Update to LArGe SC

Preliminary results of heat driven convection calculations for LArGe cryostat

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Outline

• SC system malfunction
• Updates to LArGe SC
• Heat driven convection
SC system malfunction
Feb. 15 underpressure

820 mbar of underpressure

Pressure gauge stalled
Pressure gauge restarted
Updates to LArGe S.C.

- An additional cryostat pressure gauge was installed with independent readout system (directly fed to the GDL PC using serial cable).
- The SC switches between gauges if one is malfunctioning (to be implemented asap!).
- Errors are reported via SMS and e-mail to the subscribers (shifters and responsible people)
  - Pressure/flow over or below allowed limits
  - Any sensor stalled (no change detected for longer than particular period of time)
  - Any sensor broken (invalid readout)
Error reporting

- Error reporting system may be switched off for 30 minutes if needed (e.g. during refilling)

Control system may be switched off for 30 minutes

Sending of error messages may be suppressed for 30 minutes
Active cooling (-1.0°)

Preamplifier (+0.2°)

Cryostat wall (+0.2°)
(Very) Preliminary results of heat driven flow simulation for LArGe

• The ion drifting velocity close to the detector is (quasi field-free configuration)

\[ \approx 20 \frac{V}{cm} \cdot 0.0006 \frac{cm^2}{Vs} \cdot 3600 = 0.432 \frac{m}{h} \]

• Heat driven convection close to the detector is \( \sim 0.2 \) m/h

• The convection flow is being included in general \( ^{42} \text{K} \) drifting computations
Detection of SC system malfunction

• Operating system runs a service checking for presence of Slow Control application
  – In case of error OS attempts to restart the application, then informs me;
  – Usually the application is closed by a mistake.
• External computer (LNGS Linux cluster) runs a service interchanging dummy messages with the GDL computer
  – In case of no response an error message is sent;
  – Usually means that internet connection is down or, in the worst case, the GDL computer is turned off.
• Any instance of SC www interface checks for the communication status.
• Some error situations tested.
Detection of SC system malfunction

- Web browser SC interface
- Mobile or e-mail
- Watch dog process(es)

LNGS network

- Apache www server
- MySQL database
- LArGe SC process
  - PID control of the cryostat pressure
  - Automatic / Manual flow control

"External" World

- Message reporting

GDL PC

- OS Service
  - Checks for the presence of
    - LArGe SC process
    - Apache web server service
    - MySQL database service
  - Responds to external dummy messages
Detection of sensor malfunction or invalid conditions

• Vital parameters (cryostat pressure, coolant gas flow) monitored by a single sensor.
• The mean value of the parameter determines the cryostat state.
• In the worst case a sensor shows correct value, which doesn’t reflect reality (detector stalled).
• Spread of the value (moving average over period T) is monitored
  – If spread is 0 for longer than T – sensor is stalled, report an error.
• If a parameter value is over its limits, error is reported.
Error reporting system

- **Message types**
  - Information (minor changes of the SC state)
  - Warning (major changes of the SC state)
  - Error

- **Sent over internet to recipients**
  - Information (to me)
  - Warnings (to warning message subscribers)
  - Errors (to all interested, mainly LArGe shifters, also accompanied by an SMS)

- May be disabled manually for 30 minutes (warning situation), for e.g. refilling of the LN$_2$ dear

- After re-enabling summary of registered errors and warnings is reported.
Error report

• SMS message sent to everyone on the list in case of any error:

"Hi, error in LArGe SC. Please check the status online. +39-0862-391 (GDL), -217 (Hd), -680-231 (Paganica), +xxx (Shifter) (TS:ddddd tttt)"

• TS – time stamp of the message.
• Current shifter phone (private) will be implemented soon.
Heat driven convection close to the detector is \(~0.2\) m/h.