

ATLAS Systems Safety Review

SCT Laser Safety Report

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1 Purpose

The purpose of this document is to describe the control measures proposed to ensure compliance with the IEC laser safety standards ¹ and the local CERN laser safety rules ².

2 Scope

This document covers all of the laser and optical fibre systems that will be incorporated into the SCT. It should be read in conjunction with the “Working Document on Laser Safety for ATLAS; Version 2.10, dated 27th February 2000”. This is currently available at the following web address: http://www.cern.ch/Atlas/GROUPS/FRONTEND/links/install/laser_safety

3 Description of the SCT Laser Sub-systems

There will be two separate SCT sub-systems containing lasers;

- Front-End Data Links
- Frequency Scanned Interferometry (FSI) Alignment System

These sub-systems are fully described in Sections 2.1 and 2.2 of the Working Document referred to above. Further details of the front-end links can be found in the following documents;

‘ATLAS Front-end Read-out Link Requirements’; J.D.Dowell and M.Pearce; ATLAS-ELEC-001 (July 1998). This document is currently available at the following web address: <http://preprints.cern.ch/cgi-bin/setlink?base=atlnot&categ=Note&id=elec-98-001>

‘Development of Radiation –hard VCSEL/PIN-diode Optical Links for the ATLAS SCT’; D.G. Charlton *et al.*; presented at the 4th workshop on LHC Electronics, Rome, September 1998. This document is currently available at the following web address: http://www-pnp.physics.ox.ac.uk/~weidberg/LEB98_weidberg.ps

‘Fibre routing for SCT Optical Links’; J. Troska. This document is in preparation, but is currently available at the following web address: http://www-pnp.physics.ox.ac.uk/~weidberg/fibre_routing.pdf

The vast majority of the fibre routing information in the latter will also apply to the SCT alignment system.

4 Identification of Laser Hazards

4.1 Hazards and risks for persons

The following laser hazards have been identified and classified in accordance with the requirements and procedures described in IEC 825-1 and 2.

- *Eye Hazards;*
 - Optical fibre transmission and communication systems – hazard level 3B or less
 - Class 4 laser systems

- *Skin Hazards;*
 - Class 4 laser systems

A full discussion of the classification process is included in Sections 3, 4.1, 4.2 and Appendix D of the Working Document referred to above.

4.2 Hazards and risks for the system or equipment

None identified.

4.3 Hazards and risks for the surrounding systems

None identified.

5 Risk Elimination and Mitigation During the Design Phase

Engineering control measures have been proposed in the design phase, based on the full implementation of IEC 825-1 and 2, wherever practicable. These are described in detail in Sections 6.1 and 6.2 of the Working Document on Laser Safety for ATLAS.

The lowest possible laser powers will be used, consistent with performance requirements. Systems will be totally enclosed wherever practicable.

The vast majority of the fibre optical installation will come under hazard levels 3A and k x 3A. This will include all of the optical fibres linking the SCT detector in UX-15 to the associated equipment in USA-15. Besides mechanical protection, labelling and normal good engineering practice, no special precautions will be required for this part of the installation.

The main exceptions to this will be the insides of the on-detector patch panels and ROD/FSI racks, where ribbon fibre MT connectors will be used, and the small number of power delivery fibres for the alignment system. These parts of the fibre installation will fall into hazard level 3B. More stringent control measures will be implemented to eliminate the possibility of accidental exposure to laser radiation in excess of the accessible emission limit (AEL) for class 3A. This will be achieved by the use of fail-safe, automatic power reduction (APR) systems for the patch panels and crates, combined with additional mechanical protection, where appropriate. Sense fibres will be incorporated into the cable construction for the FSI power delivery fibres. A fail-safe mechanical shutter will block the lasers coupling into these fibres whenever the low power sense signal is lost.

The class 4 lasers which will form part of the SCT alignment system will be confined to a small light-proof, restricted access room in the surface buildings. This room will fully comply with the additional requirements for a class 4 ‘laser controlled area’.

6 Risk Mitigating Actions and Safety Measures

For the vast majority of the laser sub-systems, there will be no accessible radiation during normal operation.

The only exception to this will be the class 4 lasers in the ‘laser controlled area’. This will have access restricted to authorized personnel only, who will be suitably trained and qualified. It will incorporate all of the usual engineering and administrative hazard control measures required by IEC 825-1 and CERN Safety Instruction IS-22. These will include: illuminated signs over the entrance doors linked to the laser power supplies, beam stops for all unwanted specular reflections, no vertical laser beams and safety screens fitted around the sides of the optical table. Appropriate eye protection will also be available.

APR will be implemented wherever practicable to reduce the accessible radiation to below the class 3A AEL during maintenance and test procedures. Whenever these systems are overridden, appropriate administrative controls will be implemented.

7 Residual Hazards and Risks

Special arrangements will be implemented during assembly and testing of the SCT in the surface buildings. It is currently too early to define these control measures in detail, but they will probably involve surrounding the detector with opaque safety screens and declaring the area inside a ‘controlled access’ area, with appropriate warning signs, etc. Access would then be restricted to appropriately trained and authorized personnel only. If practicable, an APR system will be implemented. Additional administrative controls will also be implemented, as appropriate.

¹ ‘Safety of laser products Part 1: *Equipment classification, requirements and user’s guide*’, (IEC 825-1) and ‘Safety of laser products Part 2: *Safety of optical fibre communication systems*’, (IEC 825-2); International Electrotechnical Commission (IEC).

² ‘Rules for the Safe User of Lasers at CERN’; TIS Division, CERN Safety Instruction/IS-22 (January 1994).