ElQA activities during hardware commissioning

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Outline

- Sector 3-4
- New tests
- Warm sectors
- Cold sectors
- General planning
- Conditions of the test
- Safety
- Conclusions

ElQA in sector 3-4

- ElQA tests during assembly
  - PAQ, HVQN, AIV1, AIV2, MPAQ, MHVQN
  - First PAQ test done yesterday
- Treated as a virgin sector!!
  - All ElQA tests at warm and cold should be performed

Phase	At warm	Flushing	At warm	Cool down 300 K to 1.9 (4.5) K	Cryogenic conditions
TP4-A					
DOC-W					
TP4-B					
TP4-C					
TP4-D					
TP4-E					
DOC-C					

New tests MIC

- Magnet instrumentation check
  - Voltage taps continuity for all main magnets in RB and RQ circuits (ICM)
  - Resistance measurement of the quench heaters (ORC-QH)
  - Insulation test of the quench heaters vs. coil and ground (HV-QH)
- Not foreseen in previous campaigns
- Essential to verify diode voltage taps wiring to the IFS
- Needs to be performed at warm and cold
- Done locally from the IFS connectors
- Will require access to the P10 and D20 (P11 and D21) connectors
  - Not a problem in the current campaign.
- EIQA procedure needs to be updated
- Currently building the hardware and software

EIQA at warm

- TP4-A. Done from the DFB
  - Fast verification of the voltage tap resistance IRC (New)
  - Ohmic resistance ORC.
  - Transfer function measurement TFM. Need reference values
  - Continuity of instrumentation ICC. (May be simplified)
  - Diode polarity DPC. Not needed.
- DOC-W Orbit dipole corrector qualification at warm. Done from each SSS
  - Fast verification of the voltage tap resistance IRC (New)
  - Ohmic resistance ORC
  - High voltage qualification HVQ
  - Continuity of instrumentation ICC
  - Transfer function TFM
- TP4-B after flushing. Done from the DFB
  - High voltage qualification HVQ

Sectors 1-2, 5-6, 6-7, <u>LSS and IT are warm in all sectors!!</u>

ElQA in cold sectors

- Sectors have been floating around 100K
- TP4-D test at the beginning of the cool-down (at 80K).
  - Insulation tests in all circuits at intermediate voltage (600 V for MB)
- One day work for a full sector
- For all sectors:
  - TP4-E in the arc, LSS and IT circuits
  - DOC-C in the orbit correctors
  - MIC-C in in arc, LSS and IT main circuits

Phase	Warm up 1.9 (4.5) K to 80 K	80 K	Cool down 80 K to 1.9 (4.5) K	Cryogenic conditions
TP4-A				
DOC-W				
TP4-B				
TP4-C				
TP4-D				
TP4-E				
DOC-C				

Monitoring during cool-down and warm-up

- Significant faults have been found by monitoring
  - NC 816386: RQD.A78
  - NC 888846: RQF.A78 (CC)
- They may be transient but so is a quench
- Will not improve with time

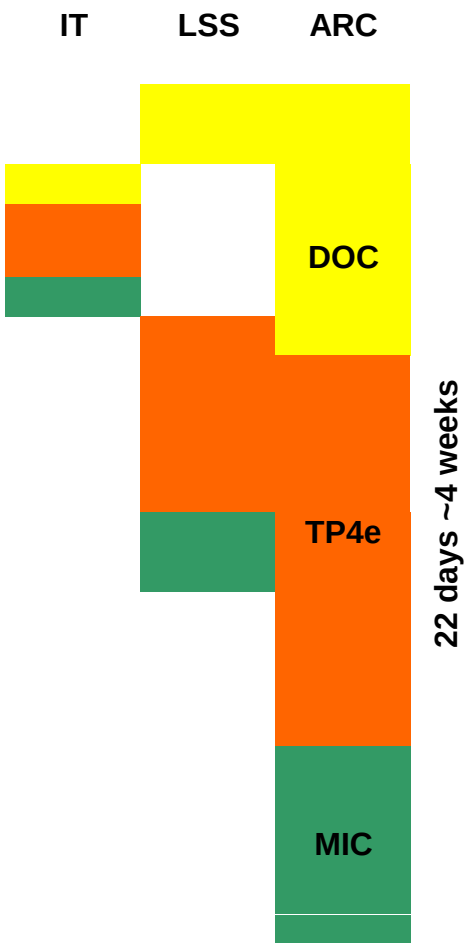
- We should monitor during all thermal cycles
- Main bus-bars and spool pieces.
- Not possible for warm-up of sector 3-4
- Not done for warm-up of sectors 1-2, 5-6 and 6-7
- Not done for intermediate cooling of sectors 2-3 and 4-5
  - Being implementing now
  - enough systems for 6 sectors.

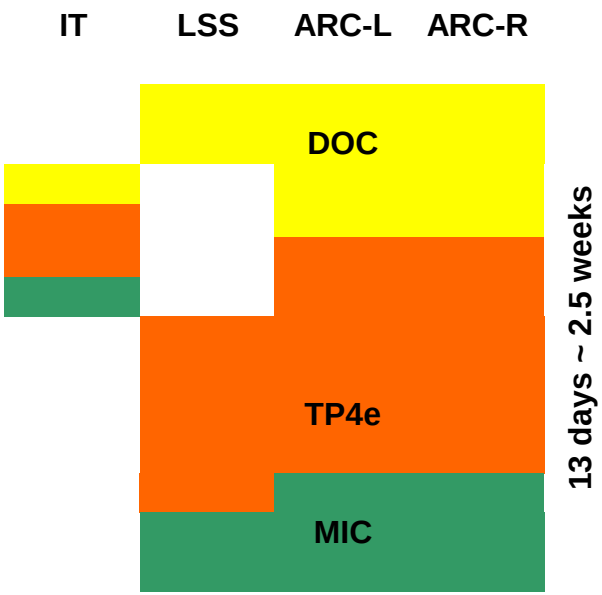
Summary of ElQA activities foreseen

		1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-1
TP4a	ORC TFM ICC DPC								
MIC-w	ORC-QH HV-QH ICM								
TP4b	HVQ								
DOC-w	ORC HVQ ICC TFM								
TP4c	ORC HVQ								
TP4d	HVQ								
TP4e	ORC HVQ TFM ICC								
DOC-c	ORC HVQ ICC TFM								
MIC-c	ORC-QH HV-QH ICM								
		1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-1

- ➔ 80 team-weeks of work in total
- ➔ 53 team-weeks at cold
- ➔ Currently four-three-four? teams

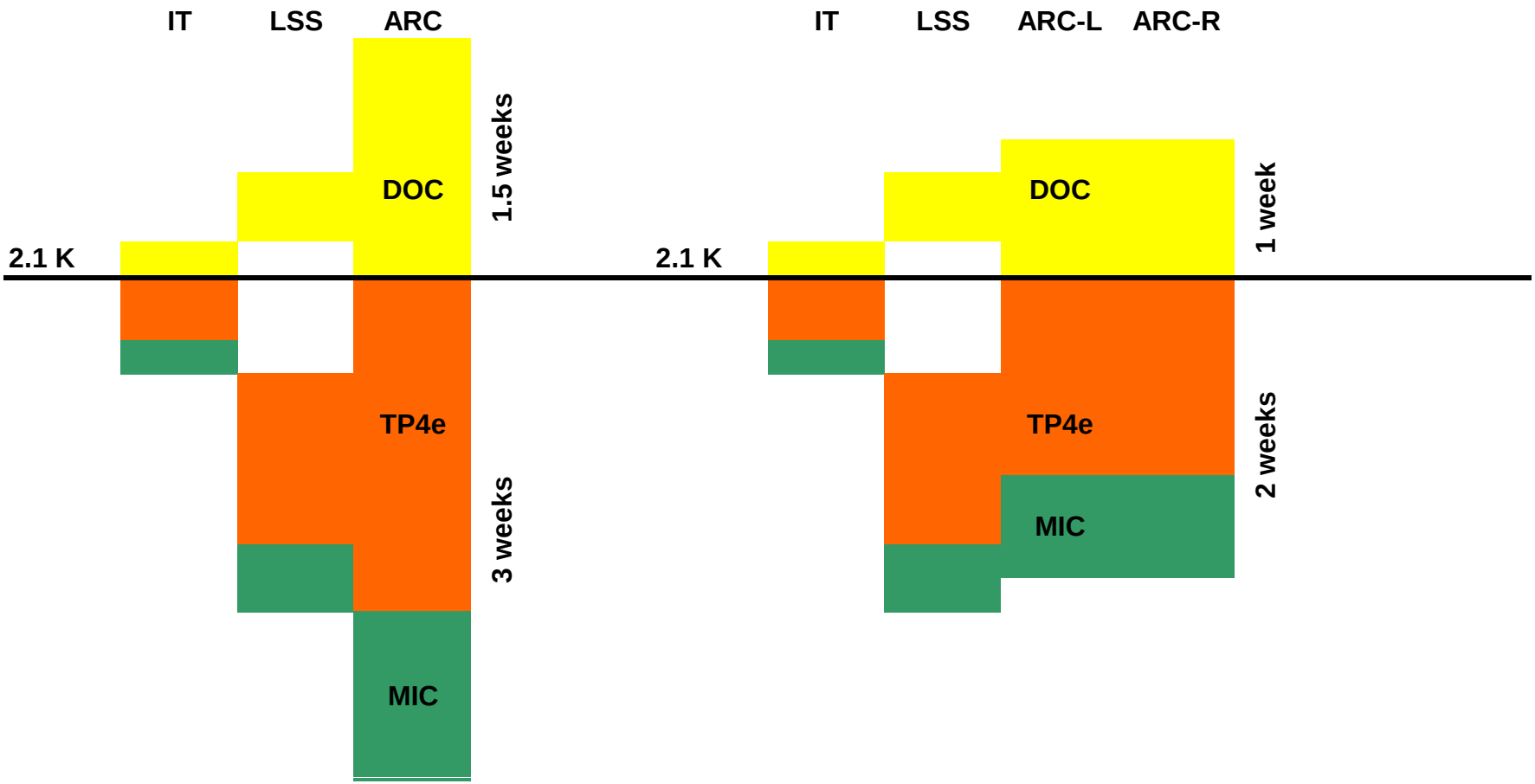
EIQA activities at warm in one sector





- Two or three teams in the sector. Four or two and a half weeks
- One week for “cold sectors”
- Limited parallelism

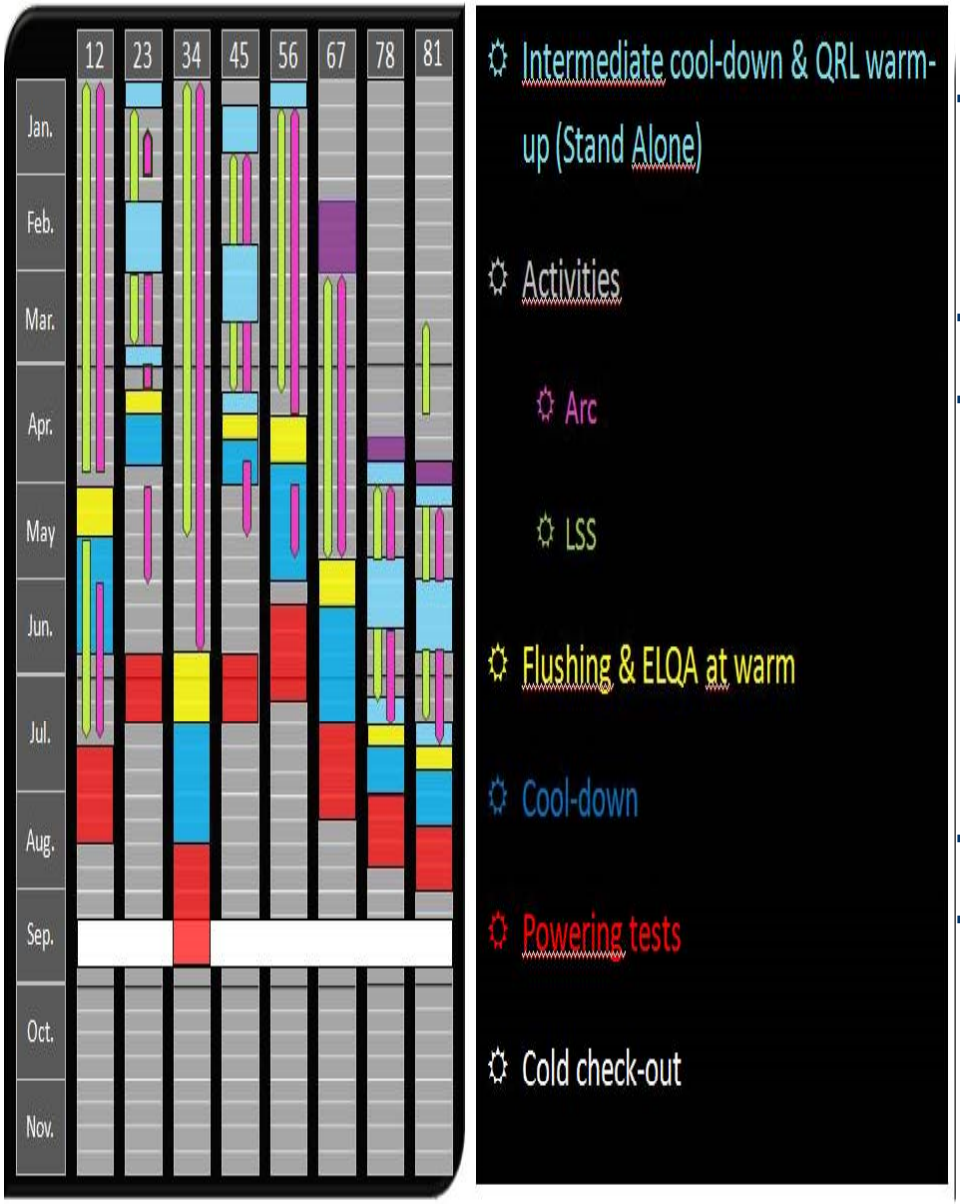
EIQA activities at cold in one sector



- ➔ Advance with DOC tests as soon as beam screen temperature is < 20K
- ➔ Two or three teams in the sector. Three or two weeks after lambda point
- ➔ Limited parallelism

<u>No time allocated in the general planning!!</u>

General schedule and planning



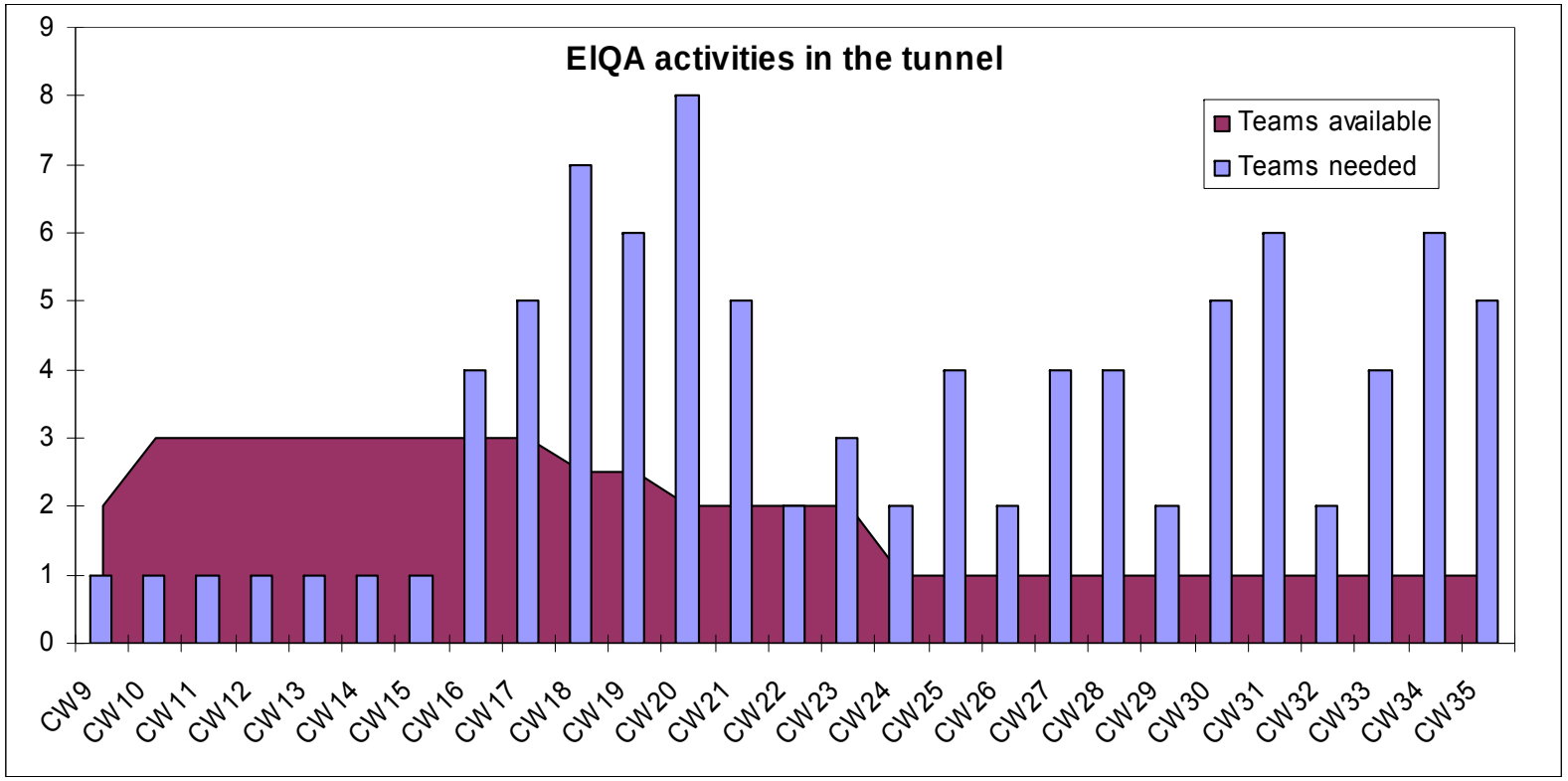
- Time allocated for ElQA at warm is somehow short 2 – 2.5 weeks
  - Sectors 4-5 and 5-6 in parallel
- Monitoring to be implemented
- No time allocated for ElQA at cold
  - Sharing time with cool-down and powering tests
  - Sectors 2-3 and 4-5 in parallel
  - Sectors 1-2, 6-7, 7-8 and 8-1 in parallel
- Up to six teams required
- ElQA team will measure the internal and bus-bar splice resistance in the DS IPQ during powering tests

Pending issues

No	1-2	EDMS	HWC phase	Circuit	Application	Date	Current Status	MTF	Status EDMS	Description
No	2-3	EDMS	HWC phase	Circuit	Application	Date	Current Status	MTF	Status EDMS	Description
No	3-4	EDMS	HWC phase	Circuit	Application	Date	Current Status	MTF	Status EDMS	Description
19	QN-ELQA-DIODECHECK-MB-A34.R3-001	980803	Warm	MB.A34	Diode Check	8-Dec-08	MCS action	OK	Initiated	Following incident in S34 (19092008), diode check test campain was lauched. MB A34R3 was showing abnormal signal shape.
20	QN-ELQA-AIV-RQTL7.R3.B1-001	985231	Warm	RQTL7.R3.B1	AIV	20-Jan-09	TE/MPE action	OK	Initiated	Following incident in S34 (19092008), instrumentation check campain was lauched, at warm.
22	QN-ELQA-AIV-RQTL7.R3.B2-001	985232	Warm	RQTL7.R3.B2	AIV	20-Jan-09	TE/MPE action	OK	Initiated	Following incident in S34 (19092008), instrumentation check campain was lauched, at warm.
No	4-5	EDMS	HWC phase	Circuit	Application	Date	Current Status	MTF	Status EDMS	Description
40	QN-ELQA-DOC-C-RCBV30.R4B2-002	985051	Cold	RCBV30.R4B2	DOC	29-Jan-09	Initiated	Not OK	Initiated	during hardware commisioning (07sept.2008), power converter RPLA.30R4.RCBV30.RB2 tripped because of current lead interlocks: U_LEAD_POS
No	5-6	EDMS	HWC phase	Circuit	Application	Date	Current Status	MTF	Status EDMS	Description
No	6-7	EDMS	HWC phase	Circuit	Application	Date	Current Status	MTF	Status EDMS	Description
No	7-8	EDMS	HWC phase	Circuit	Application	Date	Current Status	MTF	Status EDMS	Description
10	QN-ELQA-TP4D-ORC-MCBCHS5.L8B1-00	831927	Cold	MCBCHS5.L8B1	ORC	28-Mar-07	Ongoing	OK	Under way	Circuit MCBCHS5.L8B1 shows high resistance (around 22 mohm)on the cold side at 4.5 K.
48	QN-ELQA-TPE-ICC-RQ8.L8-001	991139	Cold	RQ8.L8□Lead#9	ICC	22-Jan-09	TE/MPE & CRG action	OK	Under way	After first run of LHC (sept.2008), TT893 signal of lead #9 (DFBAO, RQ8L8) was lost occasionally. MEI Group does not find any faults when measuring on site, at the level
49	QN-ELQA-TPE-ICC-RQ7.L8-001	991140	Cold	RQ7.L8□Lead#10	ICC	23-Jan-09	TE/MPE & CRG action	OK	Under way	Following the meeting of January 14th, G. D'Angelo swapped the cables between lead #9 and #10 (see NC AAAA) on 19-01-2009 .
50	QN-ELQA-TPE-ICC-RQ7.L8-002	991141	Cold	RQ7.L8□Lead#11	ICC	24-Jan-09	TE/MPE & CRG action	OK	Under way	When swapping the cables of lead#9 and #10 on 19-01-2009, G. D'Angelo temporarely disconnected cable of lead #11 (at the rear of PE) by mistake.
No	8-1	EDMS	HWC phase	Circuit	Application	Date	Current Status	MTF	Status EDMS	Description
39	QN-ELQA-TP4E-ICC-RCOSX3.L1-001	948545	Cold	RCOSX3.L1	ICC	12-Aug-08	AT/MEI action	OK	Initiated	During ICC measurement, coil seems too be resistive (about 1.1 e-3 Ohm). In agreement with Sandor Feher, it was decided to keep the circuit as it is since there is
45	QN-ELQA-TP4E-ICC-RCO.A81B1-001	955047	Cold	RCO.A81B1	ICC	27-Aug-08	AT/CRG ?	OK	Initiated	CL1 and CL2 resistance too high (measured 05/06/08). Origin to be investigated. To be checked with cryo. NC initiated.
46	QN-ELQA-TP4E-ICC-RCO.A81B2-001	955048	Cold	RCO.A81B2	ICC	27-Aug-08	AT/CRG ?	OK	Initiated	CL1, CL2 and coil resistance too high (measured 05/06/08). Origin to be investigated. To be checked with cryo. NC initiated.

- ➔ Need time and teams for performing diagnostics
- ➔ Will be planned during the hardware commissioning phases

Resources



- Based in planning of activities in 3-4 (two months old) and Katy's planning (from Chamonix)
  - May ask for some updating
- Some smoothing is definitely needed
- We will need ~6 teams of two people from mid-April until end of August

Conditions to start the test (EDMS 788197)

Before starting the TP4-A the following conditions shall be granted for each electrical safety sub-sector:

- Signalisation and fences in place (TS/HDO). BE-OP?
- Power converters of the sub-sector under test condemned (AB/PO). TE-EPC
- Warm cables galvanically insulated from the current leads (AT/MEL).TE-MSC
- Current leakage detection systems switched off (AB/PO).TE-EPC
- Current lead heating system in operation (AT/MEL). TE-MSC?
- Quench heater power supply discharged and turned off (AT/MEL). TE-MPE
- The cables (C_50) routing the current leads temperature sensors to the cryogenic electronic shall be qualified at high voltage and connected to the DFB instrumentation rack (AT/ACR). TE-CRG
- The cables routing the voltage taps for the protection of the circuits shall be qualified at high voltage and connected to the DFB instrumentation rack (AT/MEL). TE-MPE

Condemnation and galvanic insulation

- Consignation of the power converters and grounding of the current leads is already implemented as part of the start-up of the shutdown
- We will always need to monitor the insulation during thermal cycles and verify it before powering.
- Disconnection an galvanic insulation of the current leads could also be done in the entire LHC as part of this process.
- Except if the sector is kept at 1.9 K (?) difficult to imagine

Safety conditions (EDMS 788197)

- "…no assembly, construction and transport activity is allowed during the tests in the tunnel and service area being commissioned. As indicated below, access is restricted to personnel directly involved in the ELQA tests. During the tests the UA and RR will be blocked by panels and the access to the RAs and the arcs will require a special card provided by the Hardware Commissioning Coordination team…."

- What about access rules?
  - During the ElQA regular tests.
    - "Access to the safety electrical sub-sector where tests take place (service areas, vicinity of the DFBs, vicinity of the short straight sections along the tunnel) is only authorized to the ELQA personnel involved in the tests."
  - During an unforeseen intervention?

Conclusions

- 2009 campaign will be as challenging as last year
- Voltage taps and quench heaters integrity has been added to the already long list of tests
- It will evolve (slightly) in the future

- Time required for the tests can be optimized but remains underestimated
- Wee need more knowledgeable people
- We depend on HWCC to streamline the tests and on BE-OP to ensure safe access

ELQA team:

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