Electrical Safety

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Electrical safety

1. The Electrical Safety is put in place for **YOUR SAFETY**
   - The electrical safety rules are not administrative rules
   - When you do not respect the electrical safety you play with your safety
2. At CERN, the Electrical Safety is based on the **UTE-C-18-510** publication
   - The UTE-C-18-510 defines general rules to assure the electrical safety of the workers.
   - The UTE-C-18-510 must be adapted at the electrical installation
     - Code C1
     - Hardware Commissioning Electrical Safety Procedures
   - The UTE-C-18-510 defines that the electrical workers MUST be "*Habilité*" (Trained).
     - B0/H0 for the no electrical workers
     - B1/H1 for the electrical workers
     - B2/H2 for the persons in charge of the Electrical Safety.

Electrical safety

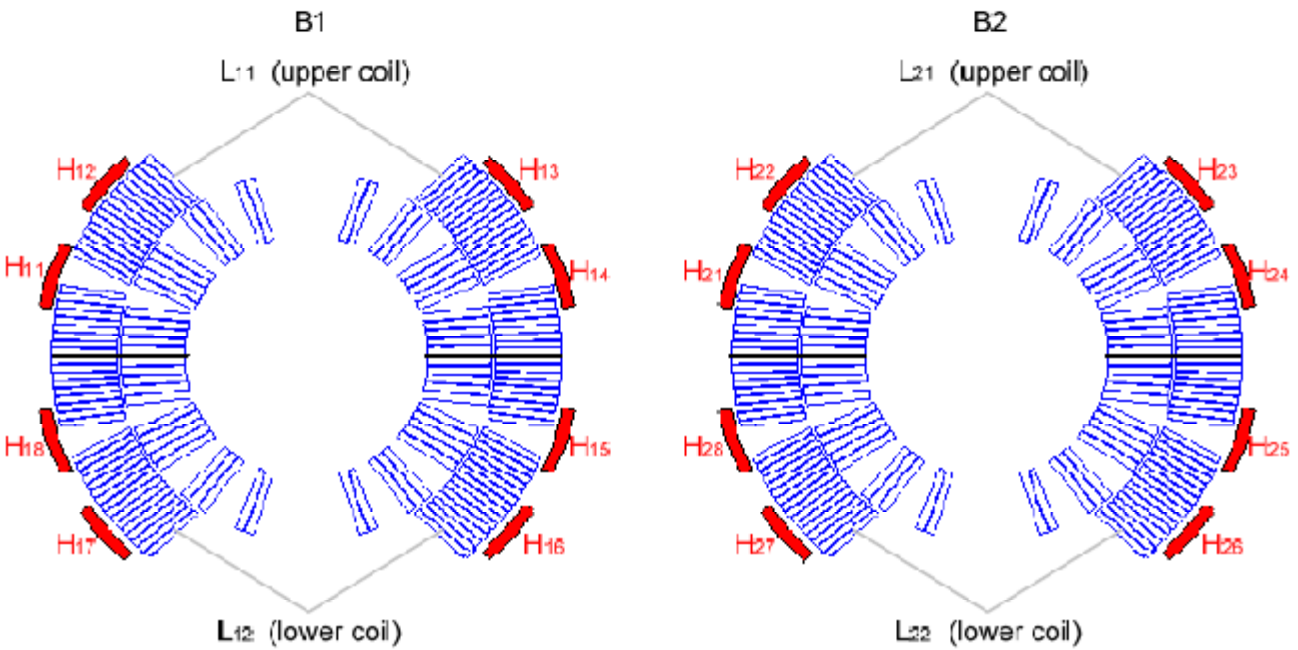
3. Electrical Safety
   - Before to work on electrical installation, all electrical risks MUST be eliminated
   - The elimination of the electrical risks is realized by the "*consignation*" of the installation
     - Separate the installation from its electrical sources
     - Lock in open position the separation devices
     - Identify the installation
     - Check that the voltage is zero and earth and short circuit the installation ("*MALT-CC*").
   - In the case of LHC:
     - The two first steps are realized by the *"chargé de consignation"* (BC).
       - The BC is a member of the equipment group
       - For an installation, we can have several BCs
     - The two last steps are realized by the "*chargé de travaux*" (B2)
       - The B2 is a member of the team which realizes the intervention for the electrical interventions.
       - The B2 is a member of the HCC team for the no electrical interventions.

LHC Specificities (at cold)

1. High energy stored in the superconducting magnets
   - The "*consignation*" as defined in the UTE publication is not enough to assure the elimination the electrical risks.
   - Before to work on an electrical superconducting circuit (see EDMS 762293)
     - It is mandatory to verify the absence of current .
     - The absence of current is realized before the "MALT-CC".
     - The absence of current is realized by the power converters group under the responsibility of the B2.
     - The EE switch must be locked in open position.

LHC Specificities (at cold)

2. High energy stored in the QPHS
   - The high current superconducting magnets are protected by QH supplied by QHPS (capacitor banks changed at 900V).
   - The QHPS can generate an electrical risk if the insulation between the HQ and the magnet is broken.

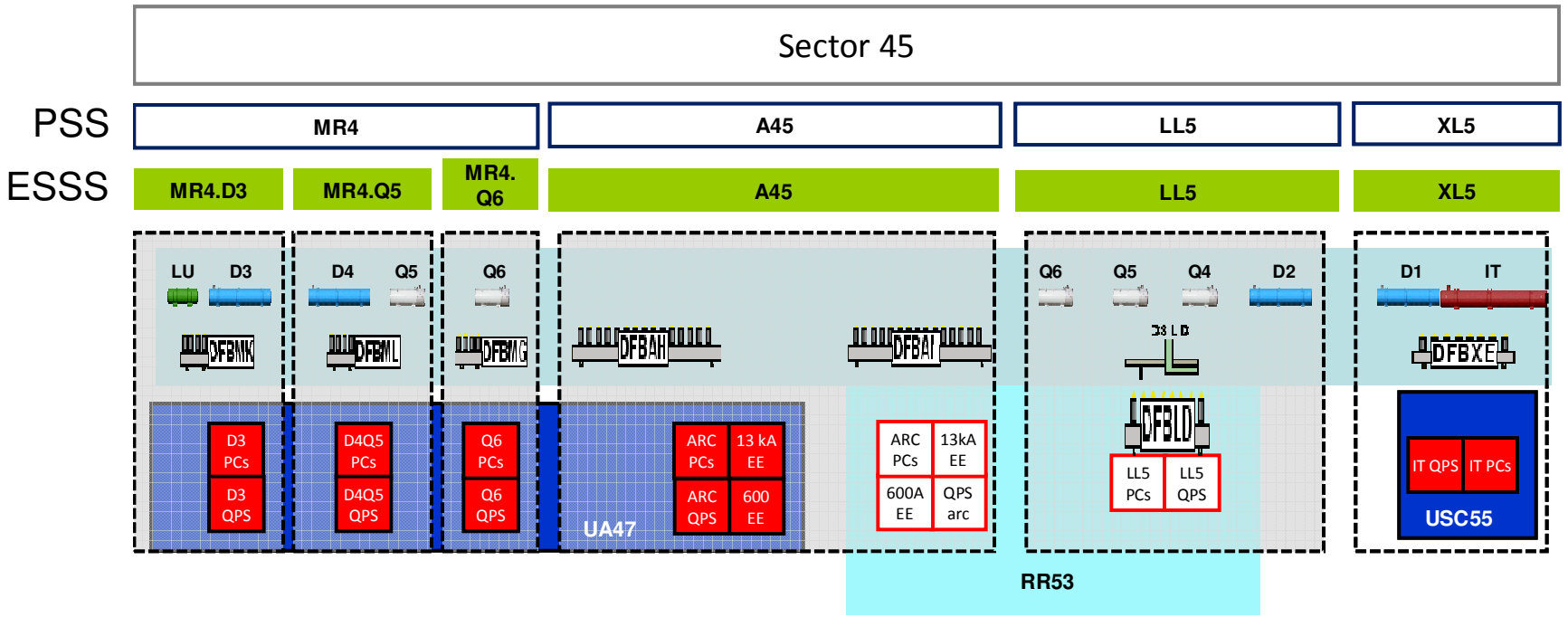


LHC Specificities (at cold)

2. High energy stored in the QPHS
   - Before the intervention:
     - For the IPD, IPQ and IT magnets, the QHPS must be switched off and discharged.
     - For the MB and MQ magnets,
       - It is mandatory to ground the current leads if the intervention is done at the level of the DFBA
       - It is mandatory to switch off and to discharge the concerned QPHS if the intervention is done at the level of the IFS boxes.

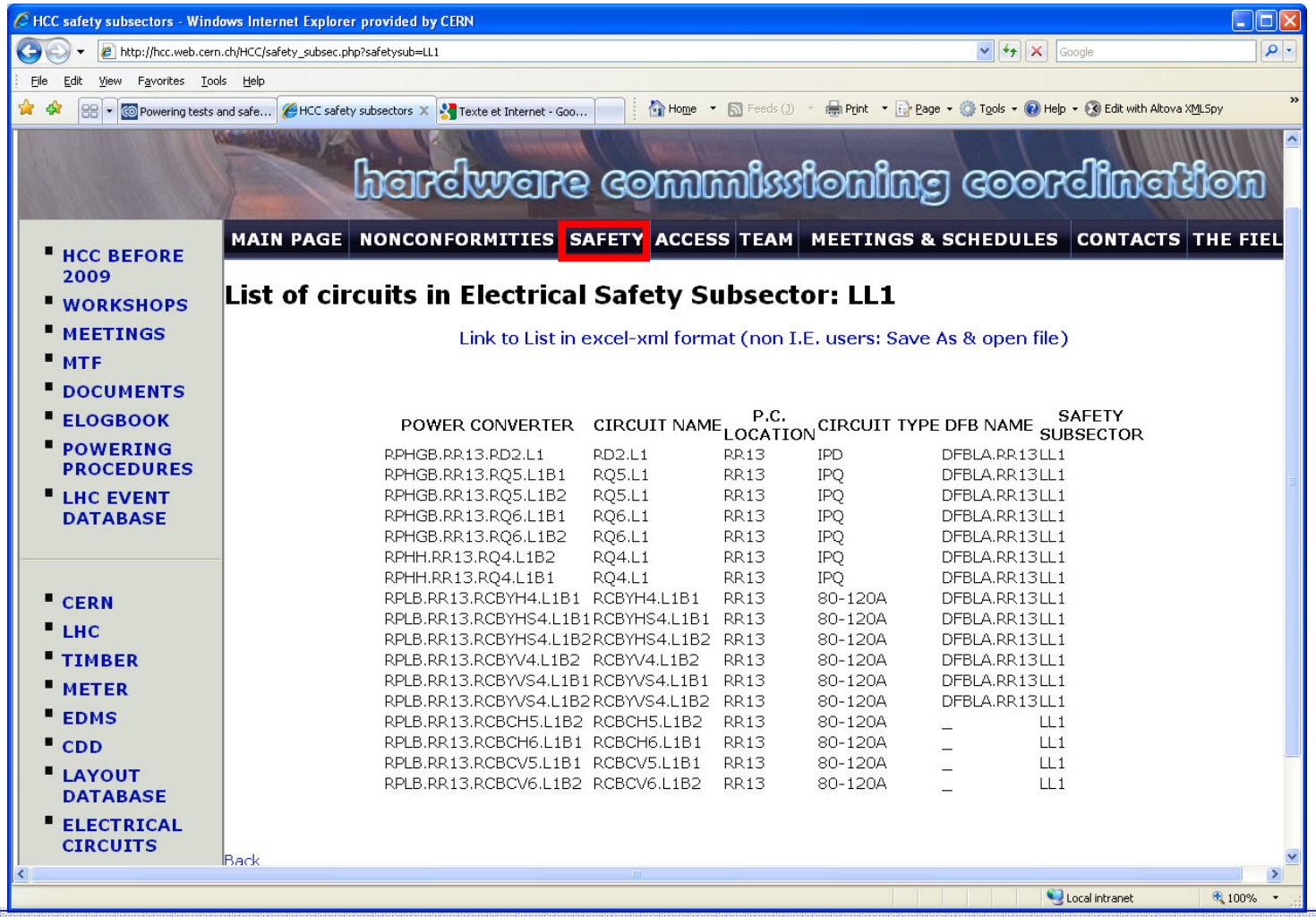
LHC Specificities (at cold)

3. Vicinity between superconducting circuits
   - In the same cryostat, the superconducting circuits are close to each other
   - To assure the electrical safety, Electrical Safety Subsectors (ESSS) have been defined (EDMS 885496):
     - An Electrical Safety Subsector is a cryogenic section electrically isolated from the rest of the machine
     - In some cases, two or three Electrical Safety Sub Sectors belong to the same Powering Subsector.



LHC Specificities (at cold)

3. Vicinity between superconducting circuits
   - The list of the ESSS is accessible from the HCC web site http://hcc.web.cern.ch/hcc/



LHC Specificities (at cold)

3. Intervention on an ESSS (except the ARC).
   - All the superconducting circuits must be "*consignés*"
     - PCs must be separated from the electrical network and their feeders must be locked in open position.
     - Absence of current must be verified
     - Absence of voltage must be verified
     - Current Leads must be grounded
     - DC cables must be grounded if necessary
   - All the EE systems must be locked in open position.
   - QHPSs must be separated from the electrical network and must be discharged. Their feeders must be locked in open position.

LHC Specificities (at cold)

3. Intervention on an ARC
   - At the DFB module level (Low Current Module or High Current Module)
     - All the superconducting circuits of the DFB module must be "*consignés*"
     - All the EE systems of the DFB module must be locked in open position.
     - All the QHPS of the DFB module and located in the UA and the RR must be separated from the electrical network and discharged. Their feeders must be locked in open position.
   - At the level of the IFS boxes
     - All concerned superconducting circuits must be "consignés"
     - All concerned EE systems must be locked in open position
     - All concerned QPHS must be separated from the electrical network and discharged. Their feeders must be locked in open position
   - No powering tests on the ARC during the intervention

Intervention Guideline

1. Before the intervention
   - The intervention must be planned with HCC (Point Owner and EIC)
     - What, when, where, etc…
     - ADI
   - The risks must be correctly identified
     - Electrical risks and the others (cryo, mechanical, etc…)
     - VIC
     - Equipment specialists, Point Owner, safety experts, etc…
   - The "*consignation*" must be realized
     - Electrical, cryo and others "*consignation*"
     - The HCC "*chargé de travaux*" (Gérard Pastor) must be contacted for no electrical intervention on or close superconducting circuits.
       - The "*chargé de travaux*" gives an "*Autorisation de travail*"
     - The "*chargé de consignation*" must be contacted for electrical intervention on or close superconducting circuits.

Intervention Guideline

2. During the intervention
   - Inform the CCC that the intervention is started.
   - The electrical safety rules must be respected.
     - Respect the fencing and the panels
   - Do not realize an other intervention
3. After the intervention
   - Inform the CCC that the intervention is finished.
   - Realized the "*déconsignations*" and give to the HCC "*chargé de travaux*" the "*Autorisation de travail*"

Remarks

1. The UTE publication and the HCC electrical safety procedures give only general rules. We can not write a procedure for each intervention.
   - The intervention must be realized by trained technicians
2. The main actor of your safety is you
   - Follow the procedures
   - Respect the fencing and the panels
3. Do not believe, be sure.
   - Have always the “yellow paper” before to start the intervention.
4. The safety is a dynamic process
5. In the tunnel, there are less and less fencing and panel