Intensity increase criteria - general

- Max. increase factor:
  - Up to 0.25 MJ : typical factor ~2, max 4
  - Up to 1-2MJ : max. factor ~2
  - Above 1-2 MJ: no more than ~2 MJ a step
- Green light for intensity increase:
  - Minimum time ~10 days – time to look at the data (and generate problems).
  - At least 10 fills / dumps – no anomaly in the PM (all 10 dumps analyzed).
    - **Exception**: we should spend a longer period (at least 3-4 weeks) with intensities in the 1-2 MJ range. Could be done in 2 different configurations (43, trains..).
  - Beam cleaning adequate and no quenches, losses under control.
    - Highest observed losses scaled by intensity increase should be << BLM thresholds (<< to be defined, factor 2?). Essential also for efficiency !
    - BLM saturation in warm regions.
  - Abort gap population under control.
    - No Q4 quenches, BLM patterns reasonable.
  - Formal “review” to approve each step (document that conditions are met).

Intensity increase – special criteria

In addition to the general criteria.

- Stability criteria [to be in place to go > 0.25 MJ (proposal)]:
  - Optics must be reproducible.
    - How to check:
      - Beam cleaning, collimator alignment & loss patterns
      - End-of-fill Qkicker measurements – not enough accuracy?
      - Insert special low intensity diagnostics fills – see also collimation (later).
  - Orbit must be stabilized to ~0.5 sigma - injection, ramp, squeeze, stable b.
- Beam intensity criteria:
  - Significant changes in bunch charge and bunch spacing should be associated to SMALL intensity factors (2 absolute max), respectively equivalent intensity.
    - Beam-beam and instabilities could drive fast(er) losses, lower lifetimes and larger loss rates for higher charges.
  - Individual bunches to trains: significantly higher densities (e.g asynchronous dumps) – review situation (mostly kicker failure prot.).

Intensity increase - general

- Tests / verifications after intensity increase:
  - Diagnostics operational (BLMs, BPMs, BCTs, BSRT/A).
    - Sounds trivial but…
      - Watch the step from individual bunches to trains.
      - BPM sensitivity switch above ~5E10.
  - Beam cleaning adequate (understand all issues, e.g. IR6 x20 factor, …)
  - Test beam dump at injection
- Special MPS tests:
  - Injection protection fully deployed and tested for 5E11-1E12 injected intensity.
  - As specified in procedures
    - To be collected and grouped according to the steps that we will foresee.

Collimation: Required Beam Time

Test	Frequency	Time required
Measure cleaning efficiency for x, y, momentum losses at injection energy	every 3 days	4 h
Measure halo population & cleaning efficiency for x losses at top energy	every 3 days	1 h end of fill or special fill
Measure halo population & cleaning efficiency for y losses at top energy	every 3 days	1 h end of fill or special fill
Measure halo population & cleaning efficiency for momentum losses at top energy	every 3 days	1 h end of fill or special fill
Setup collimation at injection	tbd	12 h
Setup collimation at top energy	tbd	24 h
High power load tests	every intensity step	1 fill

+ optics measurements

Beam tests

- Fast increase of intensity implies limited learning (from errors and ‘natural’ failures) at low intensity. We may want to trigger more failures than anticipated (procedures).
  - Collimation tests (prev. slide from Ralph) may provide precious input.
- Proposal: use ‘end-of-fill’ (EoF) with limited risk beams (100 kJ?? Depends a lot on how much confidence we in the MPS at the time).
  - Perform as many MPS beam tests at EoF. Evaluate risk to define when it can be done (max. intensity).
    - Make more test than specified to debug as much as possible.
    - Force faults to gain experience – check risk.

Commitment

- We can dictate strict rules, but we must also provide the resources to do our job and follow the rules:
  - Continuous MP performance analysis.
  - Review + documentation for intensity increase.
  - …

  >> Cannot stop because an essential person is away.

  Organization…

1 fm-1

- Since Chamonix the 1 fm-1 target for end 2011 is circulating…
- Performance models (Massi, Ralph, Roger,,,) show that to reach such an integrated Lumi, we must run flat out at L=2E32 cm-2s-1 in 2011.
  - Corollary: we must reach 2E32 cm-2s-1 by the end of 2010.
  - Beam requirements: Ib = 8E10 p, Nb ~700 bunches, ~35 MJ.

YAM

- Simple model (see last week).
- Assumptions:
  - 2 weeks between energy steps = 10 days + margin for MD, access, …
  - Follow rules for intensity increase (slide 1).
  - Move to 8E10 p/bunch ‘asap’: in this case when starting with trains.
  - To respect ~2 MJ/step, max 48 bunches of 8E10 per step (2.1 MJ).
    - May not be possible to respect 4 fold filling symmetry since this implies trains of 12 bunches or unequal length trains (not nice for beam-beam). Unless long-range is less of an issue…
- Running time 2010:
  - Max 7 months = ~32 weeks between April and end October.

Progression

- After 32 weeks: ~1E32 cm-2s-1, 12 MJ.