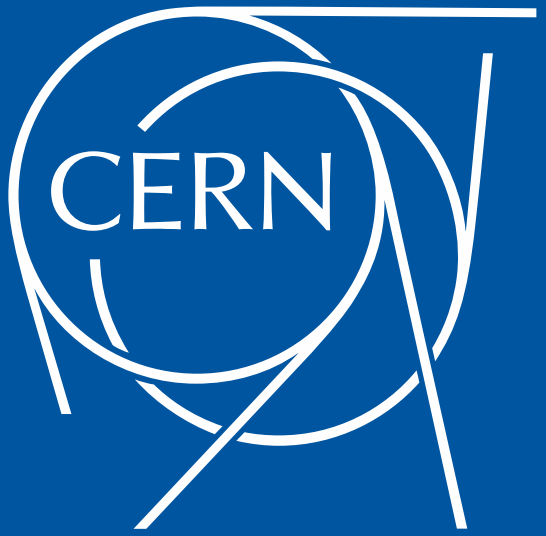

CERN

Proposal for intensity increase checklist

D.Wollmann, M. Zerlauth, J.Wenninger, et al

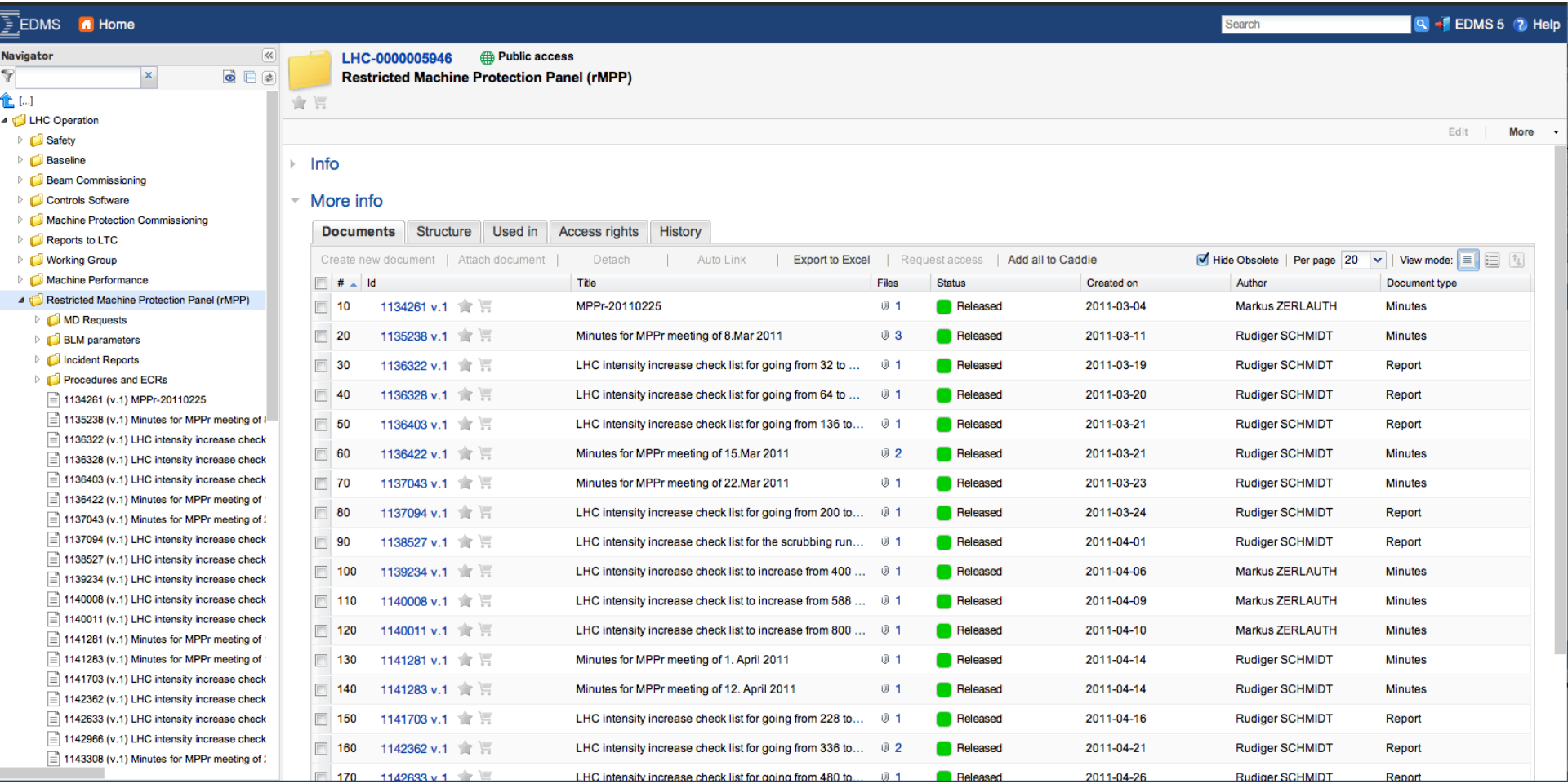
Proposal 2015… (but the machine will tell…)

- 50ns (~9 steps to 1380b)
  - 3 – 12 – 48 – 144 – 288 - 480 –768 –1092 – 1236 – 1380
- 25ns (~11 steps to 2800b)
  - 3 – 12 - 48 – 72 - 144 – 288 – 432 - 588 –1164 –1740 – 2316 - 2748
- Scrubbing run(s)
  - 3 – 48 – 72 - 144 – 288 – 400 – 600 – 800 – 1000,..
- Note:
  - (If aligned) Roman pots could be inserted during each 2nd fill at each intensity step, after 2-3 hours (as part of beam process + TCL6,…). If beams dumped due to RPs no further insertion until reason fully understood.
  - EXP would like to collect data with reduced pile-up ($0.01<\mu<1$) early on (without delaying ramp-up or giving in too much int luminosity)
    - Either with separated beams (beam stability, what separation allowed) or with low(er) intensity bunches during commissioning

Intensity increase check lists -Motivation

- **Check and document each fill** with intensities, dump reasons and stable beams time during the intensity increase.
- Systematically check and document **readiness** for next intensity step of **protection critical systems**/elements.
- **Detect non-conformities**.
- **Delay intensity increase** in case of issues in MP critical system **until resolved** or satisfactory understood.
- Proposal 2015: 9x for 50ns; 11x for 25ns, ~8-10x for scrubbing

Documentation in EDMS

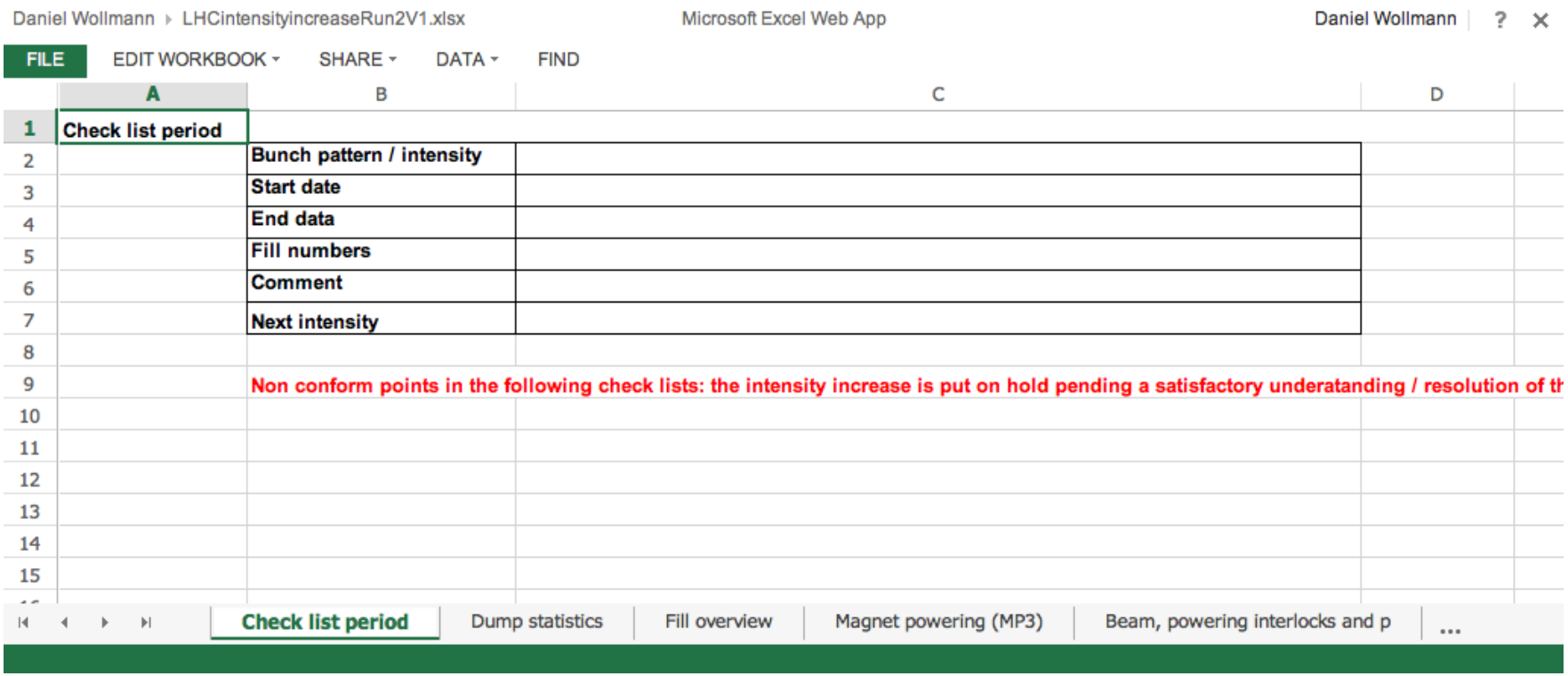


Systems / categories

- Magnet powering (MP3)
- Beam and powering interlocks, post mortem
- RF
- Beam instrumentation
- Collimation
- Operation, orbit and feedbacks
- Beam Dump
- Injection
- Heating of Equipment

Proposal for Run2

- Using OneDrive (sociel.cern.ch) excel sheets, to ease exchange and filling.
- Documentation in EDMS after finalizing.
- LHCintensityincreaseRun2V1.xlsx



Check list period

Bunch pattern / intensity	
Start date	
End data	
Fill numbers	
Comment	
Next intensity	

Non conform points in the following check lists: the intensity increase is put on hold pending a satisfactory underatanding / resolution of the issue

Dump statistics (from APEX or AFT?)

Dump caused by	# of dumps
Programmed dump (EOF)	
Fault of BPM IR6 (BPM IR6)	
Fault of LBDS (LBDS)	
Operator fault (OP)	
Controlles fault (CO)	
Orbit excursions (Orbit)	
Fault of Orbit feedback (FB1)	
Fault of Tune feedback (FB2)	
Beam losses (Beam loss)	
Fault of BPM system (BPM)	
Electrical network glitch (EL Net)	
Water fault (Water)	
Fault of BLM system (BLM)	
Fault of SIS (SIS)	
Machine Protection test (MPS test)	
Fault of Cryogenic system (Cryogenic)	
Fault of QPS (QPS)	
Fault of Collimation control (Coll Sys)	
Wrong collimator positions (Coll Ad)	
Fault of BCM (BCM)	
Experiments (EXP)	
Fault of vaccum system (VAC)	
Fault of BIS (BIC)	
Fault of PIC (PIC)	
Fault of FMCM (FMCM)	
Power converter fault (PC)	
RF fault (RF)	
Fault of access system (Access)	
Fault of tune kicker (MKQ)	
Transv. beam instability	
Long. beam instability	
Machine Development (MD)	
Fault of MKI or MKD (Inj./Extr. Kicker)	
UFO	
Magnet Quench	

Note: The dump cause indicates the system, which caused the dump due to a fault, not the first detection of the issue.

Fill overview (from APEX or AFT?)

Event Timestamp	Fill #	Intensity B1 [1e10]	Intensity B2 [1e10]	Stable Beams [hours]	Mps Expert Comment

Magnet Powering

No magnet quench after beam dump in RQ4.R/L6.
No unexplained quench or powering event in a circuit.
No problems with loss of QPS_OK for main circuits following injection process.
No unexplained firing of quench heaters.
No unexplained abort of the fills by magnet powering system.
No un-validated change to the magnet circuit protection system
No un-validated configuration change detected in the QPS configuration management system
No magnet quench due to too high BLM thresholds
In case of quench: dump first triggered by QPS and not by BLMs e.g. in IP7

Beam, powering interlocks and post mortem

No unexplained IPOC failure in Post Mortem for FMCM.
No unexplained IPOC failure in Post Mortem for PIC.
No unexplained IPOC failure in Post Mortem for BIC.
No unexplained false beam dump from any of the MPS systems.
No unexplained abort of the previous fills by FMCM.
No failure of BIS pre-operational check.
No unexplained PM event with intensities > 8 nominal bunches
No unexplained PM event above 450 GeV.
UFO occurrences.

RF

Check klystron forward power during ramp, all klystrons. Report peak demanded power for each.
Check transient beam loading compensation and corresponding klystron power in physics (previous fill). Set Point module acquisition. All cavities.
Check Temperature and Power levels in all HOMs during the previous intensity fills (Timber or RF application).

Old tasks (intensity ramp up for scrubbing) - tbc
Check Temperature and Power levels in all HOMs during the previous intensity fills (Timber)
Check main coupler positions, all cavities
Make sure that NO RAMPING is intended in the next intensity period
Check for noise in the Cavity Field (Timber)
Measure during last fill (SR4): Phase Noise PSD (all cavities) + HOM spectra
Check for instabilities using BQM (ripples) via Timber

Beam Instrumentation

BLM Internal sanity checks results must be true.
Rise time (10 to 90%) of fast losses must be larger then 200 us.
No unexplained BLM check failures.
BLM system modification (ECRs) have to be agreed on, EDMS: notified persons signature is needed.
No nonconformities in the energy transmission to the BLM crates.
BSRA functioning and abort gap population always properly monitored
Change of BLM thresholds
No un-explained glitches of the Setup Beam Flag (SBF)

Collimation

Valid set of betatron loss maps (hor/ver at Inj., flat top, squeezed separated, colliding) done in last 3 months (→ experience will show).
Valid set of off-momentum loss maps (pos./neg. at Inj., flat top, squeezed separated, colliding) done in last 3 months (→ experience will show).
Loss maps for re-qualification after technical stop did not show unexpected losses distributions.
No observation of abnormal cleaning efficiency.
No observation of abnormal passive protection.
Collimators at agreed positions during cycle.
Correct LSA positions, thresholds, limits, warning levels.
Orbit monitoring at TCSPs and TCTPs operational, no unexplained offset changes observed.
No unexplained beam dumps due to collimators.
No beam dumps from collimator temperatures.
XRPs at agreed positions during cycle.
XRPs: Correct LSA positions, thresholds, limits, warning levels.
No unexplained beam dumps due to XRPs.

List of disabled/faulty sensors and masked channels

Operation, orbit, feedbacks

OFB operational status
QFB operational status
Global orbit in tolerance in stable beams (< 0.2 mm rms)
Orbit IR3/IR7 collimators within ± 0.2 mm in stable beams
Orbit at TCTs in tolerance in stable beams (≤ 1 sigma in IR1/5, ≤ 3 sigma in IR2/8)

Old tasks intensity ramp up for scrubbing 2011
Global orbit in tolerance at 450 GeV (< 0.2 mm rms)
Orbit IR3/IR7 collimators within ± 0.2 mm at 450 GeV

Beam dump

Asynchronous dumps understood? Protection worked correctly?
Parasitic asynchronous dump data show no loss of protection.
BPM IP6 (interlock BPM) during first beam with higher intensity and different bunch pattern.
No positioning errors on TCSG/TCDQ.
No settings or thresholds mistakes/wrong sequences/unexplained faults on TCSG/TCDQ.
Loss leakage to TCTs below 0.5% of losses at TCDQ during beam dumps.
No unexplained MKD, MKB kicker, TSU or BETS faults.
No potentially dangerous XPOC or IPOC failure on MKD or MKB.
No unexplained synchronization problem with TSU.
Pressure and temperature rise in TDE block within tolerances.
Requalification passed OK at 450 GeV and 6.5 TeV with pilot in case of any important component exchange.
Simulated asynchronous beam dumps by operator OK

Injection

Injection protection devices at agreed positions during cycle.
Correct LSA positions, thresholds, limits, warning levels.
Injection oscillations within tolerance for all injections.
No unexplained large beam loss on TCDIs.
Expected losses for the beam to be injected at least 30 % below threshold level.
Line has been re-steered successfully if losses have been to high.
No issues in injection procedure, settings or tolerances.
Orbit in injection region in tolerance wrt reference (tolerance <0.5 mm).
Resetting of TL trajectories, TCDIs and optics done when needed.
No increased rate of MKI flashovers.
No increased rate of MKI switch erratics or missing.
No unexplained MKI vacuum or temperature activity.
No machine-protection related injection system hardware failures.

Equipment heating

Heating of ALFA
Heating of BSRT
Heating of Collimators (TCP, TCS, TCTP, TCDQ, TCL)
Heating of BGV
Heating of MKI
Heating of TDI
Heating of beam screen
Heating of ALICE beam pipe (after TS1)
Heating of TOTEM and neighbouring vacuum
Heating of LHCb VELO
No unexplained heating of other equipment observed.
Variation of bunch length within the usual range.
Variation of beam spectrum within the usual range.
No additional non-conformities in vacuum observed (RF-fingers, etc.)

Summary / status

- Check lists will be run through rMPP before every increase in intensity.
- Assure readiness of all protection relevant systems for next intensity step.
- First iteration of check list content with system experts nearly finished → **RF expert** missing.