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# *Summary of Findings of the LER Inquisitional Tribunal*

***(or; How to be slow-roasted but still get a free dinner)***

***(a.k.a. the official LER Workshop)***

***CERN 10.11.06***

John Johnstone

# Participants & Presentations

1. Welcome & Introduction to LER —Lucio Rossi (CERN)
2. Basic Layout of LER —Gijs de Rijk (CERN)
3. Major LER Components —Henryk Piekarz
4. LER & Beamline Lattice Design —John Johnstone
5. Power Supplies for Arc & Fast SwitchingTransfer Magnets —Steve Hays
6. Cryogenics for Arc & Transfer Magnets —Yuenian Huang
7. LER AP Issues ( I): Beam Impedance & Instabilities —Vladimir Shiltsev
8. LER AP Issues (II): Coalescing, Field Quality & Dynamic Aperture,Correction Systems, Emittance —Tanaji Sen
9. Detector Safety Systems with LER—Henryk Piekarz

10. Guided 'Discussion' —A Cast of Thousands (CERN)
11. Conclusion — CERN

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# Rossi

1. CARE (Co-ordinated Accelerator Research in Europe) report identified 5 critical study and R&D test, including;
   - a) pulsed magnets for an SPS upgrade, and;
   - b) magnets for a LE Ring in the LHC tunnel.

   Rossi claims we have learned that the LHC magnets have large multipoles at injection which limits intensity due to the 20 minutes of fill time and, also, the SPS is intensity-limited. Problems would go away with higher injection energy and faster fill time (< 1 sec).

   History of the 'pipetron' magnets was presented since the VLHC days & their application for a 1.5 TeV LHC injector.

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# De Rijk / Piekarz

2. LER would accelerate 0.45 TeV protons from the SPS to 1.5 Tev & transfer both beams simultaneously to LHC in a single turn.

   In the LHC tunnel the tiny LER magnets fit above the LHC at an altitude of 1.35 m.

   The LHC & LER would share beampipes through the high intensity detectors at IR1 & IR5.

3. Detailed presentation of the transmission-line arc magnet parameters & design of the fast transfer line magnets.

# Johnstone / Hays / Huang

4. Lattice solution for the arcs replicating the LHC optics. Also, design of transfer lines at IR1 & IR5 for transfering beams achromatically through the detectors using fast, pulsed vertical dipoles.

5. Detailed design of a 100 kA pulsed kicker-style supply & inductor to pulse DC current off in < 3 μsec.

6. Helium inventory for LER Ring = 0.5 L/m

   Helium inventory for switching magnets = 0.24 L/m.

   ⇒ this small amount (@ 4.6K) can be tapped off the large LHC cryogenics inventory - no one will notice the theft. No problems.

# Shiltsev

7. Comparison of TMCI, Space-charge, AC tuneshift, and e-cloud in LER with SPS, VLHC & Tevatron.

| | LER | SPS | TeV | VLHC |
|---|---|---|---|---|
| TMCI e9 $N_{thr}/N_{nom}$ | 770/115 | 260/115 | 1500/300 | 28/25 |
| Space-charge dQ | 0.0002 | 0.05 | 0.001 | 0 |
| Res Wall $N_{turns}$ | ~50 | ~70 | 1800 | 1 |
| AC tune e-3 max/comp | 24/2 | 3 | 0.4 | 200/20 |
| E-cloud wrt SPS | ~1 | 1 | 0.12 | 0.3 |

LER stability falls somewhere between the Tevatron (not much of a problem) and VLHC (lots & lots of trouble).

# Sen / Piekarz

8. Preliminary results of slip-stacking simulations to increase bunch intensity by x2.

   Capture RF voltage ~16-22 MV, precluding use of the LHC RF (12 MV).

9. Sketched program for beam abort into distributed dumps around the ring in the event of catastrophic failure.

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# ‘Discussion’

10. LER ‘gain’ arguments are weak - rebuilding the SPS addresses all of these same issues:

    a) higher energy injection and higher intensity;

    b) same amount of LHC downtime to install new magnets as presented in the case for the LER;

    c) the SPS provides a single critical ‘pilot’ bunch for tuning LHC prior to filling with 2808 batches - something the LER is incapable of providing with single turn injection;

    d) there is no physics argument to support constructing the LER - it only enhances the performance of another machine — the SPS upgrade enables a new neutrino physics program, and;

    e) two rings in one tunnel is a bad idea.

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# *Tribunal Conclusions*

11. "You have a solution looking for a problem."
We're not interested.

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