Quench detection for Super-FRS

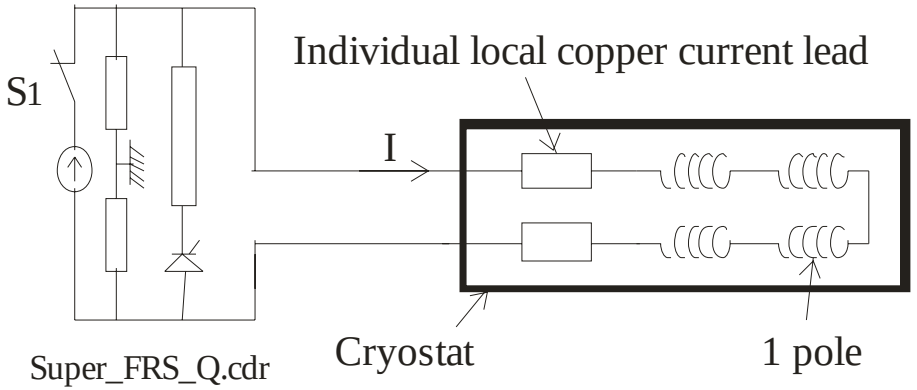
- 190 superconducting magnets in the Super-FRS
- Quench and current lead protection scheme
- 2 types of detection electronics
- Quench control and analysis system
- Time schedule and personal requirement

Superconducting magnets

09_July_08	dipoles	long quadrupoles	short quadrupoles	octupoles	hexapoles	steerers	sum
Total Super-FRS	28	22	46	40	42	12	190

- There are 9 strings of 3 dipoles in series.
- All the other 163 magnets are powered individually
- The current is all these magnets should be not more than a few hundreds of amperes
- All the magnets have individual copper current leads installed directly on the magnet

Individually powered Super-FRS quadrupole

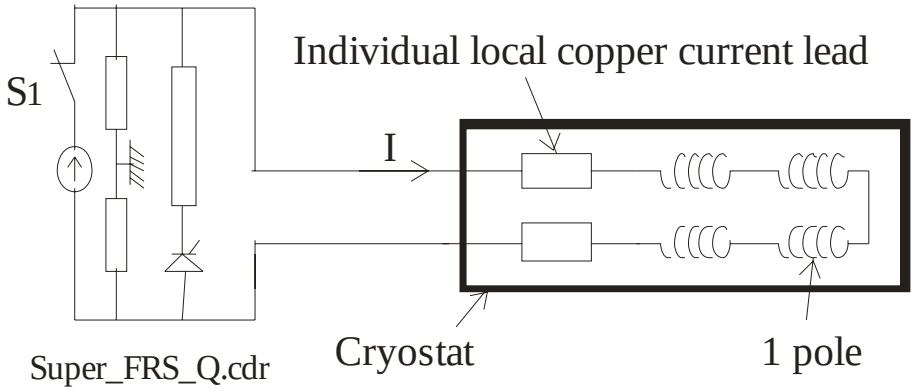


Quench and current lead protection scheme

- Quench : transition from superconducting to the resistive state
- During a quench the magnet stored energy is transformed into heat inside the coil
- To protect the Super-FRS magnets against over heating and over voltages (due to the quench resistance), the current will be dumped by using a resistor

- Insufficient cooling of a copper current lead can lead to thermal run away that finally burns the lead
- In case of thermal run away, the current will be dumped with a resistor

Individually powered Super-FRS quadrupole



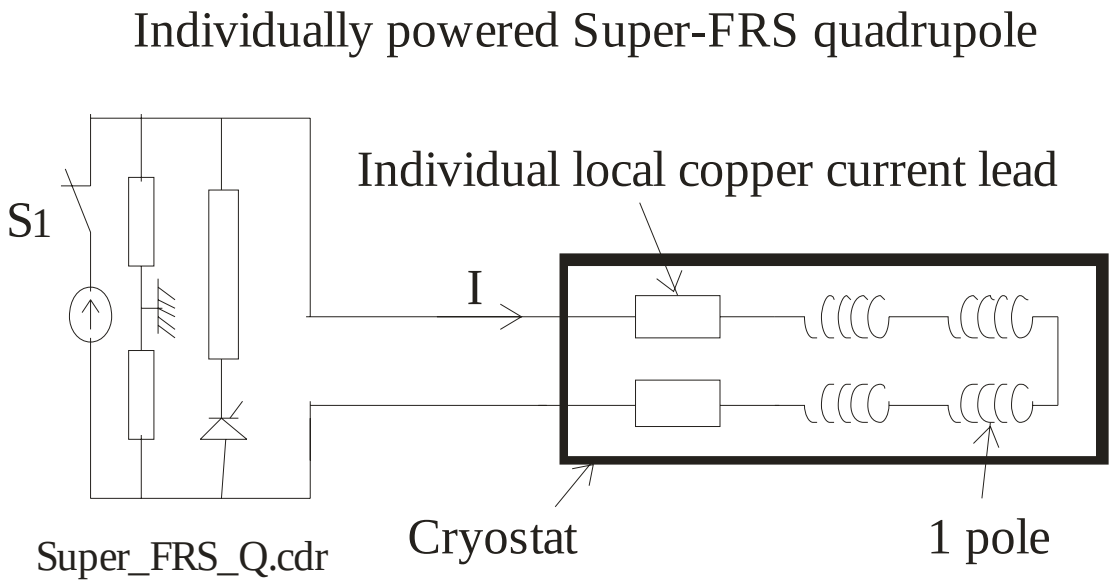
Quench and thermal run away detection

- The quench must be detected when the resistive voltage R_q*I is around V_{mag}/100 =L*dI/dt/100 = V_{th}

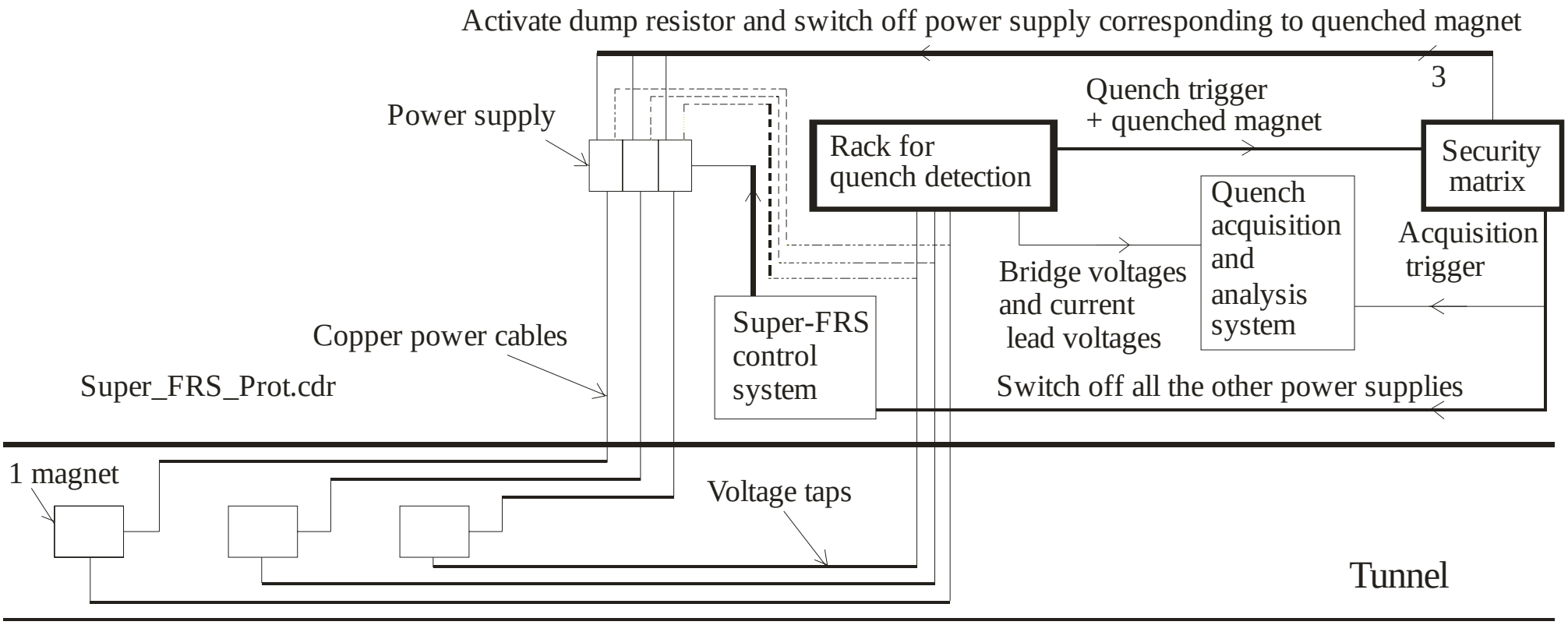
- The Super-FRS dipole ramp up voltage is 46 V, we will detect the quench with a threshold $V_{th} = R_q$*I = 0.5 V

- To detect the quench we must use a bridge : $V_b = (V_{upper\ pole} - V_{lower\ pole})/2 = \pm R_q$*I/2

- The thermal run away of a current lead will be prevented by surveying its voltage and detecting the moment it goes over V_{th} = 0.1 V (done by using the CLQD1 detection unit).



Control systems



Personal requirement for electronics hardware and control system

According to Master plan 10	2009	2009	2009	2009	2010	2010	2010	2010	2011	2011	2011	2011	2012	2012	2012	2012	2013	2013	2013	2013	2014	2014	2014	2014	2015
.	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
Super FRS preseires manufacturing																									
Super FRS from installation to end of commissioning with beam																									
SIS100 preseires manufacturing																									
SIS100 from installation to end of commissioning with beam																									
Quench detection delopment (prototypes)																									
Construction of prototype electronic modules and test on prototype magnets																									
Development of the pre-series hardware and fabrication for SIS100 string test																									
Installation of preseries hardware and commisioning on the SIS100 string																									
Follow-up of the manufacturing of Super-FRS and SIS100 quench detection electronics																									
Installation + cabling + commisioning of quench detection for Super FRS																									
Installation + cabling + commisionning of quench detection for cabling for SIS100																									
Development of the quench control and analysis system																									
Installation and test o the control system on SIS100 string test																									
Installation and commissiong of control system on Super FRS																									
Installation and commissiong of control system on SIS100																									
1 engineer in electronics																									
2 engineer in electronics																									
1 engineer in data transfer and processing																									
Total personal requirement = 15 person*year																									
green corresponds to Super-FRS																									
pink corresponds to SIS100																									
yellow corresponds to common development																									