Visual Alarm Device research work

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Introduction

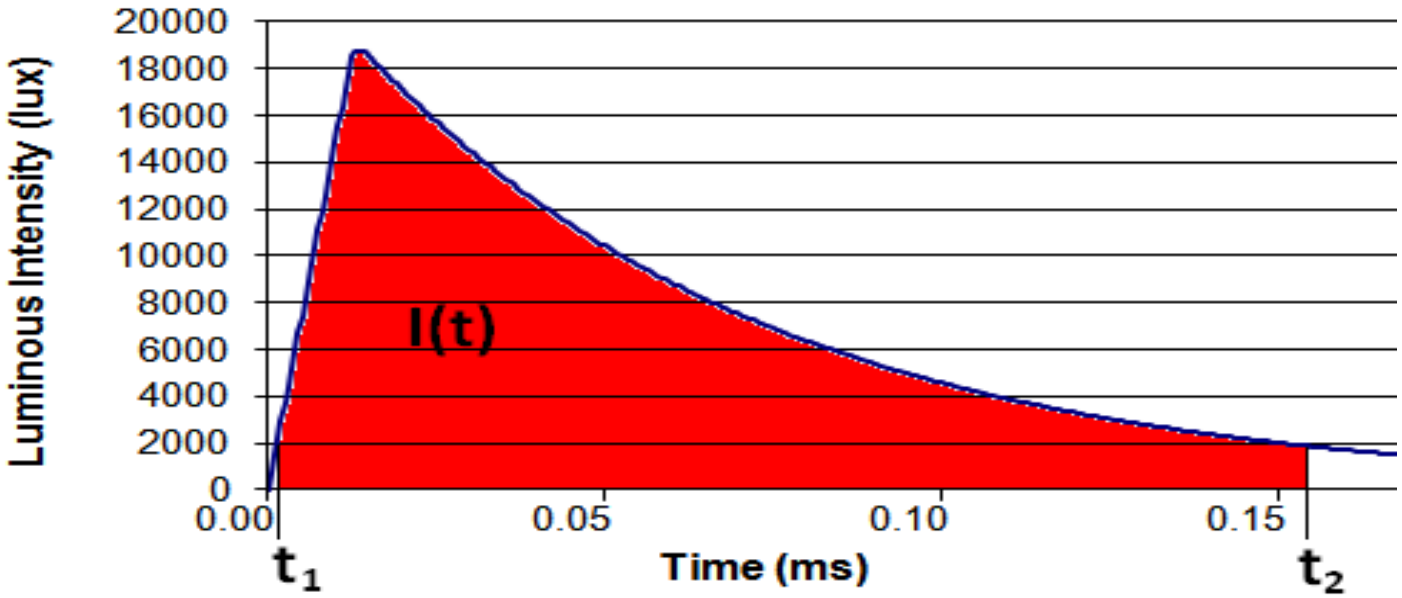
- Visual Alarm Devices (VADs) provide visual warning of fire for D&HH, operating theatres, live broadcast studios etc.
- In Europe under the Construction Products Regulation VADs must comply with EN 54-23
- Two types of VADs- Xenon and LEDs
- Test methodology used in EN 54-23 aims to equate performance
- Xenon’s are considered more effective
- Our client questioned this with the increasing capabilities of LEDs

Blondel-Rey

The effective luminous intensity (I_{eff}) is given by:

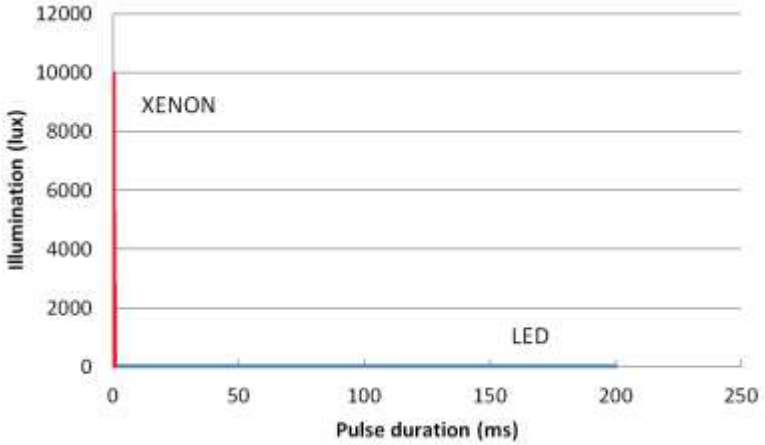
$$I_{eff} = \frac{\int_{t_1}^{t_2} I(t)dt}{a+(t_2-t_1)}$$

I(t) = instantaneous value in candela (cd)
t2 - t1 is the pulse duration (10% of peak)
a = 0.2 s;



Previous work and aim of research

- The value for the effective luminous intensity from a Xenon device (high peak intensity/very short pulse) and an LED device (low peak intensity/ very long pulse) can be the same.



- Formula was derived from a study of direct viewing of point sources in darkness
- It's suitability has been questioned by the Savage- Jan 2011 and Lighting Research Center (LRC)- Sep 2013.
- LRC claimed a = 0.01s was more suitable than 0.2s for predicting the performance of a flashing light viewed indirectly
- This study aimed to investigate the relative effectiveness of shorter LED pulse durations (≤ 40ms) and of LED colour temperatures with a Xenon

Device selection

- The following devices were used:
  - Xenon device
  - Warm white 40ms and 20ms LED device
  - Cool white 40ms, 20ms and 10ms LED device
- This would allow the following to be established:
  - how the LED devices performed in relation to the Xenon
  - the effect of decreasing pulse lengths
  - the comparative performance of warm white and cool white LED devices.
- From the LRC study the following were used:
  - Target high ambient condition was 500 lx on table top and 200 lx on screen.
  - Target low ambient condition was 250 lx on table top and 100 lx on screen.
  - 1Hz only was used this study.

Room selection

- Suitable sized room was selected
- Reflectance levels of surfaces were measured
- Locations of light fittings and types were noted
- These were modelled using the light simulation package DIALux 4.12 (by DIAL GmbH) to identify suitable light fittings

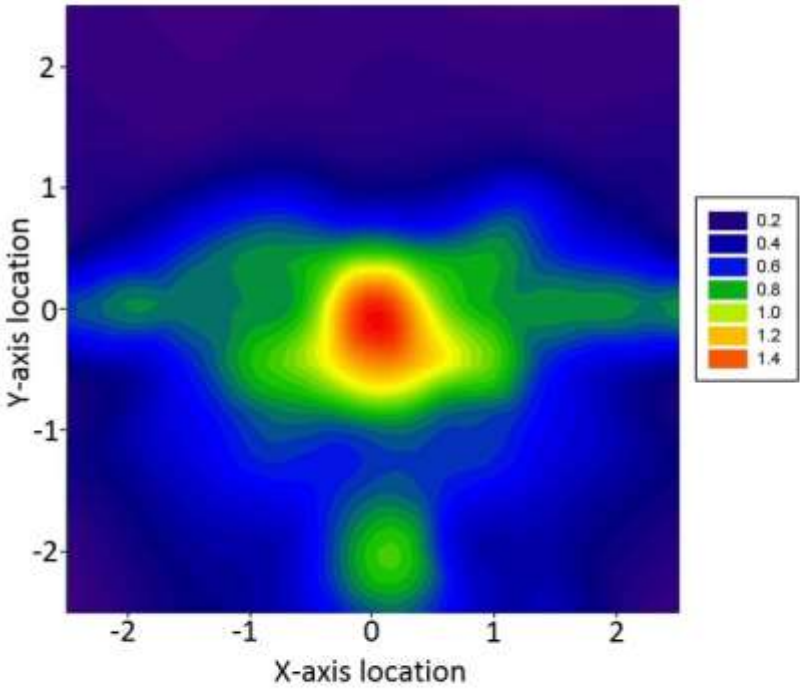
Illumination level identified

Actual illumination level (high ambient light)

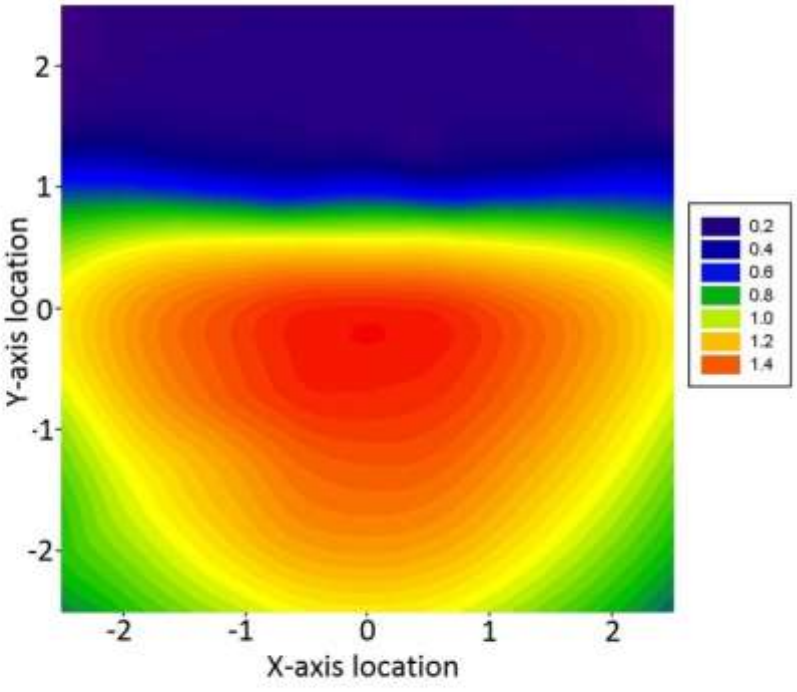
Actual illumination level (low ambient light)

Device mismatch

- Shows illumination distributions on a screen opposite device
- Xenon device (L) and the CW 10ms LED device (R).



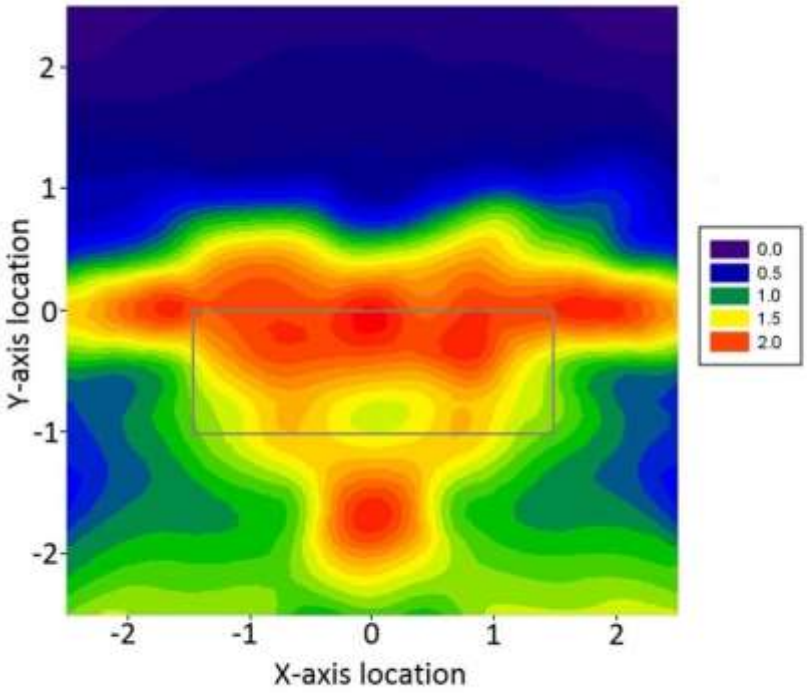
Peak illumination at (0,0) = 1.46 lux



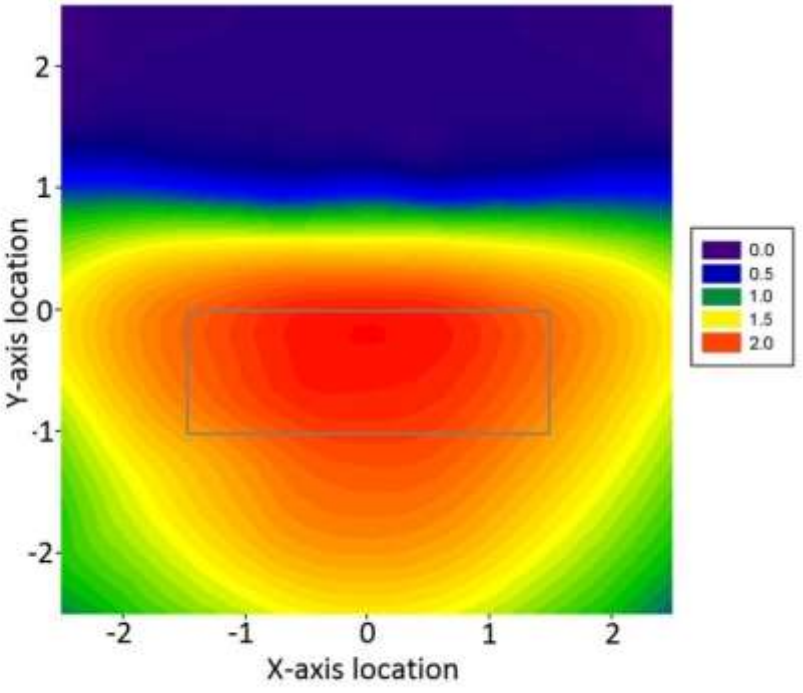
Peak illumination at (0,0) = 1.25 lux

Devices matched

- Xenon device (L) and the CW 10ms LED device (R).



Peak illumination at (0,0) = 1.94 lux

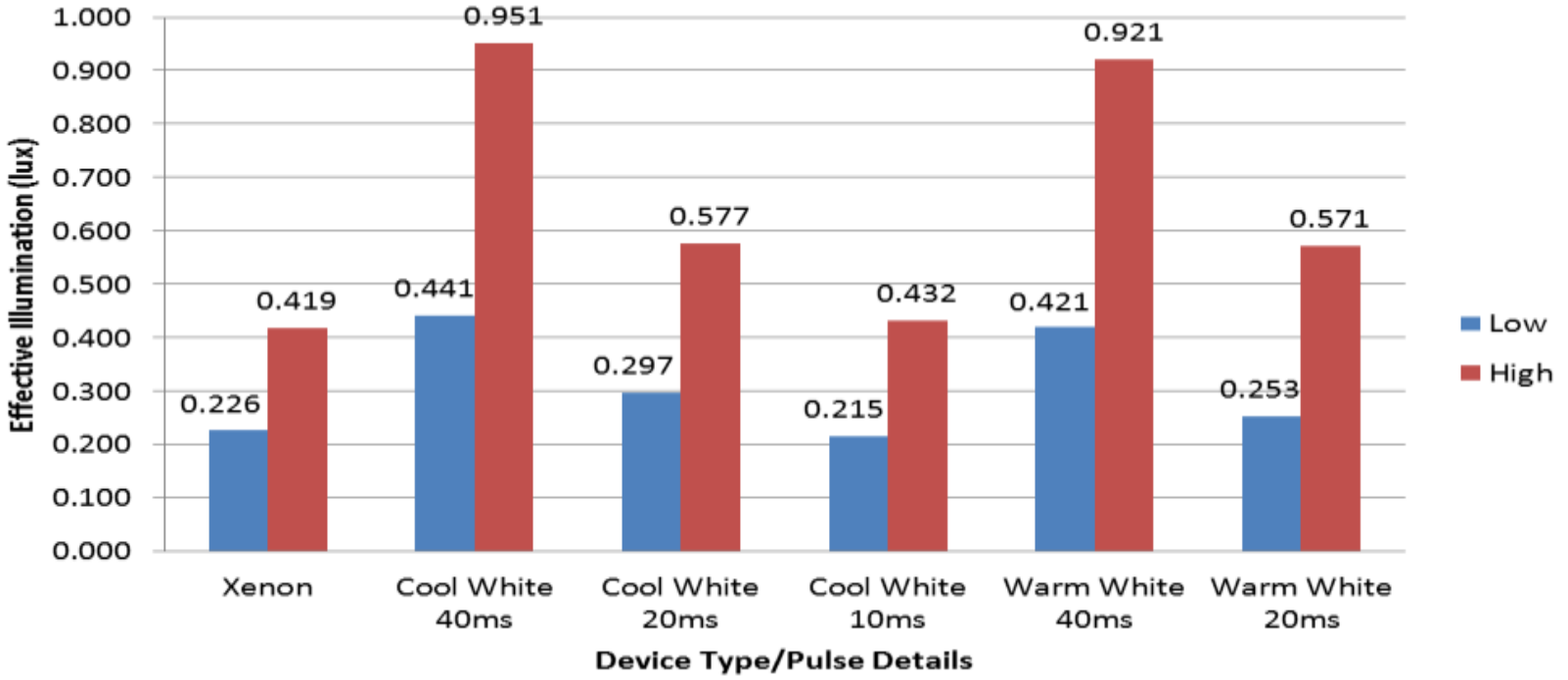


Peak illumination at (0,0) = 1.86 lux

Video

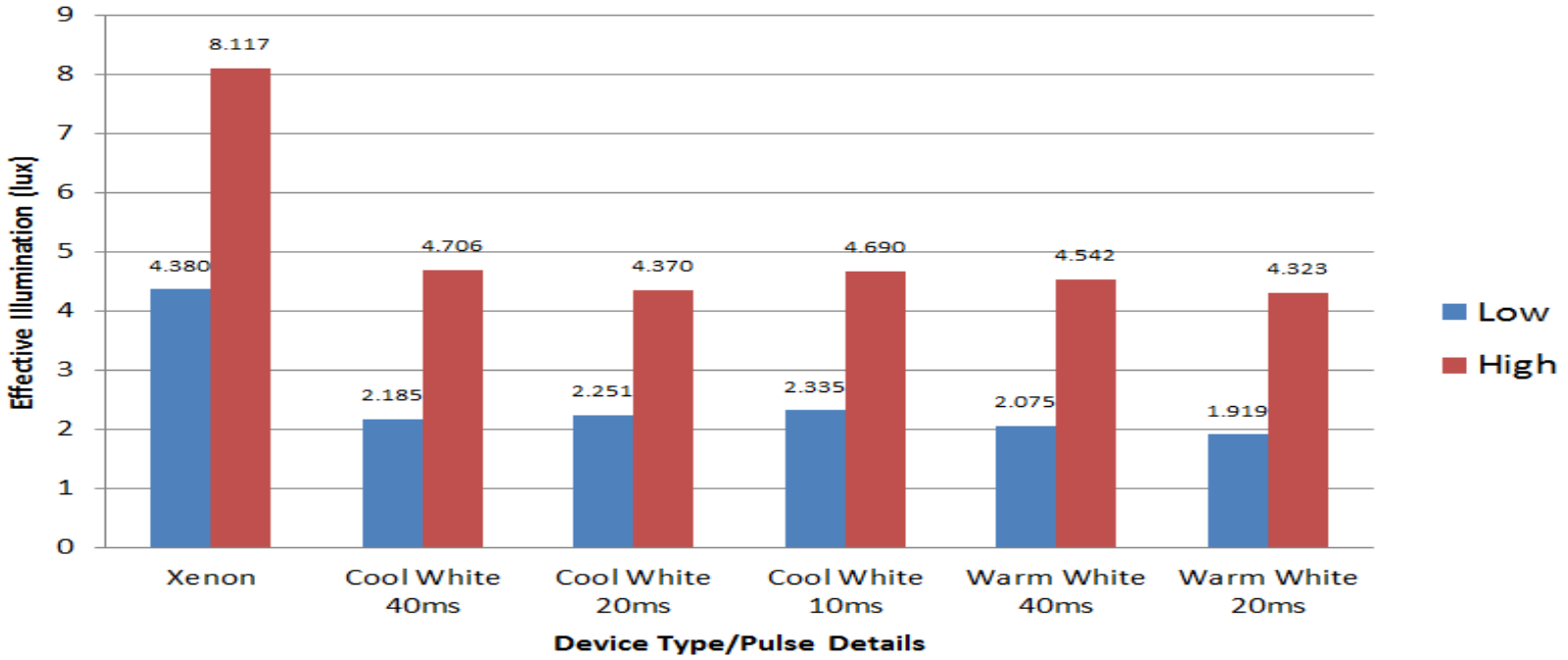
Detailed analysis of results

- According to the Blondel-Rey all should be the same!
- As PW of LED devices ↓ attention effectiveness increase ↑
- WW LED devices with the equivalent CW ones show that the responses are at similar levels.
- Xenon ~ 10ms cool white LED device.



Detailed analysis of results

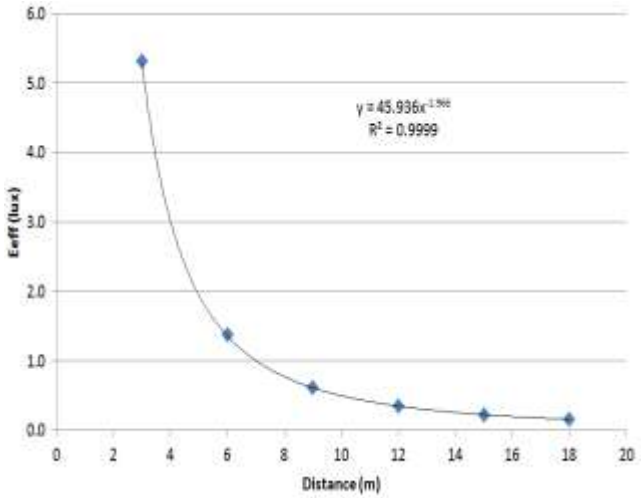
- The LRC claim of using a=0.01s was investigated
- Using F = (0.2 + P) / (0.01 + P) where F = multiplying factor and P = Pulse Duration (s) we get the revised chart.
- LEDs match more closely
- Xenon stands out

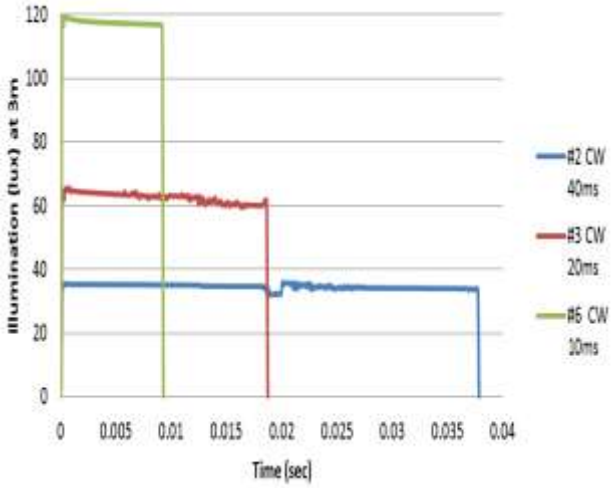


Briefing paper

Report also details of:

- Peripheral vision limitations
- Subject selection process
- Pulse profiles
- Methodology used to normalise the devices
- Characterising distance/illumination
- Analysis of sample numbers
- Analysis of demographic sets





Conclusions

It was identified that:

- As pulse widths of LED devices shorten the attention drawing effectiveness increases
- Performance of WW and CW LEDs are about the same
- Xenon and 10ms CW LED were about the same

The LRC claim of a=0.01s was verified for LED pulse durations between 10ms and 40ms for WW and CW LEDs.

For Xenon devices the new constant is not appropriate as pulse duration of Xenon device <<0.01 s.

Further information

– To download the briefing paper or view the video please go to www.bre.co.uk/firedetectionresearch

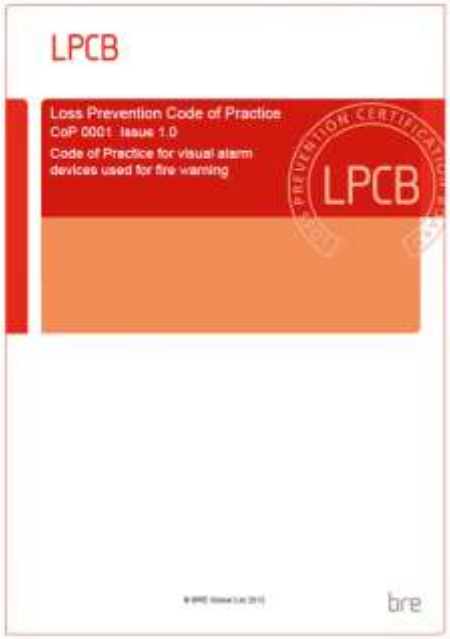
Further work

– The current revision of LPCB CoP0001 for VADs has identified the following areas for further investigation:

- 1 VAD Colours : To identify what is the effect of different coloured VADs on attention drawing effectiveness
- 2 Surface effects : To identify the effect on the reflected light from red and white VADs with various coloured surfaces
- 3 Background light: To identify the effects of broader range of background light on attention drawing effectiveness
- 4 Direct/Indirect: To identify a relationship between the response of subjects to indirect and direct presented light
- 5 Pulse durations: To identify the effects of greater pulse durations on subject responses

Summary of outputs

- Identified benefits of using LED technology (including illumination distribution)
- Findings will lead to changes in:
  - Revision of EN 54-23
  - Revision of LPCB Code of Practice 0001 for VADs
- Leading to better understanding and providing appropriate guidelines for installation of VADs



Thanks

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