LHC Emergency Lighting

jm FORAY EN/EL/BT

Initial project :

The current LHC emergency lighting system was designed and installed at the time of the LEP : Low Pressure Sodium type

- end of life technology
- fixed at approximately 40m centres, which creates a region of total darkness between them

Main objective :

Find a new solution and evaluate
the radiation effect.

Development of two test bench :

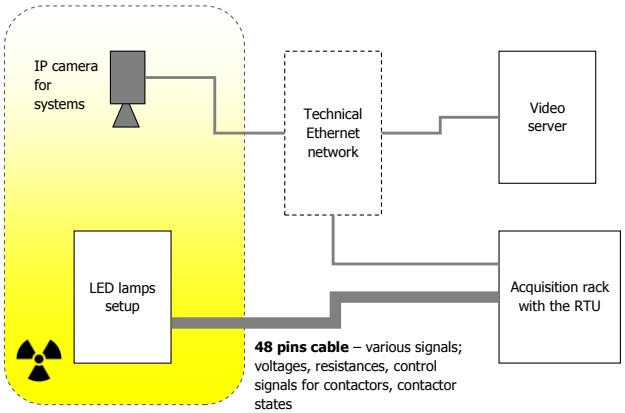
- an active test bench in TSG46 & TSG45
  - to evaluate the lifetime of different technologies

- a passive test bench
  - to evaluate the drift of luminosity.

Active TEST : performed from March 2011 to December 2012

Developed a test bench placed in TSG46
aim : - Radiation tests on :
- Power source :
  - Current transformers
  - Voltage transformers + a Graetz bridge
- Lighting system :
  - PowerLed technology
  - Standard led technology

Samples have been qualified with an equivalence of radiation dose for a five year life



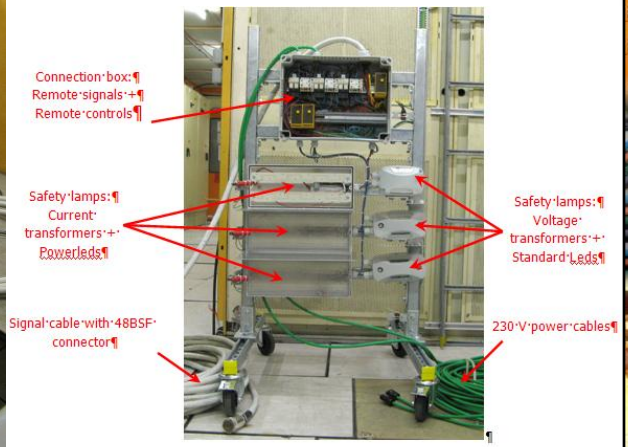


Figure 1 LED test bench

Data acquisition with a remote Webcam +
ANA/TOR signals

Active TEST : performed from March 2011 to December 2012

2011	2012	december 2012
installation in TSG 46	installation in TSG45	removed the test bench
low radiation	high radiation	

Conclusions:

- Radiation evaluation test has concluded for the development of a new safety lighting system :
  - To not use current transformers: Broken at ≈ 7×10^{12} HEH/cm^2
  - Powerled technology and standard led not affected by the radiation
  - Safety lighting system powered by a transformer + Graetz bridge can be a solution.

Passive TEST :

A test bench was constructed using a microprocessor and three sensors to characterise the optical performance of each LED sample tested. The test bench was housed in a sealed black plastic enclosure to prevent ambient lightning conditions influencing the results.
The optical measurement package consisted of:

TiO2 300nm UV Photodiode
BPW 34F Optical Photodiode
BPW 21 Infrared Photodiode

devices under test:

3 No. Zumtobel 2W LEDs, one of which continuously illuminated and irradiated in CNGS for 6 months to simulate an approximate LHC 5 year dose
2 No. Zumtobel custom PMMA lenses, 1 of which was irradiated with the LED in CNGS
1 No. Thorlux 3W LED
1 No. Acriche 230V LED

Workflow:

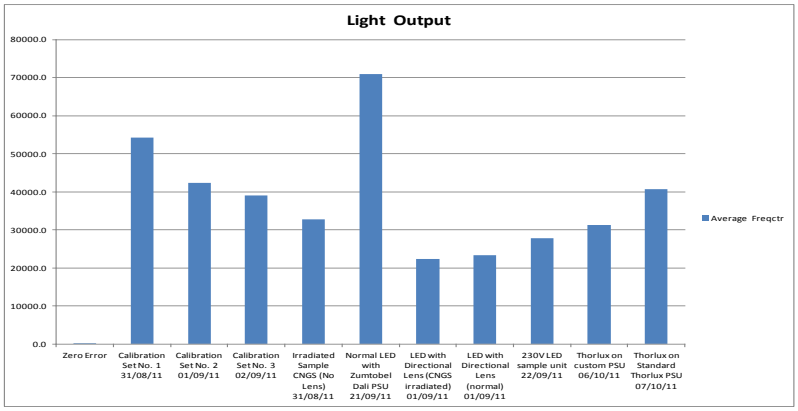
Passive TEST :

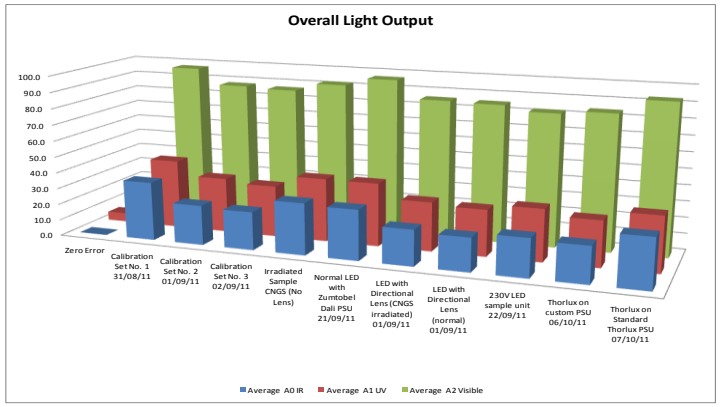
Conclusion :

The observed drop in light output as a function of the type of power supply was 43% for the Zumtobel fitting
The observed drop in light output from the Zumtobel LED as a result of 6 months continuous illumination and exposure to a 5 year LHC radiation dose was 19.5%.
The PMMA lens used in the CNGS trials suffered a performance reduction of 3.9% as a result of the radiation exposure

5 year performance = Initial performance x (57%) x (80.5%) x (96.1%)

5 year performance =44% Initial performance





Next Step :

Devices also installed in those locations where the radiation levels will be significantly higher (kGy/y and more) like in the collimation, injection, dump extraction and inner triplet areas.

Need to perform further tests at Fraunhofer institute + CEA to

To be schedule with EN/STI this year