Operational Procedures for Abort Gap Cleaning

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Thanks to:
W.Bartmann, C.Bracco, E.Gianfelice, B.Goddard, W.Höfle, V.Kain, M.Meddahi, D.Valuch

Abort Gap Cleaning at 3.5 TeV / 4.0 TeV

- No changes for energies below collision energy
  - Abort gap cleaning always on at injection
  - Abort gap cleaning not needed on the ramp
- Proposal to be applied to proton running, from start-up 2012 onwards
- Cleaning ideally left on all the time, but this costs us a few percent in luminosity, so only switch on when required
  - Might be better in the future after improvements of the transverse damper hardware, mainly in LS1
- Cleaning always to be applied simultaneously to both beams
  - Avoid any confusion
  - Abort gap population of the two beams are often correlated, for some non understood reason…
- Relies on application to better monitor Abort Gap Population (fixed display) and more easily enable / disable cleaning or change cleaning strength
  - Delphine, GHH, Verena
- If AGC switched on with too large abort gap population, order of 1e12, the losses on the TCP collimators risk to dump the beam at the worst moment
- Tried to keep procedures simple, to avoid confusion

BSRA protons, few days in October

Clean at 3.5 TeV

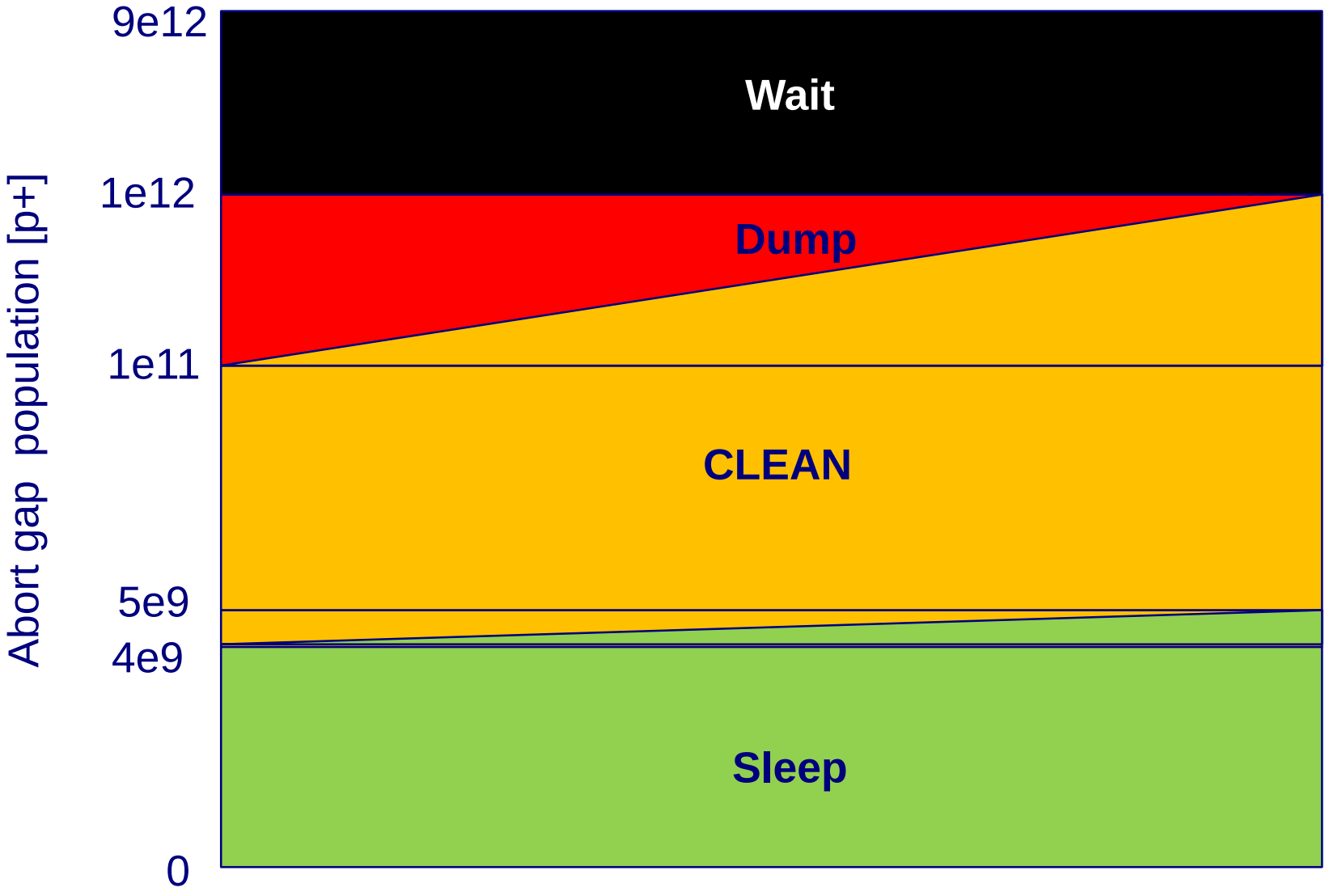
Very few occasions with AG population > 1e10

1 day

Proposal

- I_{ag} > 5e9 p+
  - LHC announcer to ask for abort gap cleaning to be activated, similar to request of lumi optimisation for experiments
  - Based on 2011 experience this would be a few times per month
  - The operator needs to check abort gap population over last hour (fixed display on application) and see if it can be trusted (see next slide). If so:
    - Switch on cleaning at 50 % of nominal strength, long cleaning pulse (2.5 μs)
    - During a few minutes, check BLM losses around the ring, should stay below 25 % of dump level
    - If ok, switch on cleaning at 100 % nominal strength
    - The cleaning should never be switched on when population > 1e12 p+
- I_{ag} < 4e9 p+
  - Switch cleaning off
- I_{ag} > 1e11 p+ AND I_{ag} < 1e12 p+
  - Manually dump the beams
- I_{ag} > 1e12 p+
  - Logically one should never arrive here
  - Don’t touch. Wait for decay below 1e12 p+ and dump the beams (max population is 3000/50 * 1.5e11 = 9e12 p+)

Summary of procedures



Can you trust the BSRA readings?

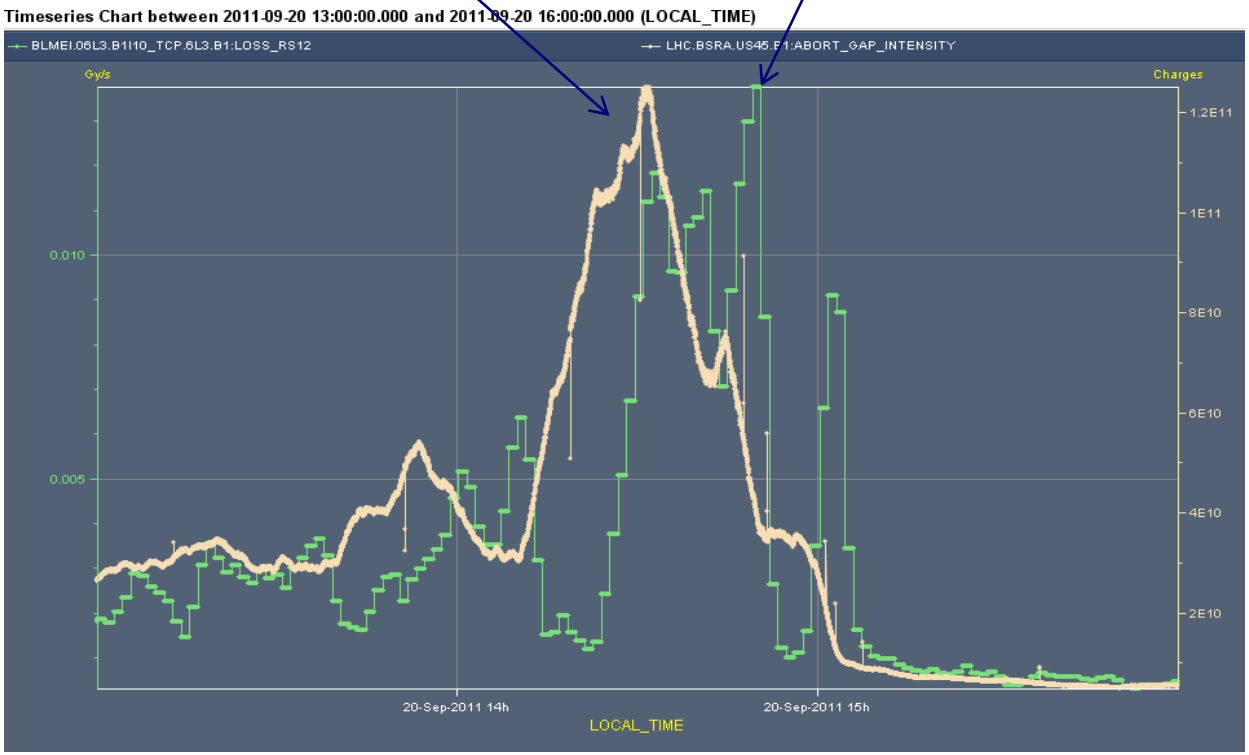
- Check the “is valid flag” of the BSRA
  - Should be in application to be written
- Check that there are no huge jumps or sudden ‘unphysical’ changes
- If population is important, should see this as an increment of IP3 losses
  - Don’t dump above 1e11 if IP3 losses have not been going up as well
  - Put IP3 and IP7 BLMs also in the application’s fixed display

Questions already asked (Wolfgang, Markus)

- Question 1:
  - Markus:
    - If we arrive at >1e12 this very likely means that the gap population for some reason is continuously increasing and that we missed the announcements/dump occasions, so maybe the increase is outweighing the natural cleaning. Should we maybe think of a very cautiously increased cleaning, e.g. start with few % cleaning strength and increase it slowly as a function of losses seen?
  - Jan:
    - More than 1e12 is very unlikely and the RF or BLM losses will probably already have dumped us
    - Cleaning above 1e12 population is likely to dump the beam on losses in IP7, so don't increase or start cleaning: play with fire
    - All experience so far has shown a 'wave behaviour' in abort gap population, so better dump on a low.
- Question 2:
  - Markus:
    - Should we clean every 15 or 30 min for about 2 minutes
  - Jan:
    - Important abort gap population seems to come in 'waves' and in a few minutes
    - It is good to keep an awareness on population = RF performance and train what to do if population suddenly goes up

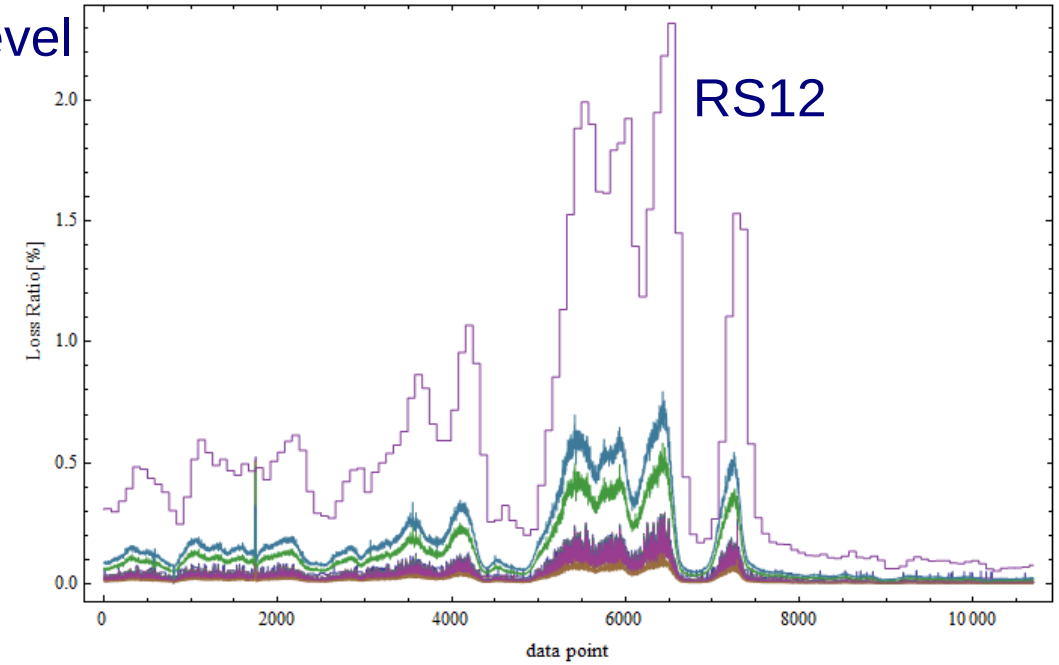
Check on IP3 losses, no cleaning

- Worst population seen during 2011:
  - 1.2e11 p+ in AG on B1
  - BLMs at IP3 on RS12 (83 seconds) reached 2.3 % of dump threshold
  - Also checked B2: OK
- Also considering different occasions and extrapolation: abort gap population of 1e11 p+ leads to max 10 % of BLM limits in IP3

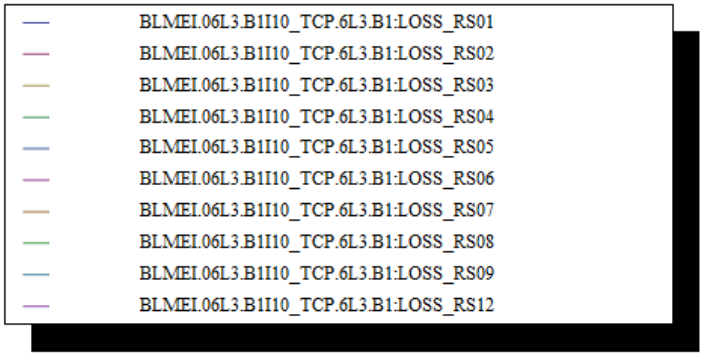


Losses at IP3 [% dump threshold]

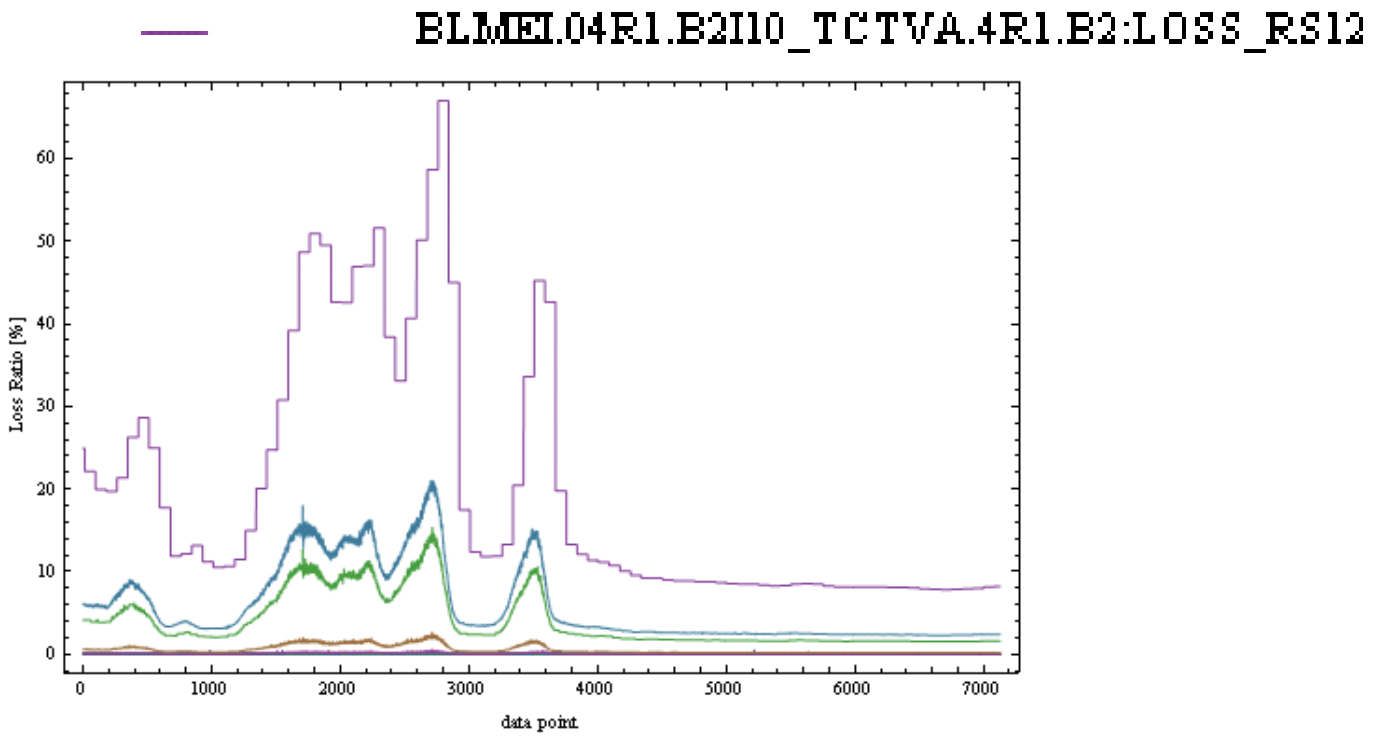
Loss % dump level

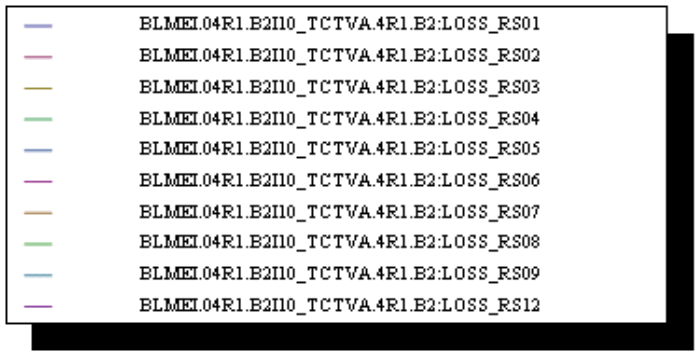


Time



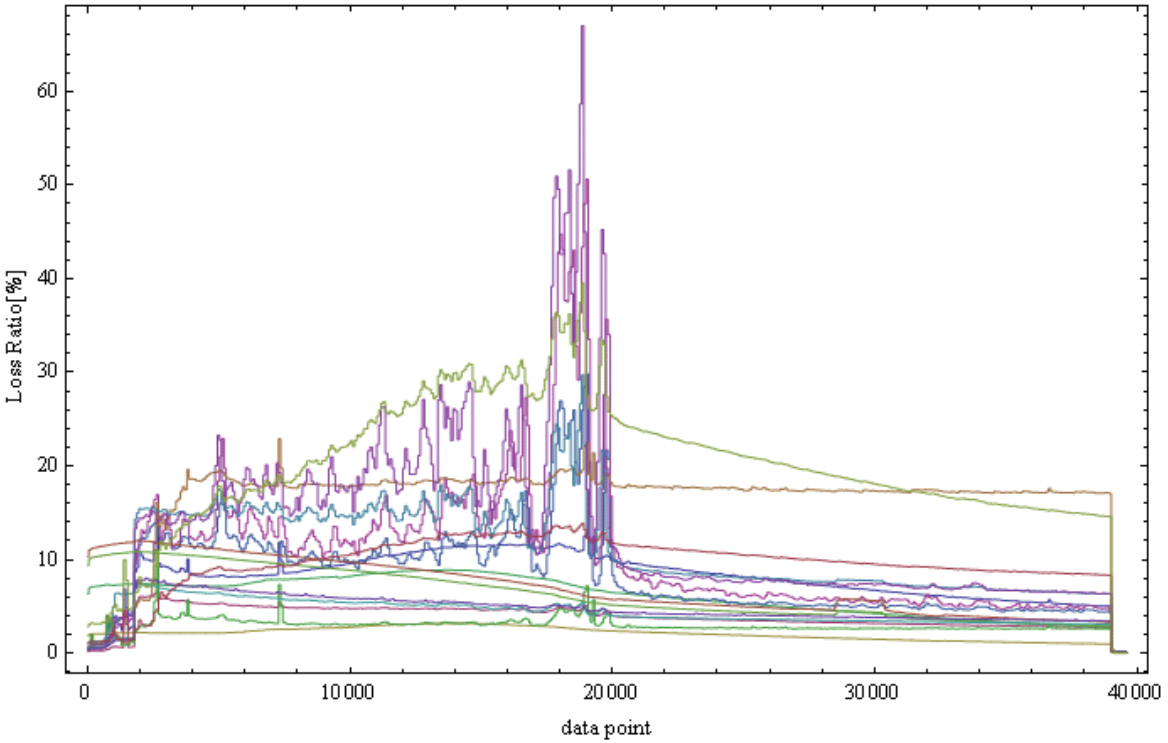
Most limiting TCT during that period

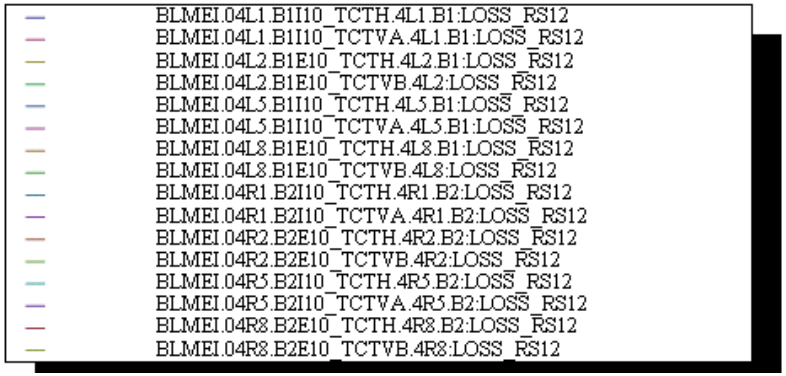




Plot for all the different running sums

All TCTs over that period





Plot for RS12 only

Future developments

- Dedicated application for 2012 start-up (Delphine, GHH, Verena)
  - Shows fixed display of population from BSRA
    - Take into account BSRA validation flag
  - Show losses BLMs IP3, IP7 and possibly also TCTs
  - Facilitate changing of cleaning parameters, can possibly automatically be adjusted depending on AGC measurement
    - Cleaning length and amplitude
- Still need something else to alert the operator besides
  - Announcer
  - Cleaning application
- If the BSRA is that important ask BI for
  - A more reliable BSRA system
  - Similar, but redundant BSRA system
  - Can then start cleaning automatically or dump when required
- Hardware on ADT side (see first slide)
- Tests with stronger cleaning over a shorter period