hence move it at most by a few tens of degrees in a row! Check the digital panel (front of the rack) before and after the tuning to see
if the flows changed in the expected way...

- **counterclockwise** tuning: flows decrease
- **clockwise** tuning: flows increase

Back view of the DIRC gas rack with the manometer to be used to tune the N2 flows.

Once you're done, do not forget to report any significant adjustment of the Nitrogen flow(s) in the BaBar and DIRC logbooks.

**Electronics flowmeters and epics monitoring**

The electronics flowmeters are located in a rack (#5) on top of the detector in the BaBar hall.

**Troubleshooting:** Since this page has been written, tags have been added on all faces of rack #5 to make sure one does not forget to disable the dump valve mechanism *before* doing any work on it.

The picture below shows the front view of this rack. In the upper part, several water and humidity
sensors are visible, just like in the DIRC gas rack on top of the E.H. Below, 12 digital screens display the flows measured by the electronics flowmeters. It is clear on this picture (taken in October 2005) that sector 4 screen is no more reliable.

Front view of the DIRC electronic flowmeters on top of BaBar.

The next picture shows the back part of the rack. In particular, the N$_2$ electronics flowmeters GMB (the generic BaBar board used to transfer any kind of sensor data to the epics world) is visible in the bottom.
Rear view of the DIRC electronic flowmeters on top of BaBar. The GMB board which is used to send the data from the flowmeters to epics is visible in the bottom of the rack.

If the GMB board is not working, values displayed on epics will be non-sense. This occurred at least once during the October 2005 shutdown after a scheduled UPS outage which also cut the whole IR2 computer network. In that case, the GMB needs to be reset. This can be done either by power-cycling the board by using the white switch labelled with a tag, or (preferred method), by power-cycling the low-voltage power supply of rack #5 (the 5U blue box with a flip-switch and some indicator lamps).

**Whatever the method you choose, do not forget that all hardware interventions require a prior disabling of the SOB dump valve.**
The DIRC epics panel providing the measurements of the electronics flowmeters can be accessed from the main BaBar epics panel `odc_main.dl` by selecting 'DRC' (`→ Monitor.dl`) and then 'Gas Status' (`→ ../../drc-gas/dl/gas.dl`).
Epics panel for the DIRC gas system.

Everything should be green on this panel: otherwise, it's likely that there is a problem somewhere which must be addressed -- don't panic, it can simply be a readout issue like e.g. a problem with the GMB. The panel also contains various buttons allowing one to start stripcharts to monitor the time history of the flowmeter readouts.

Readouts in sectors #0 and #10 are not reliable as these two flowmeters are saturated. Indeed, in the early times of BaBar, humidity was detected in these two sectors: to get rid of it, the initial rotameters were replaced by more powerful ones able to make a larger flow circulate. The consequence of this
upgrade on the electronic flowmeters located downstream was not discovered until Spring 2005. As making the two flowmeters compatible with the incoming flow was not an easy task, it was decided to keep things unchanged: if the N₂ flow gets too small in one of these sectors, the flowmeters will not saturate anymore and one will get an alarm -- epics alarm levels are indeed tighter in these two sectors.

**Documentation**

- DIRC Water Alarm.
- Schematic of the N₂ system (scanned document)
- Additional schematics (scanned document)

Web Page by Nicolas Arnaud
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