BDS Pulsed Magnets RDR Completeness

Thomas Mattison
University of British Columbia

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Abort Kicker Technical

- **Purpose: collimator protection, rate-limiting**
- **Parameters from ebds0_2006e_parts.xls, 250 GeV**
  - 131 Gauss, 20 mm high, 9x2 m long
- **Design logic**
  - Field+dimensions+fudges give stored energy
  - Risetime-->power-->pulser-count, which dominates cost
- **My assumptions**
  - 20 mm wide, 100 ns magnet fill time
  - Vacuum striplines, external matching caps+termination
  - HV coax cable connections to pulsers
  - Pulsers “like” linac modulators (13 MW for 1 ms, 5 Hz)

Abort Kicker Costs

- **$XXXk for 13 MW 1 ms 5 Hz pulser unit**
  - From early publicly-available main linac estimates
  - Seems sane for big lab-built box of high-power stuff
  - Just to set scale, unlikely to really use ML modulators
- **2 units per side**
  - 33% more power than needed
- **$XXk per 2-m stripline-pair + $Xk stand x 9 units**
- **Triangular, +100% –50%.**
  - Won't be more certain until real engineering
- **$XX.Xk/side EDIA (mag tech sys internal calc)**
  - Only covers "routine" hours, not development!

Abort Kicker Concerns

- **Check that beam anywhere in aperture with any parms is cleanly aborted**
- **Combination of fast rise and long pulse is unusual**
  - Possibly costs much more than estimate
  - Possible savings from advanced pulse+sustainer design
- **Needs ~man-years of engineering development**
  - Not in project budget, not clear if anyone will volunteer
- **Tradeoff between kicker+drift length and pulser-cost**
  - Longer = less power, but more tunnel+vacuum cost
  - Present design is sane but not optimized
- **RDR text assumes gated-DC mode also available**
  - Not added to cost, but probably less than the errors

Abort Septum Technical

- **Bends kicked beam into separate extraction beamline**
- **Parameters from ebds0_2006e_parts.xls**
  - Thin: 4.1 kG, 10 mm blade, 30 mm high, 2x2 m long
  - Thick: 9.6 kG, 20 mm blade, 30 mm high, 1x2 m long
- **Design logic**
  - Current density limited by cooling issues
  - Field --> thickness
  - Temp rise, pressure drop require parallel water flow
- **My assumptions**
  - DC copper “current sheet” + iron flux return
  - 5mm square Cu conductor with 3mm water passages
  - Plumbing nightmare at the ends

Abort Septum Costs

- **$XXk per magnet+coil + $Xk stand**
  - Same fairly conventional iron for 3 types include RTML
  - Two fairly conventional coil types + 1 for RTML
  - Low production volume (share design across ILC!)
  - Special cooling, interlock, coil position, mag-msr issues
- **Two thin, one thick per side**
- **Triangular, +40% –40%**
- **$XXk x 2 power supplies per side**
  - About 1000A if 5mm square conductor, 2&4 layers
  - Thins are in series
  - Thick is not in series but runs at almost same current
- **$XXk/side EDIA**

Dump Sweeper Technical

- **Sweeps train in 30 mm radius circle on dump to avoid boiling a hole through the water**
- **Parameters from M. Woodley, somewhat piecemeal**
  - Small: 560 G, 110 mm diam, (5x+5y) x 1 m long
  - Large: 560 G, 240 mm diam, (5x+5y) x 1 m long
- **Design logic**
  - Moliere radius --> 30mm, +distance --> angle --> kG-m
  - Mishaps or disruption --> aperture
- **My assumptions**
  - Ceramic beam pipe, ferrite flux return, air-cooled coil
  - Cap bank, switch, flyback diode
  - 1 ms period bipolar sine pulses, 90° diff between x,y

Dump Sweeper Costs

- **$XXk per large aperture magnet + $Xk stand**
  - 40 mm thick ferrite flux return for 340 mm diam, 690 G
  - $X/cc for ferrite, $XXk for ceramic beam pipe
  - Did not adjust cost (downward!) for present parms
- **$Xk per large sweeper for power supply**
  - Scaling $/J of ML modulators, also $/J of caps + switch
- **$XXk per unit for small aperture magnet + $Xk stand**
  - Large magnet scaled down by a factor of 4
- **$Xk per small sweeper for power supply**
  - Large power supply scaled down by 2
- **Triangular +100% –50%**
- **$XXk/side EDIA**

Dump Sweeper Concerns

- **I have no experience with this kind of device**
  - I'm least confident in my relative errors here
- **Not sure I fully understand/agree-with present parms**
- **Didn't re-estimate (even scale) for present parms**
- **Ferrite and ceramic pipe is expensive**
  - Should consider copper-coil-in-vacuum magnet design

Odds and Ends

- **No big technical concerns in BDS (unlike DR kickers!)**
  - BDS was great about listening, and adjusting optics to avoid making my job (too) hard
- **It's timely to do consistency checks to flesh out RDR**
  - Note co-authored by optics, vacuum, magnets (me)?
- **Kickers, septa, and sweepers are not "commodities"**
  - Costs inherently less certain than most other systems
  - Won't be more certain until more engineering gets done
- **There are significant cost tradeoffs with tunnel-length**
  - What is the forum for deciding such things?