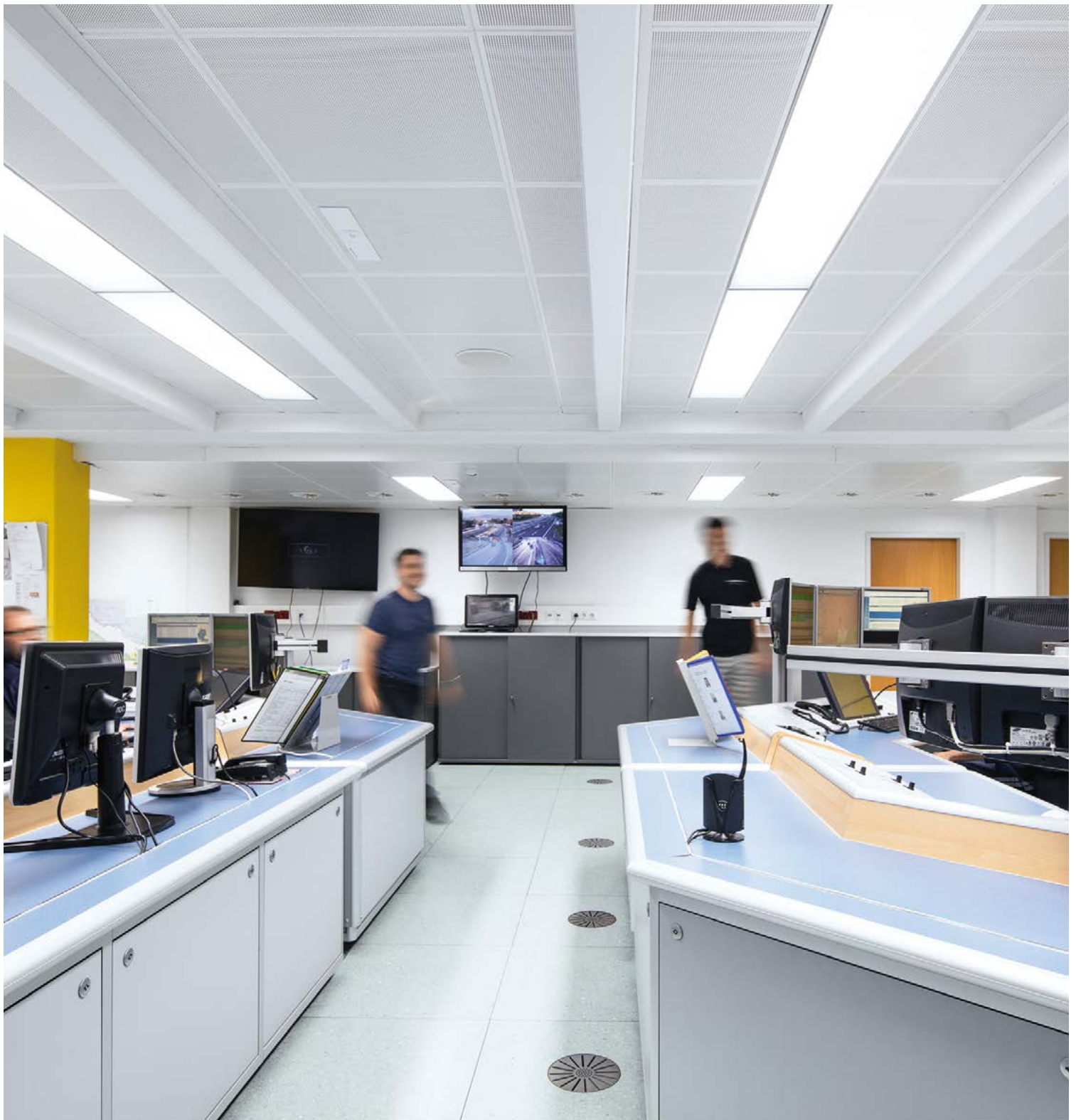


**Area Control
Centre of the
State Police
Headquarters
Vorarlberg, AT**



Light for the night shift

Study from the Research Centre for User-Centred Technologies

The Area Control Centre of the Vorarlberg State Police Headquarters operates around the clock. The renovation of the control centre in the town of Bludenz has been used to implement a modern lighting solution and to test a dynamic lighting concept, with the aim of making the night shift more comfortable for the members of staff. UCT Research, an interdisciplinary research centre for user-centred technologies at the FHV technical college in Vorarlberg, had the task of programming various lighting scenarios and then evaluating these as part of a pilot study. The investigation was carried out in the winter months to achieve the clearest results. Participants recorded their state of alertness during the course of the night shift, along with the quality of their sleep in the subsequent relaxation phases. The scale ranged from 1 to 10, with 1 representing the best possible rating.

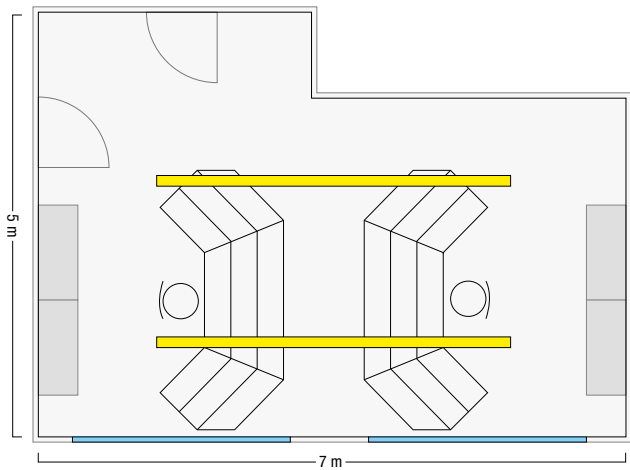
Aim in Phase 1: Move the sleep-wake cycle

The first test phase involved trying to move the sleep-wake cycle in line with the night shift (from 19:00 to 06:00). For this purpose, the illumination level was increased to between 455 and 490 lux during the night. The results were very satisfactory, with an average score of around 4 points.

Aim in Phase 2: Maintain the natural rhythm

In the second phase, the illuminance level of 385 lux at the beginning of the shift was reduced to 160 lux at midnight. This light level was then maintained for the remainder of the shift until 06:00. The colour temperature was kept at a constant 3000 Kelvin. With an average of 1.5 points, this scenario was markedly better rated, as the police personnel felt significantly more awake and alert during the night and were then able to sleep much better when they had finished work. The improvement was particularly noticeable amongst members of staff aged 50 and over.

The conclusion: There is a better solution than simply trying to turn the night into day. There should be sufficient light available during the night shift to carry out tasks efficiently, to stay alert and then to help individuals return to a natural daily rhythm. Professor Guido Kempter from the FHV technical college found the effects of light on the circadian rhythm and the overall results of the study to be statistically significant - especially when it came to workers aged 50 and above.



Dimmable ECOOS pendant luminaires illuminate the Area Control Centre in Bludenz with high-quality light – controlled to deliver precisely the right levels of illumination that help staff work efficiently during the night shift and then sleep well afterwards.

Vorarlberg State Police Headquarters, Area Control Centre, Bludenz | AT

Study: UCT Research from the Fachhochschule Vorarlberg, Dornbirn | AT

Client: Vorarlberg State Police, Bregenz | AT

Programming of the lighting scenarios: UCT Research from the Fachhochschule Vorarlberg

Lighting solutions: ECOOS dimmable pendant luminaires with micro-pyramidal optic

The right light at the right time

Light supports the natural sleep-wake cycle



Both the illuminance levels and the colour temperatures have been optimised to help ensure that the team in the Area Control Centre in Bregenz can maintain their natural 24-hour cycle, despite the rigours of regular shift work.

Police Area Control Centre, Bregenz | AT

Client: Bundesimmobiliengesellschaft m.b.H. (federal real estate company), Feldkirch | AT

Electrical installation: Elektrotechnik Fink GmbH, Riefensberg | AT

Lighting solution: LIGHT FIELDS evolution tunableWhite recessed LED luminaires



The productive cooperation with the Vorarlberg State Police was continued with the renovation of the lighting at the Area Control Centre in Bregenz - with a lighting solution that offers both variable illuminance levels and adjustable colour temperatures. In this way, the findings of UCT Research relating to shift work could be combined with the existing knowledge about the biological effects of light. A tunableWhite lighting solution with LIGHT FIELDS evolution luminaires was chosen for the Area Control Centre in Bregenz to deliver exactly the right light at precisely the right time.



Increase wellbeing

A good lighting solution creates visual conditions in which people feel comfortable, helping them to go about their work in a concentrated and motivated fashion. Key parameters such as a uniform illumination of the working plane, friendly-looking faces and bright walls and ceilings have a direct effect on the physical and mental state of the staff.



Establish identity

When it comes to personal preferences, customisable lighting scenarios with variable colour temperature and adjustable light levels can make a valuable contribution to increasing employee satisfaction and creating identity. High-quality product design and architectural lighting design also play a major role here.



Reduce costs

Lighting solutions have a direct influence on operational costs through a combination of energy efficiency, durability and lighting management systems. The significance and reputation of a company or building also benefit directly from a resource-efficient environmental policy.

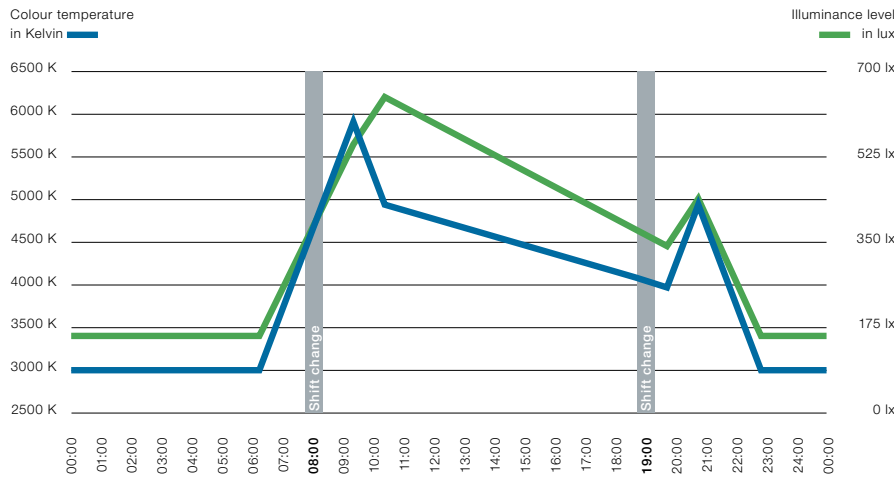
Comfort around the clock

Day and night have different requirements

♥ Increase wellbeing

It is generally accepted that night shifts disrupt the natural rhythm of the body and may even have an adverse effect on the health of workers. However, shift work for essential services like the fire brigade, hospitals and police is clearly unavoidable. The Vorarlberg State Police use the biological effectiveness of light to enhance the wellbeing of their personnel. The results of the study have been reflected in the programming of the control profiles to help make the night shift more tolerable. This research showed that it is better to work with the natural circadian rhythm and to ensure sufficient levels of stimulating light at the right time, rather than seeking to artificially move the sleep-wake cycle with overstimulation during the night.

Control profiles at the Area Control Centre, Bregenz



| Time | Colour temperature | Illuminance level | Dimming level from a base of 700 lx |
|--------------|--------------------|-------------------|-------------------------------------|
| 00:00 | 3000 K | 160 lx | 23 % |
| 01:00 | 3000 K | 160 lx | 23 % |
| 02:00 | 3000 K | 160 lx | 23 % |
| 03:00 | 3000 K | 160 lx | 23 % |
| 04:00 | 3000 K | 160 lx | 23 % |
| 05:00 | 3000 K | 160 lx | 23 % |
| 06:00 | 3000 K | 160 lx | 23 % |
| 07:00 | 4000 K | 295 lx | 42 % |
| 08:00 | 5000 K | 430 lx | 61 % |
| 09:00 | 6000 K | 565 lx | 81 % |
| 10:00 | 5000 K | 665 lx | 95 % |
| 11:00 | 4890 K | 630 lx | 90 % |
| 12:00 | 4780 K | 595 lx | 85 % |
| 13:00 | 4670 K | 560 lx | 80 % |
| 14:00 | 4560 K | 525 lx | 75 % |
| 15:00 | 4450 K | 490 lx | 70 % |
| 16:00 | 4340 K | 420 lx | 60 % |
| 17:00 | 4230 K | 420 lx | 60 % |
| 18:00 | 4120 K | 385 lx | 55 % |
| 19:00 | 4000 K | 350 lx | 50 % |
| 20:00 | 5000 K | 450 lx | 64 % |
| 21:00 | 4000 K | 305 lx | 44 % |
| 22:00 | 3000 K | 160 lx | 23 % |
| 23:00 | 3000 K | 160 lx | 23 % |
| 24:00 | 3000 K | 160 lx | 23 % |
| 00:00 | 3000 K | 160 lx | 23 % |

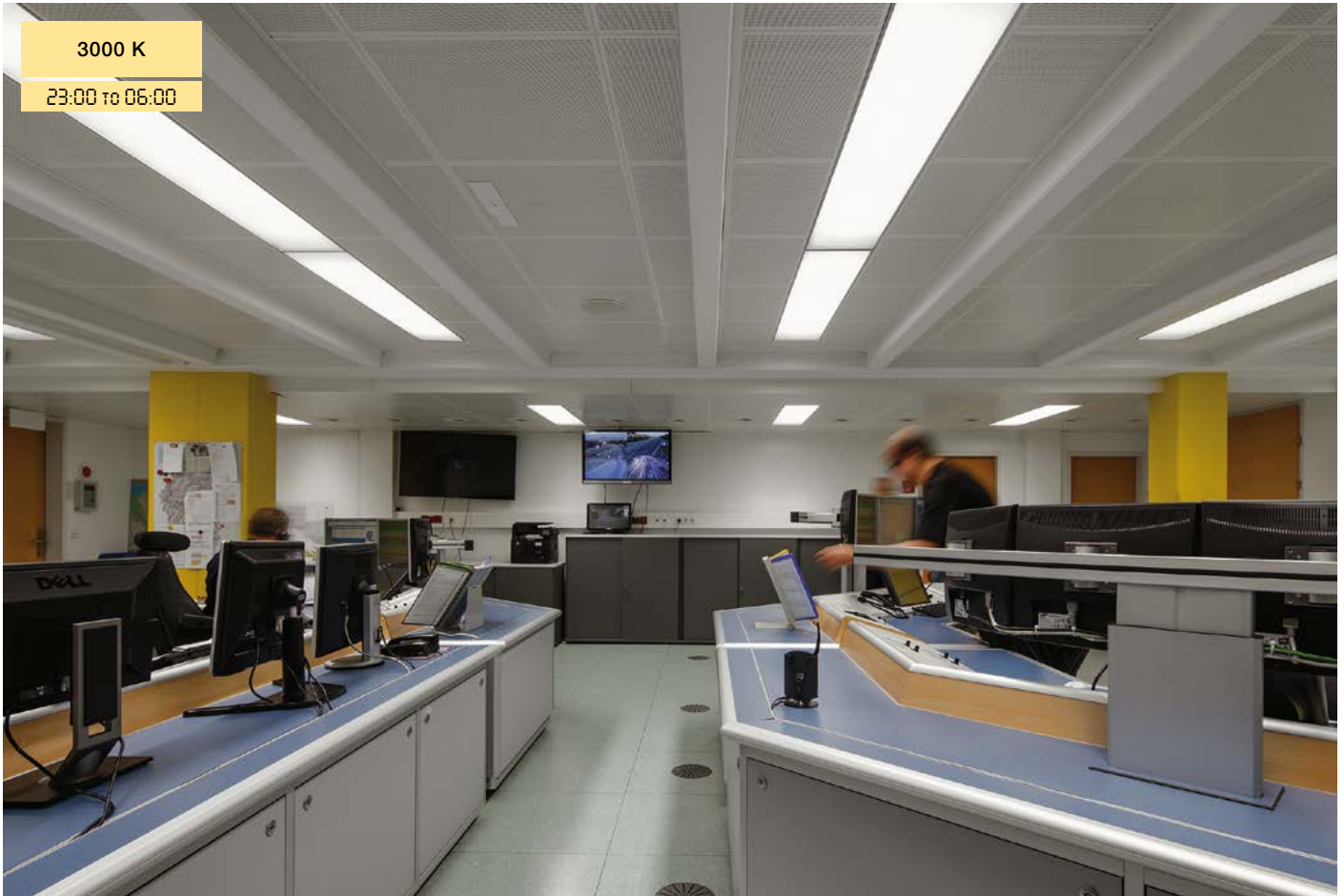
The automatic light identity profile is activated when each shift changes, supporting staff who have just started work with higher light levels and appropriate colour temperatures. These automatic sequences can of course be interrupted and manually adjusted at any point.



 **Establish identity**

LIGHT FIELDS evolution tunableWhite luminaires offer a wide range of technical features, making it possible to adjust both the lighting intensity and the colour temperature to suit the individual requirements of employees. Light levels of up to 800 lux and variable light colours ranging from 2700 K to 8000 K enable the realisation of biologically-effective lighting sequences that maintain the natural sleep-wake cycle, even when working through the night. An intelligent control system further supports the concept of adaptable workplace lighting.





3000 K
23:00 to 06:00




4000 K
07:00 | 19:00 | 21:00



5000 K
08:00 | 10:00 | 20:00



6000 K
9:00

 **Reduce costs**

Just the right amount of energy is consumed by providing precisely the lighting levels that are required. Reducing the illuminance level during the night to 160 lux helps lower the energy consumption compared to previous lighting concepts. The use of long-life LED luminaires instead of T16 fluorescent lamps increases the energy efficiency and cuts maintenance costs. This combination of factors guarantees significant long-term cost savings.

Increase wellbeing

The biological effects of light



Morning stimulus

Colour temperature: 5000 K

E_h^* (daylight and artificial light): more than 500 lx

Target: synchronization of the internal clock and complete suppression of the melatonin release



During the day with sunshine

Colour temperature: 4000 K

E_h^* (daylight and artificial light): more than 1000 lx

Target: Create wellbeing with specific colour temperatures (warmer light colours when the sun shines)



* E_h = horizontal illuminance

The DIN SPEC 67600:2013-04 offers planning security and concrete application recommendations for holistic lighting concepts that have a biological effect

- **Synchronisation of the internal clock is not guaranteed indoors by daylight during the dark winter months**
- **enting daylight with biologically effective artificial lighting concepts is particularly recommended in office areas**
- **Biologically effective artificial lighting solutions, based on natural light, stabilise the circadian rhythm**

The DIN SPEC 67600:2013-04 is the first attempt to outline concrete planning recommendations for lighting that is biologically effective, bringing together innovative technical possibilities and the latest research findings. The approach shown here is based around daylight. Depending on the season, geographic location, weather conditions and positioning of the workplaces in the room, the amount of daylight is not always sufficient to synchronise the internal clock of those spending long periods indoors. In such cases, biologically-effective artificial lighting solutions are the key to supporting daytime activity and sleeping well at night.



During the day with a cloudy sky

Colour temperature: 6000 K
 E_h^* (daylight and artificial light): more than 800 lx

Target: Create wellbeing with specific colour temperatures (cooler light colours when it is overcast)



Getting ready for a night's rest

Colour temperature: 3000 K
 E_h^* (daylight and artificial light): more than 500 lx

Target: synchronisation of the internal clock; no interference of the release of melatonin; restful sleep



Decisive for the planning is not therefore the classic lighting level on the working plane, but the spectral distribution and vertical illuminance on the eye, which combine with other factors to influence the human state (see table). In addition to biological effectiveness, the emotional effect of light also plays a significant role. For example, whilst strong bluish-looking light colours at the right time can have a stabilising and activating biological effect, various studies have shown that these same light colours are rejected when the sun is shining. The goal is quite simply to harmonise the visual, emotional and biological effects of light.

Extract from DIN SPEC 67600:2013-04

| More intense biological effects of light are produced by | Less intense biological effects of light are produced by |
|-------------------------------------------------------------------|-----------------------------------------------------------------|
| Higher illuminance | Lower illuminance |
| Longer duration of exposure | Shorter duration of exposure |
| Higher proportion of blue light | Lower proportion of blue light |
| Wide-area lighting | Pinpoint lighting |
| Dynamic lighting changes | Constant light |
| Lower level of radiation before the light exposure under review** | |
| Morning light is most effective for synchronising the body clock | Light in the afternoon has little effect on the body clock |

** People who adapted to darkness for an extended period before being exposed to light are more sensitive to light and show a stronger response



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