



HL-LHC

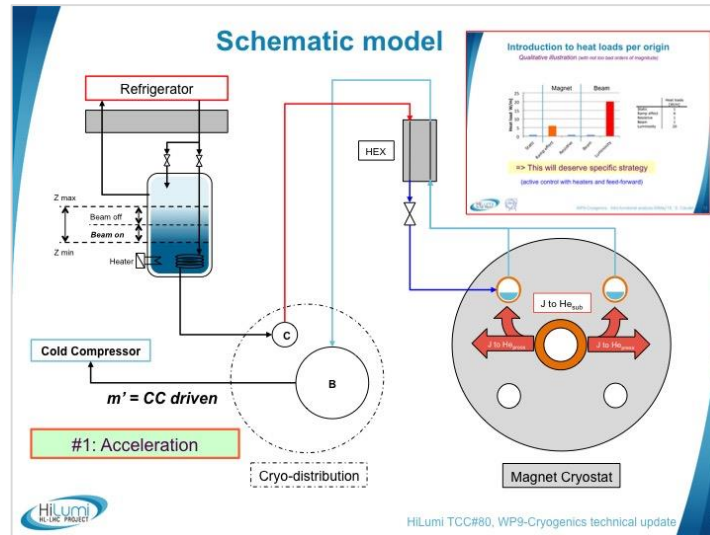
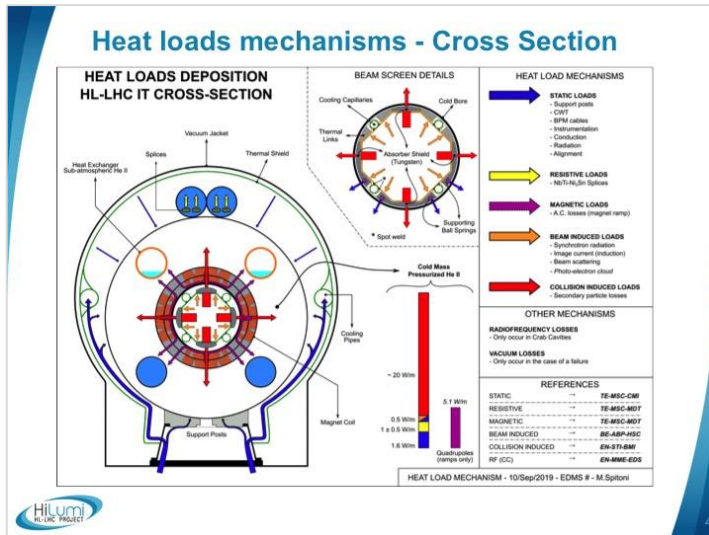
WP9 Cryogenics, Process studies, Coping with Peak Lumi (ramps)

S. Claudet, 24Mar'20

(HiLumi – follow up of [WP2_160th meeting](#) on 24Sept'19)



Introduction (recall) of context



Cryo parameters evolution when colliding

Limited impact of header B volume, Big impact of flow rate

DN 250 → service galleries
DN 200 → tunnel level

#1: Acceleration

DESIGN ESTIMATION	No pre-load on cold mass			50% pre-load on cold mass				
	Cryostat	Bayonet	Header B	Cryostat	Bayonet	Header B		
LHC Spec.	5 g/s/min	Max temperature [K]	2.01	1.96	4.98	1.9	1.87	4.44
		Max pressure [mbar]	1304	27.7	27.7	1307	20.8	20.8
		Min pressure [mbar]	1127	0.016	0.016	1224	0.016	0.016
LHC now	10 g/s/min	Max temperature [K]	1.91	1.88	4.51	1.87	1.84	4.24
		Max pressure [mbar]	1343	21.7	21.7	1306	18.6	18.6
		Min pressure [mbar]	1205	0.016	0.016	1255	0.016	0.016
Out of reach ...	15 g/s/min	Max temperature [K]	1.9	1.87	4.46	1.87	1.84	4.24
		Max pressure [mbar]	1384	21.1	21.1	1328	16.5	16.5
		Min pressure [mbar]	1213	0.02	0.016	1255	0.016	0.016

#2: Pre-load + active controls

Collision ramp-up time → secondary effect
Header B available volume → negligible effect

Minimum pre-load of 50% strongly recommended

Active controls required with pre-load (heating),
GHe heating more robust than electrical systems required,
And 5-10 min to reach peak luminosity appreciated!

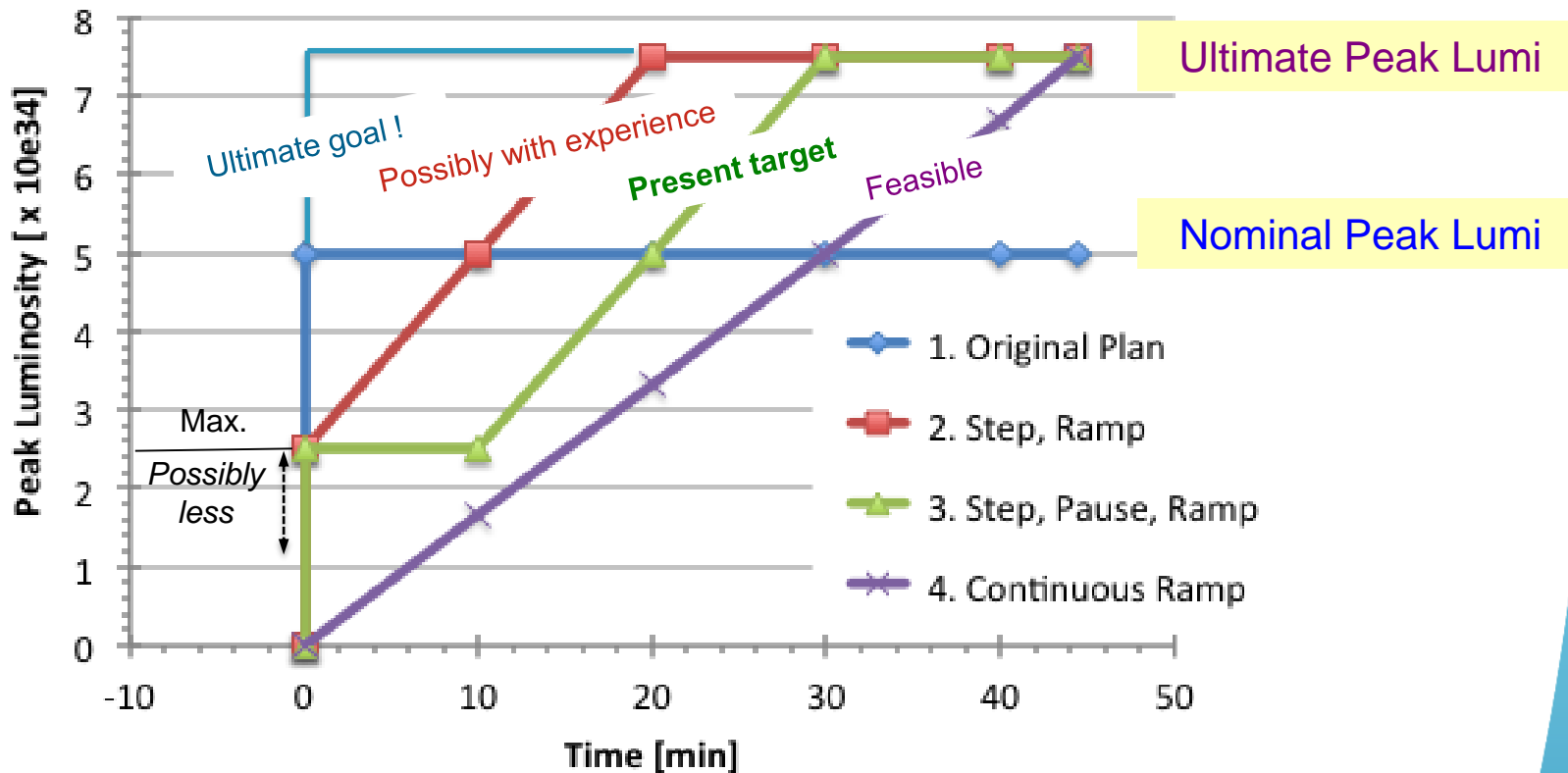
#3: Lumi ramp

HILumi TCC#80, WP9-Cryogenics technical update

- ### Strategy to manage transients
- Cold compressors acceleration (not much to expect by buffering effect) **Max. already reached**
 - Pre-load and active controls (in high TID area, test & developments ongoing) **Progress expected**
 - Ramp on Luminosity (1e34 within ~sec, 5-7.5e34 within ~10min) **Flexibility expected**
 - A mix of all that to start with, and tuning-optimisation will tell what is best, but "knobs" will be there for that
- Daniel Berkowitz (TE-CRG) - Heat Load Working Group

Luminosity scenarii considered by WP9-Cryo

Considered for Cold Compressors control and mass-flow adjustment capabilities



Rmk: Control/adjustment for beam dump feasible, with positive effect (reduction) of magnet temperature (while increase not acceptable at ramp-up)