HL-LHC Hollow Electron Lens Naming V2.0 + Discussion about layout naming conventions for magnets not acting on the proton beams

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WP2 meeting
2021-06-01

https://edms.cern.ch/document/2513426/0.9
HEL Naming V0.9

- What we aim to define
  - Equipment codes for 8 new magnet families
  - Circuit names
  - Naming for electron gun, collector, anode modulator, supports, BPM, Vacuum components (outside scope of MCF)
  - Approach to follow standard LHC naming convention [LHC-PM-QA-204](#)

<table>
<thead>
<tr>
<th>Circuits for HEL</th>
<th>Magnet Type</th>
<th>Circuit Name</th>
<th>Number of circuits per IP side</th>
<th>Total number of circuits</th>
<th>I_{nominal} [A]</th>
<th>I_{ultimate} [A]</th>
<th>Required Precision Class of PCs (*i)</th>
<th>Required ramp rate [A/s]</th>
<th>Required acceleration rate [A/s^2]</th>
<th>Ramp Up Time [s]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gun Solenoid 2</td>
<td>MLEG</td>
<td>RLEG</td>
<td>1</td>
<td>2</td>
<td>257</td>
<td>tbd</td>
<td>Class 4</td>
<td>1</td>
<td>1</td>
<td>257</td>
</tr>
<tr>
<td>Gun Solenoid 1 and After Valve Solenoid</td>
<td>MLEA</td>
<td>RLEA</td>
<td>1</td>
<td>2</td>
<td>320</td>
<td>tbd</td>
<td>Class 4</td>
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<td>1</td>
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<tr>
<td>Bending Solenoid</td>
<td>MLEB</td>
<td>RLEB[1,2]</td>
<td>2</td>
<td>4</td>
<td>335</td>
<td>tbd</td>
<td>Class 4</td>
<td>1</td>
<td>1</td>
<td>335</td>
</tr>
<tr>
<td>Main Solenoid</td>
<td>MLEM</td>
<td>RLEM[1,2]</td>
<td>2</td>
<td>4</td>
<td>330</td>
<td>tbd</td>
<td>Class 3</td>
<td>0.7</td>
<td>1</td>
<td>472</td>
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<tr>
<td>Dipole Compenator</td>
<td>MCBEC</td>
<td>RCBEC</td>
<td>1</td>
<td>2</td>
<td>220</td>
<td>tbd</td>
<td>Class 4</td>
<td>5</td>
<td>1</td>
<td>44</td>
</tr>
<tr>
<td>Collector Solenoid</td>
<td>MLEC</td>
<td>RLEC</td>
<td>1</td>
<td>2</td>
<td>100</td>
<td>tbd</td>
<td>Class 4</td>
<td>1</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Electron Gun Corrector - Vertical and Horizontal</td>
<td>MCBEG</td>
<td>RCBE</td>
<td>G(V,H)</td>
<td>2</td>
<td>4</td>
<td>110</td>
<td>tbd</td>
<td>Class 4</td>
<td>5</td>
<td>1</td>
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<tr>
<td>Main Solenoid Orbit Correctors</td>
<td>MCBEM</td>
<td>RCBE</td>
<td>M(V,H)[1,2,3,4,5,6]</td>
<td>12</td>
<td>24</td>
<td>120</td>
<td>tbd</td>
<td>Class 4</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>
Corrector magnets for HEL

New codes (for discussion)

M Magnet
MC Corrector
MCB Dipole

MCBE Diople corrector e-lens

MBCB Orbit Correctors in Arc Quadrupoles
MCBC Orbit Correctors in the Insertion Region, Short Version
MCBL Orbit Corrector in the Insertion Region, Long Version
MCBM Superconducting Dipole Corrector Magnet in LHC MSCB
MCBR Orbit Corrector in RF Region Quadrupoles
MCBW Orbit Corrector for Spectrometers in the Alice and LHCb Experiment...
MCBX Single Aperture (70mm) Orbit Corrector in Inner Triplet Quadrupoles
MCBXF Single Aperture (150mm) Orbit Corrector Associated to MQXFB ...
MCBY Orbit Corrector in Wide Aperture Quadrupole
MCBYY Orbit Corrector in Enlarged Aperture (90mm) Quadrupole
MCD Decapole Corrector (b5) in Arc and Triplets
MC1 Injection line correctors
MCO Octupole Corrector (b4) in MCD0 (Spool Piece Corrector)
MCOSX Skew Octupole Spool-Piece (a4) Associated to MQSX in MQSXA
MCOSXF Single Aperture (150 mm) Skew Octupole (a4) MCOSXF
MCS MBB (Spool Piece Corrector)
MCTSXF Single Aperture (150 mm) Skew Decapole (a6)
MCX Dodecapole Spool-Piece (b6) Associated to MCBXA
MCTXF Single Aperture (150 mm) Dodecapole (b6)
MCX Inner Triplet Upgrade Phase I Correctors Family
Solenoid magnets for HEL

Modified Proposal (for discussion)

Magnet
ML Solenoid
MLE Solenoid e-lens
MLEA Gun 1
MLEAB After Valve
MLEB Bending
MLEC Collector
MLEG Gun
MLEM Main
Solenoids (idem for right of 4 Beam 2)
- RLEA.L4B1  After Valve /Gun1 Solenoid Circuit left of 4 Beam 1
- RLEB.L4B1  Bedning Solenoid Circuit left of 4 Beam 1
- RLEC.L4B1  Collector Solenoid Circuit left of 4 Beam 1
- RLEG[1,2].L4B1 Gun Solenoid Circuit left of 4 Beam 1
- RLEM[1,2].L4B1 Main Solenoid Circuit left of 4 Beam 1

Correctors (idem for right of 4 Beam 2)
- RCBECH.L4B1 Main orbit dipole compensator, left of 4 Beam 1
- RCBEGH,L4B1 Gun Solenoid Corrector Circuit horizontal, left of 4 Beam 1
- RCBEGV.L4B1 Gun Solenoid Corrector Circuit vertical, left of 4 Beam 1
- RCBEMH1.L4B1 Main Solenoid Corrector Circuit horizontal, closed to IP4, left of 4 Beam 1
- RCBEMV1.L4B1 Main Solenoid Corrector Circuit vertical, closed to IP4, left of 4 Beam 1
- ...
- RCBEMH6.L4B1 Main Solenoid Corrector Circuit horizontal, closest to IP4, left of 4 Beam 1
- RCBEMV6.L4B1 Main Solenoid Corrector Circuit vertical, furthest from IP4, left of 4 Beam 1
For circuit names the half-cell is generally omitted in favour of more generic localisations (L4, A23)

Numbering in main solenoid correctors aimed at solving issue with multiple occurrences (RSF1.A23B1, RSD2.A78B2...)

But we also have already: RQTL9.L3B2, RCBCH6.L3B1, RCBXH1.L1... -> Index is reference to half-cell of magnet

Numbers proposed instead of letters to avoid interpretation as different magnet types
Points for improvement in proposal V0.9

- No reference on half-cell in circuit name of correctors -> my mistake

- No reference in magnet nor circuit name for elements only acting on e-beam

- How to best (+ consistently?!?) solve occurrence of >1 circuits of same type in same half-cell (for both main/bending solenoids and correctors)
  - One (not so straight forward) case already exists in LHC today
    - MCBYV.A4R1.B1, KICK := acbyvs4.r1b1
    - MCBYH.4R1.B1, KICK := acbyhs4.r1b1
    - MCBYV.B4R1.B1, KICK := acbyv4.r1b1
## Alternative proposals

<table>
<thead>
<tr>
<th>Magnet Name</th>
<th>Description</th>
<th>Beam</th>
<th>Circuit V0.9</th>
<th>Variant 1 (Swap M-&gt;R)</th>
<th>Variant 2 [comments EC]</th>
<th>Variant 3 [e- /p]</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLEAB.5L4.B1</td>
<td>After Valve Solenoid</td>
<td>e-</td>
<td>RLEA.L4B1</td>
<td>RLEAB.5L4B1</td>
<td>RLEA.L4B1</td>
<td>RLEA.5L4B1</td>
</tr>
</tbody>
</table>

*Alternative proposals*
Conclusion

- No fully coherent solution possible anymore, as some exceptions already exist in todays LHC
- Variant 2 appears (to me) as the most consistent compromise given all constraints
- Variant 3 – while being more precise - might bear the risk of several code changes/complications all along the change
- Following todays agreement, update document for new approval round (+ presentation in e.g. LBOC if deemed useful?)
- Circuit location logic identical (L4, A23)
- Occurrence numbering different between correctors and solenoids, but consistent with what we have today in LHC
  - half-cell for correctors, occurrence for others
- Small risk of interpretation as different magnet types for correctors (RCBEMHA = RCBEMHB = RCBEMHC...)

HEL Circuit Naming Variant 2

IP4
Circuit location logic identical adopts new beam line E1/E2 or better E41/E42 (in case in the future we need to accommodate e- beams in other areas of LHC?), which would also have to be adopted for related magnets.

Items in joint region maintain the convention of the p beam line.
Thank you for your attention