

HL-LHC

Cryogenics for sc links

S. Claudet, 19Nov'14

KEK - 4th joint HiLumi LHC-LARP Annual Meeting

Content

- **The case of P7: (LS2 t.b.c)**

Detailed cooling scenario & schemes studied by Udo Wagner

Slides mostly extracted from MS57 reference document recently integrated in HILUMILHC-Del-D6-2-V0

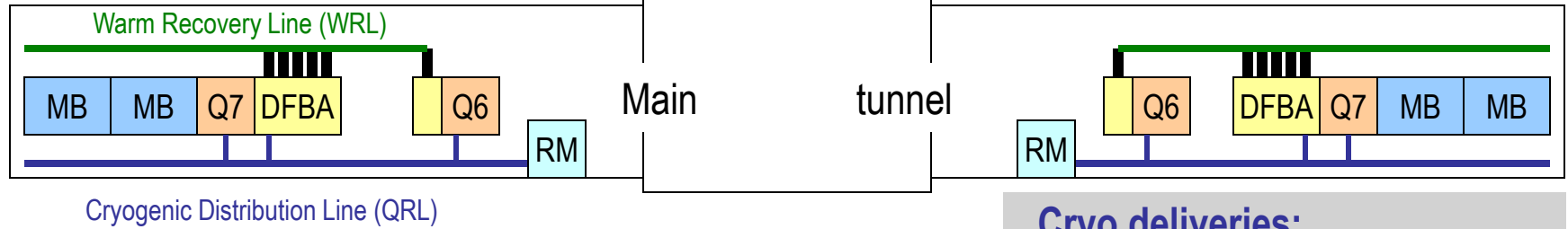
- **The case of P1/P5:**

Basic considerations so far (LS3...)

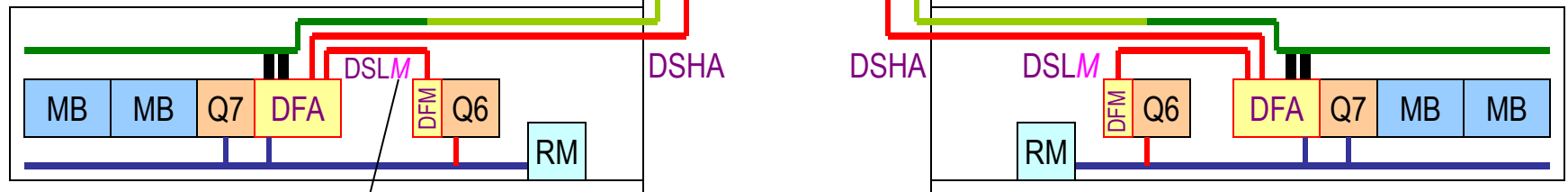
Link cooling almost for free due to large mass-flow required for leads
(how to make sure for P7 that the rather small cooling flow is well distributed around the conductor all along the length and bends?)

HL-LHC new sc links @P7

LHC scheme



HL-LHC scheme



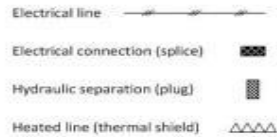
Cryo deliveries:

- Functional specifications
- Cryo Instrumentation/controls
- Return to WRL
- + QRL interface !

*Suggestion,
t.b.c by coding team*

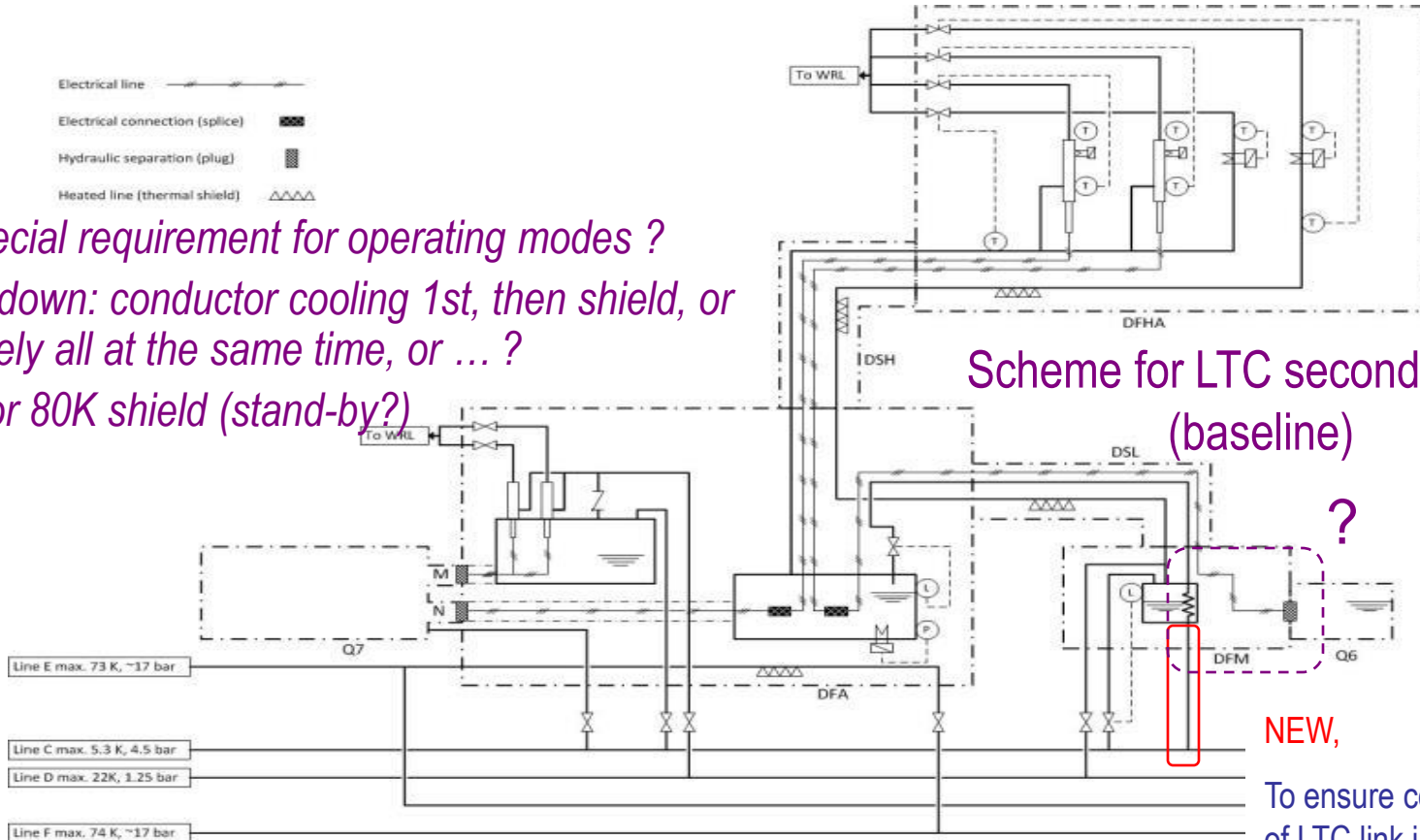
Baseline as presented in "HILUMILHC-DeI-D6-2-V0"

Schematic & work by Udo Wagner



Any special requirement for operating modes ?

- *Cool-down: conductor cooling 1st, then shield, or tentatively all at the same time, or ... ?*
- *20K or 80K shield (stand-by?)*

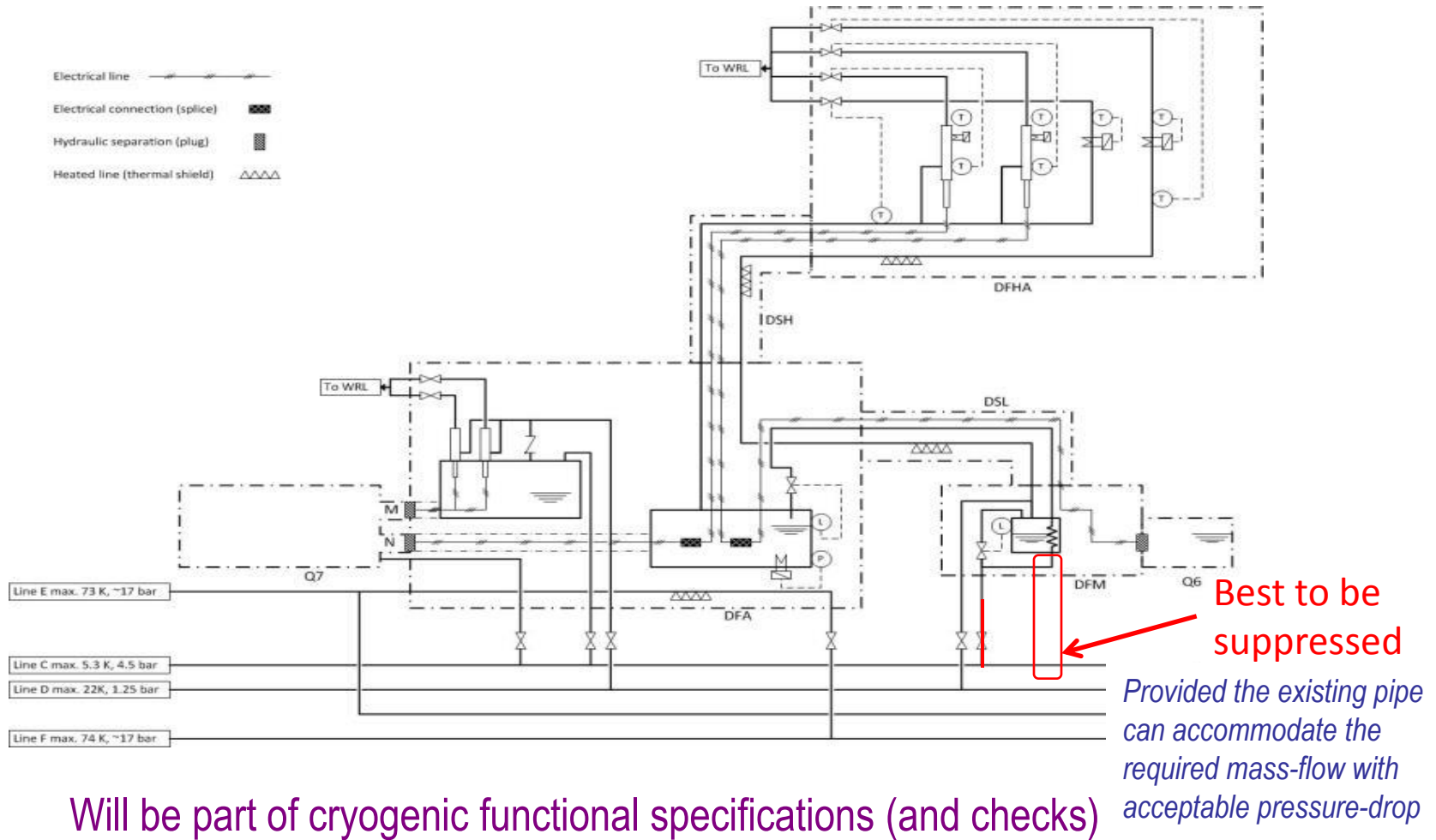


Scheme for LTC secondary link (baseline)

NEW,
To ensure correct cooling of LTC link in case of perturbation of Line_C temperature

To come next: (timing to be confirmed)
Functional specification for cryogenic circuits, valves, volumes, safety devices, instrumentation, ...

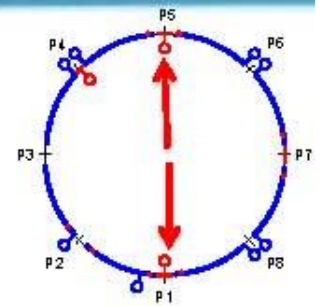
Baseline as presented in "HILUMILHC-DeI-D6-2-V0" with out modification of the QRL header. *Schematic & work by Udo Wagner*



Will be part of cryogenic functional specifications (and checks)

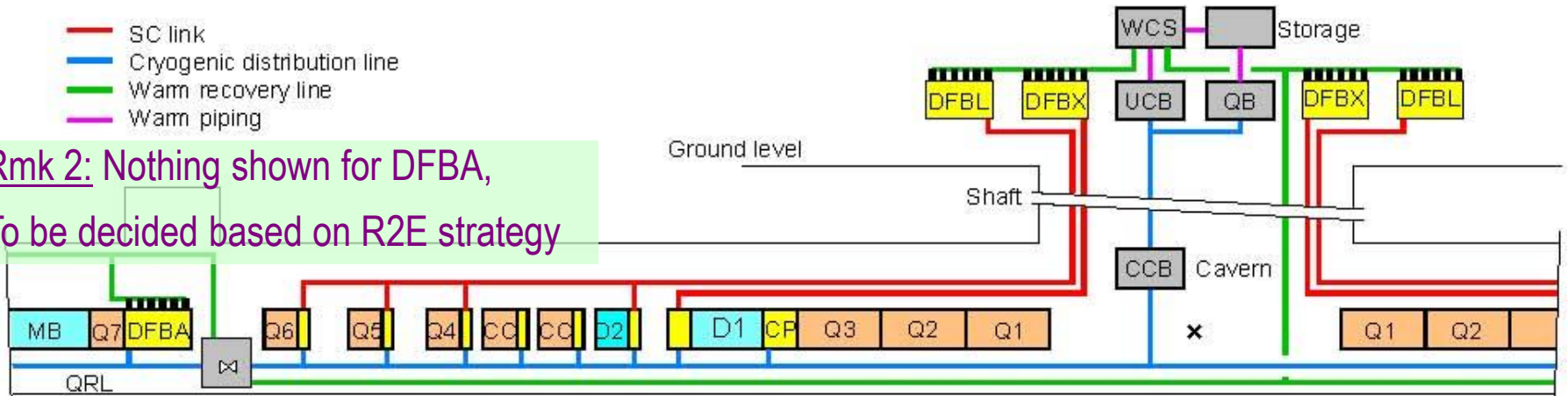
New cryogenic infrastructure at P1 and P5

Rmk 1: basic scheme to illustrate principles, naming to be updated with appropriate coding



- SC link
- Cryogenic distribution line
- Warm recovery line
- Warm piping

Rmk 2: Nothing shown for DFBA,
To be decided based on R2E strategy



- 1 warm compressor station (WCS) in noise insulated surface building
- 1 upper cold box (UCB) in surface building
- 1 cold quench buffer (QB) in surface
- 1 or 2 cold compressor boxes (CCB) in underground cavern
- 2 main cryogenic distribution lines
- 2 interconnection valve boxes with existing QRL

Critical
integration
issue

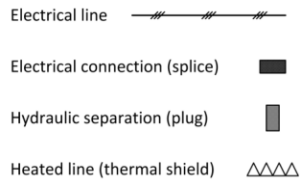
Text extracted from Del 6.2

Cooling options for the cold powering system

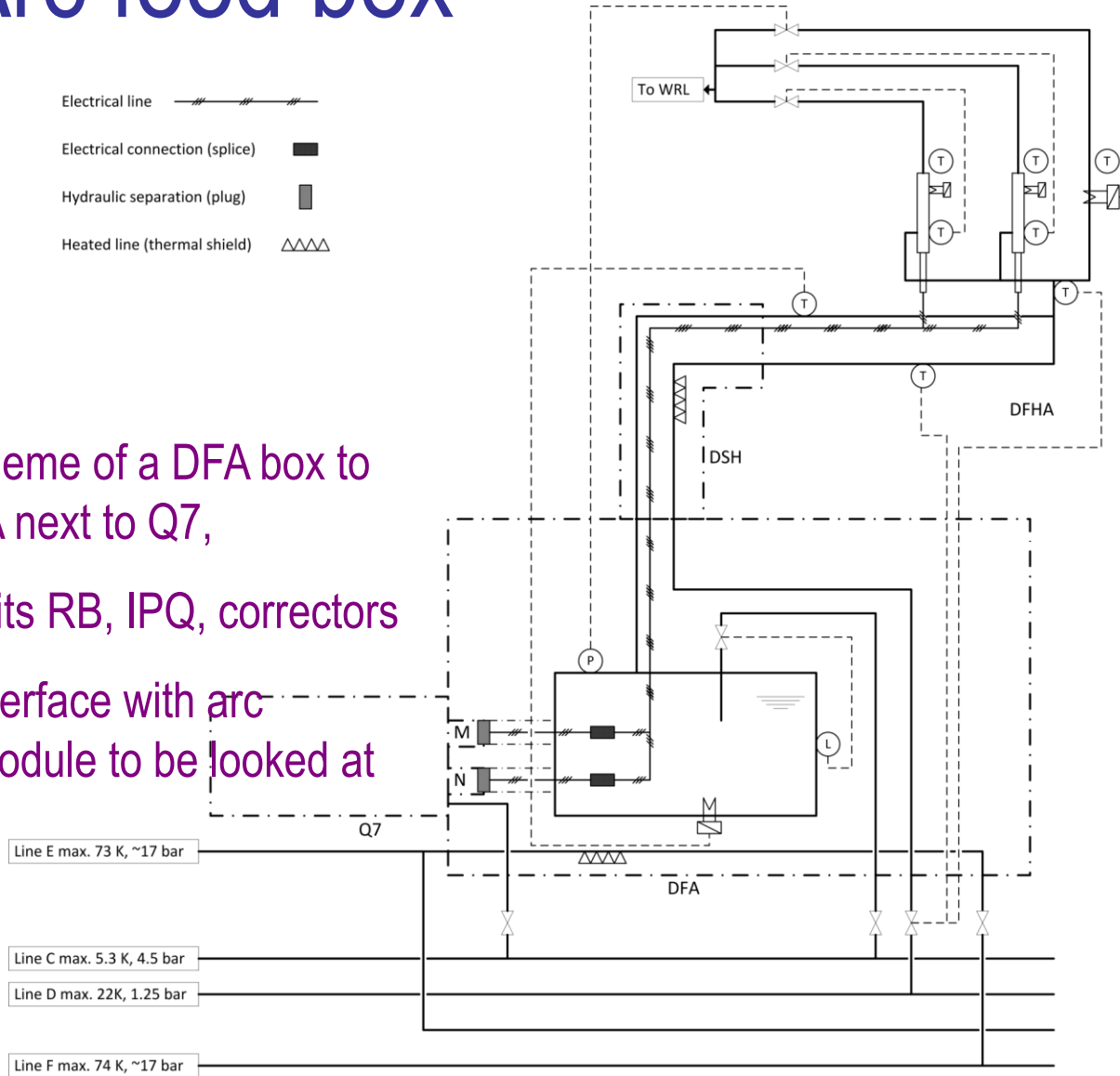
The cooling system for the current feed boxes of the inner triplets and the matching sections at LHC P1 and P5 is still under study. At this stage, the general cooling principle retained is the same as for the arc current feed boxes in these points. For the feed boxes, the option exists to use a dedicated transfer line on surface level between the new refrigerator and the DFHX to cool the current leads – instead of using the link for transferring gas from the tunnel as done for the cold powering system at LHC P7.

A final cooling system will be elaborated in parallel with the work to be made for the definition of the new refrigerators and for the design of the DFA and DFH cryostats.

Arc feed box



Simplified scheme of a DFA box to
 replace DFBA next to Q7,
 + Many circuits RB, IPQ, correctors
 + Delicate interface with arc
 termination module to be looked at



Main messages

- For P1 & P5, a completely new cryogenic distribution system will be studied and implemented: the needs for the sc links will surely be part of the design and associated optimisation. The potential vertical part might need specific study (transient, stability)
- For P7, a cooling process compatible with existing constraints exists since spring'14, we would be ready to proceed with definition of piping & valve requirements