Laser Safety Review Preparations

FEBRUARY 29th at 9 h @ CERN, BUILDING 40, Room 4- C01

(this is a one day meeting)

The safety aspects of the following 4 LASER sytems will be reviewed:

1) Laser Front End Links M. Pearce

2) Inner Detector(SCT) alignment lasers D.F.Howell

3) Tile Detector calibration system F. Vazeille

4) Muon Detector alignment system C. Guyot (tbc)

The reviewers will be the following 4 experts:

- M. Hoefert Cern/TIS

- G. Roubaud Cern/TIS

- W. Weingarten Cern/TIS

- J. O'Hagan NRPB/UK (National Radiological Protection Board)

Mark Pearce - KTH Stockholm -

pearce@particle.kth.se

Documentation

http://www.cern.ch/Atlas/GROUPS/FRONTEND/links/install/laser_safety

- Introduction to ATLAS Systems Safety Review (ASSR)
- Guidelines for writing ASSR reports:
  - Description of systems concerned
  - Description of identified hazards
  - Risk elimination or mitigation during the design phase
  - Risk mitigating actions and safety measures
  - Residual hazards and risks
- Working document on Laser Safety in ATLAS / V1.1 (6th February 2000)
  - SCT + LArg used as prototype systems
  - Other systems not expected to raise significant new safety issues

No longer a draft!

Mark Pearce - KTH Stockholm -

pearce@particle.kth.se

Working Document on Laser Safety

- VCSEL-based links operating with MM fibres at 850nm
- Document based on recommendations laid out in:
  - IEC 825-1 : ‘self-contained laser products’ (TIS note 22 uses this)
  - IEC 825-2 : ‘Extension to cover optical fibres’
- Strategy:
  - Identify and classify (1, 2, 3A, k x 3A and 3B) potential hazards
  - Implement appropriate control measures to prevent or reduce exposure to acceptable levels
- Laser classification = f(λ, emission time, emission angle, radiated power)
- Off the shelf links are *often* CLASS 1 - no additional measures required for use
- No CLASS 2 ratings as VCSELs emit invisible light
- No CLASS 4 ratings as all output powers < 500mW for FE-Links
- CLASSes 3A, k x 3A and 3B apply [k x 3A extends 3A into 3B for fibre optic systems]

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Laser Classifications

- ‘Simple’ rules for single fibres and connectors outlined in IEC documentation
- Fibre ribbons are more complicated:
    - Broken ribbon can be treated as bundle of randomly pointing fibres. Radiation field is **not** additive.
    - **BUT** … if ends are cleaved and polished (ie: MT connector) then radiation fields **are** additive, ie: lower power per fibre is tolerated for a given hazard level.
- Working assumptions:
    - **SCT:** Typical Fibre Coupled Power (FCP) = 300 - 500µW **/** Max FCP = 2mW
    - **LArg:** Max output power = 3mW / Max FCP = 2mW
    - NA (min) = 0.18

MUST BE FAIL-SAFE !

- So:
    - **Single fibres**: <2.2mW per fibre for 3A / <6.6 mW per fibre for k x 3A, so: **k x 3A**
    - **MT**: <0.18mW per fibre for 3A / <0.55mW per fibre for k x 3A, so: **3B**

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Actions Arising from Classifications

- Safety requirements depend on location of equipment:
  - ‘Controlled access’ - Cable ducts etc.
  - ‘Restricted access’ - Industrial / commercial premises
  - Unrestricted access’ - Domestic
- ATLAS has ‘Restricted access’ : so, **systems must be 1, 2, 3A or k x 3A**
- If < k x 3A, mechanical protection, labelling and good engineering practices suffice
- **If 3B systems exist, must reduce exposure levels to k x 3A or less**
- Normally one can simply totally enclose affected parts BUT must account for test and maintenance periods - there will be many in ATLAS
- IEC requires:
  - Automatic Power Reduction (APR)
  - Extra mechanical protection
  - Special tools to demate connectors

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pearce@particle.kth.se

Proposed Measures

- Vast majority of fibres are < k x 3A, so:
  - Mark to distinguish from other services
  - Mechanical protection to IEC-794-2
  - Connectors >3A labelled (if not enclosed) and require special tool to demate
  - NB: No sense fibre needed for 96-fibre cable!
- MT-12 based patch panels (on and off-detector) - need to reduce to < k x 3A:
  - Totally enclose patch panels (labelled / robust / tool to open / warning lights)
  - Shuttered MT connectors could be OK - need to verify.
  - Otherwise: fail-safe hard wired interlocks to turn off VCSELs if MT-12's are exposed (definitely needed for SCT, as shutters impractical)
  - Need to be radiation tolerant / fit into detector grounding rules or be optical (eye-safe!) / shouldn't go through DCS etc.

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pearce@particle.kth.se