FLUGHAFEN KASSEL-CALDEN

Fraport

# New Kassel-Calden Airport

# Optimized LED Installation


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LUCEBIT

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## Topics

- The Kassel-Calden Airport project
- Used technology concepts
- The implementation in practice
- The energy benefits in total compared to a standard installation
- The lifetime benefits and
- Technology and cost estimation for the increase of work safety by implementation of the Safety Extra Low Voltage (SELV) standard.

# The Kassel-Calden Airport Project

**Regional Airport Kassel-Calden:**

- **IATA-Code: KSF**
- **ICAO-CODE: EDVK**

**Opening date:**

- **04 April 2013**

**Runway details:**

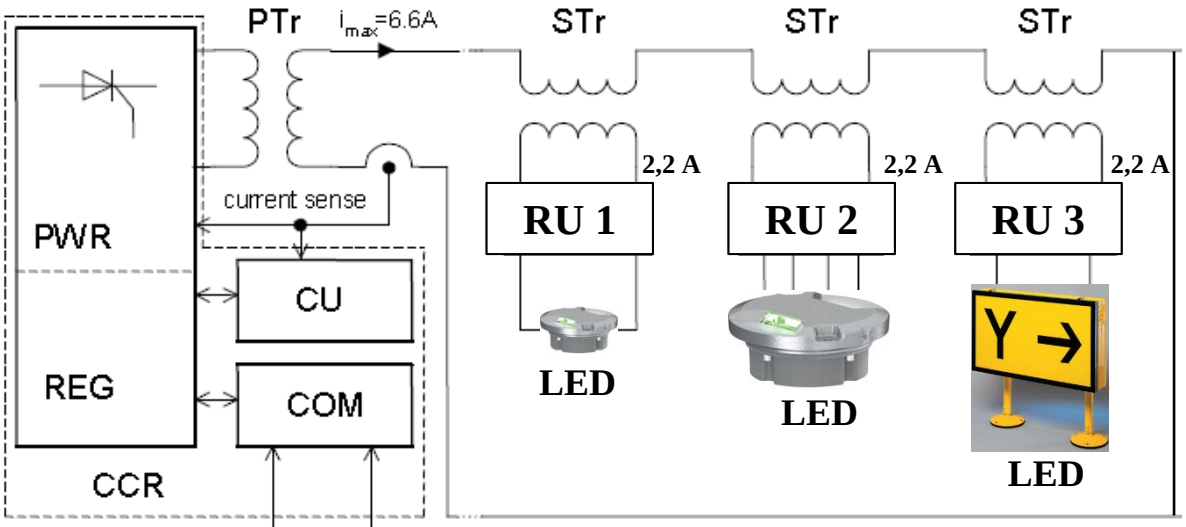
- **length: 2.500 m**
- **width: 45 m**
- **orientation: 09 / 27**
- **ILS CAT I (09) and CAT III/b (27) operation**

# New Kassel-Calden Airport

| | |
|---|---|
| Halogen Lights (6.6A) | 708 |
| LED Lights (2.2 A) | 981 |
| LED-Flash Lights (35 VAC) | 44 |
| Single Lamp Control Units | 781 |
| Primary Cable | 147 km (91 miles) |
| Secondary Cable (2,5 $mm^2$; AWG 13) | 59 km (37 miles) |
| CCRs | 52 |
| Total Power for all Circuits | 181 kW |
| LED Circuits only | 91 kW |

# Used technology concepts

## Construction details airfield lighting



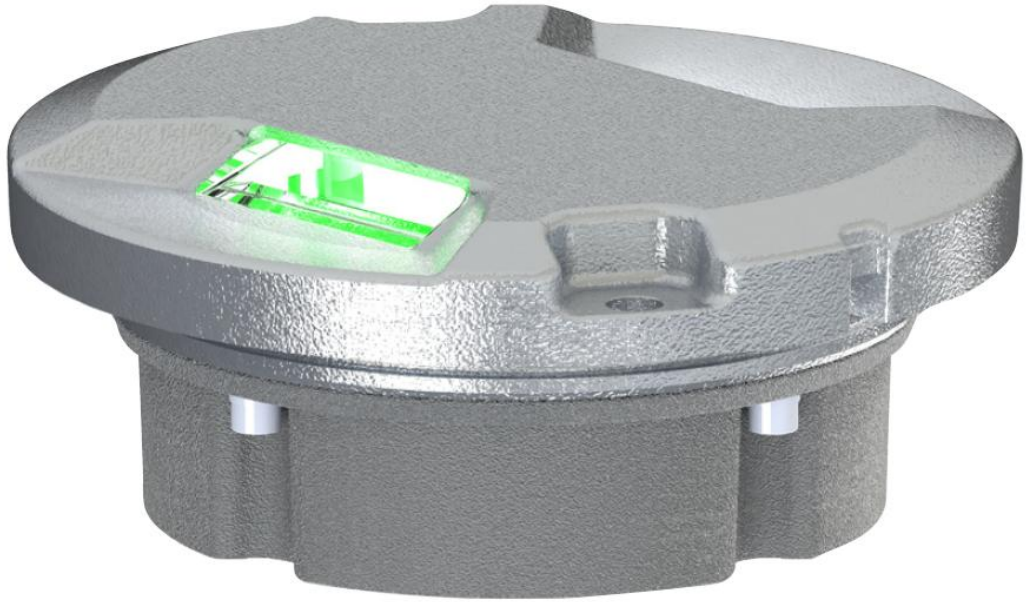

| | | | |
|---|---|---|---|
| AFL C&M | Airfield Lighting Control & Monitoring | RU | Remote Unit (Scroll) |
| CCR | Constant Current Regulator | PTr | Primary Transformer |
| CU | Central Unit (Scroll) | STr | Secondary Transformer |
| COM | Communication Unit | PWR | Power Control Unit |
| REG | Regulation Unit | | |

# LED Taxiway Light Fixture

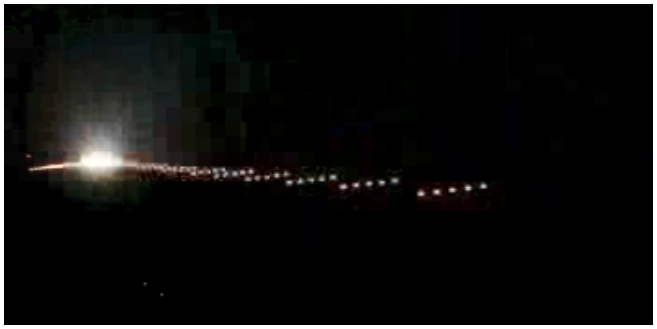
Light fixture constructed for both secondary current systems

Automatically adapting electronic for

- 6.6 A or
- 2.2 A use



# LED Approach Sequence Flash Light



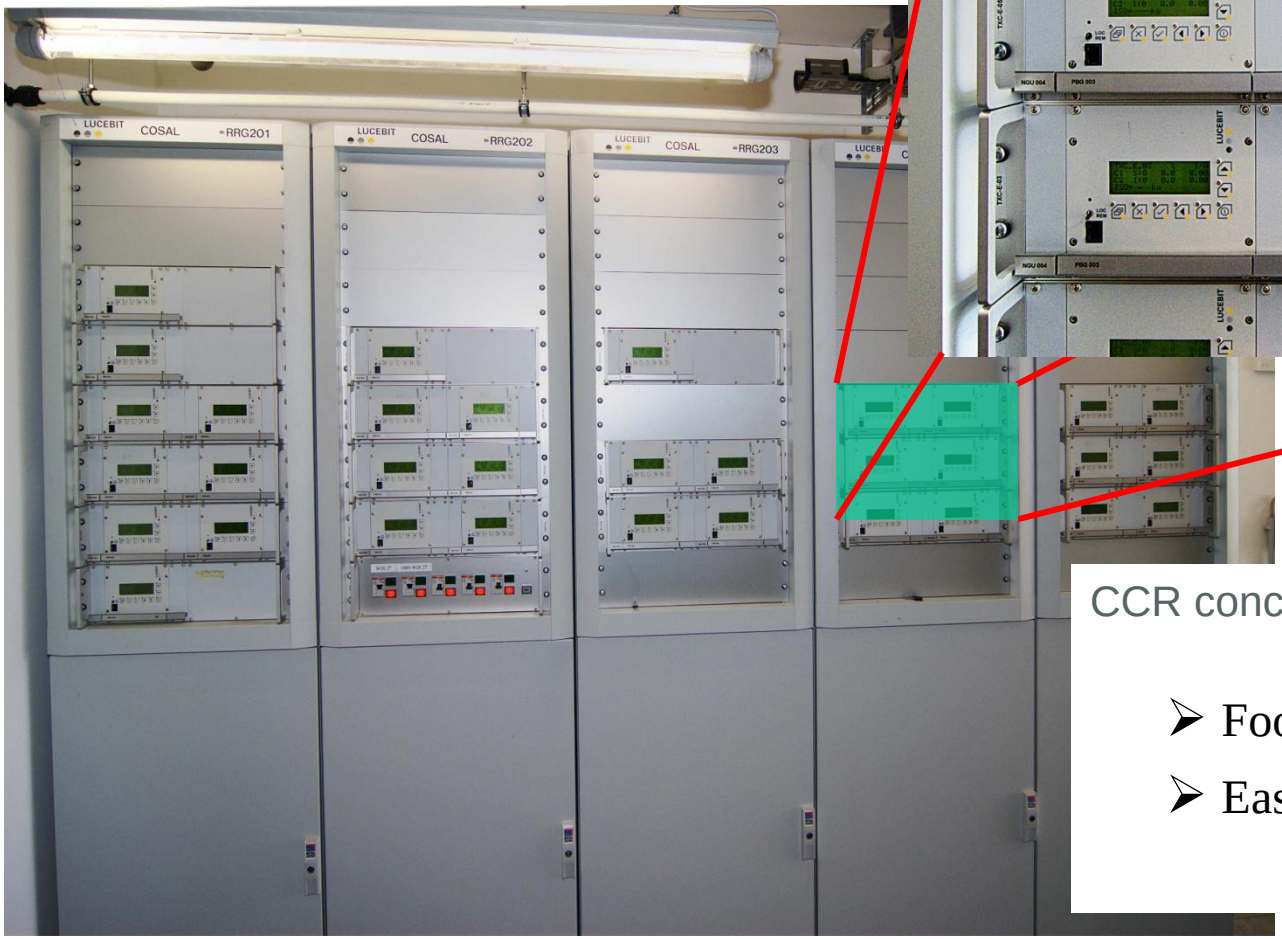
Light fixture constructed for
max. 100’000 cd peak intensity

Light fixture are powered with
SELV 35 VAC

# New Kassel-Calden Airport

## Power station

### Construction details CCR cabinet




CCR concentration in racks:

- Footprint saving space
- Easy to maintain

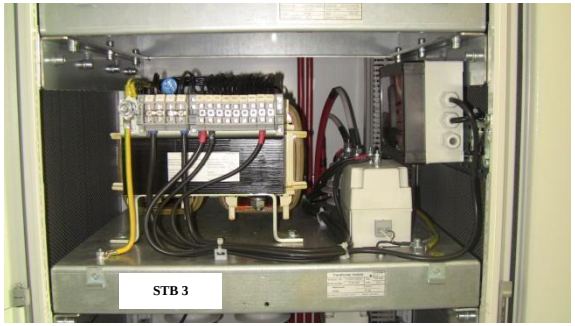
# New Kassel-Calden Airport

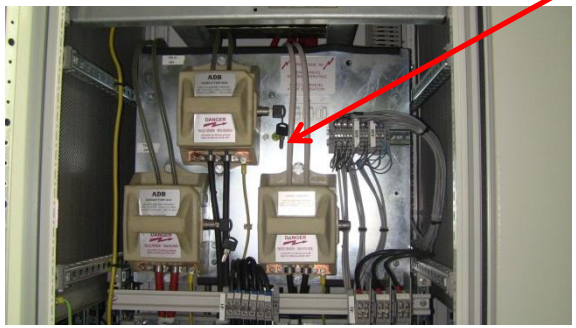
## Construction CCR transformer

- **Primary transformer cabinets**:
  - Footprint saving
  - Easy to maintain
  - Clear separation between high (transformer) and low (CCR) voltage

# New Kassel-Calden Airport

## Construction details transformer rack



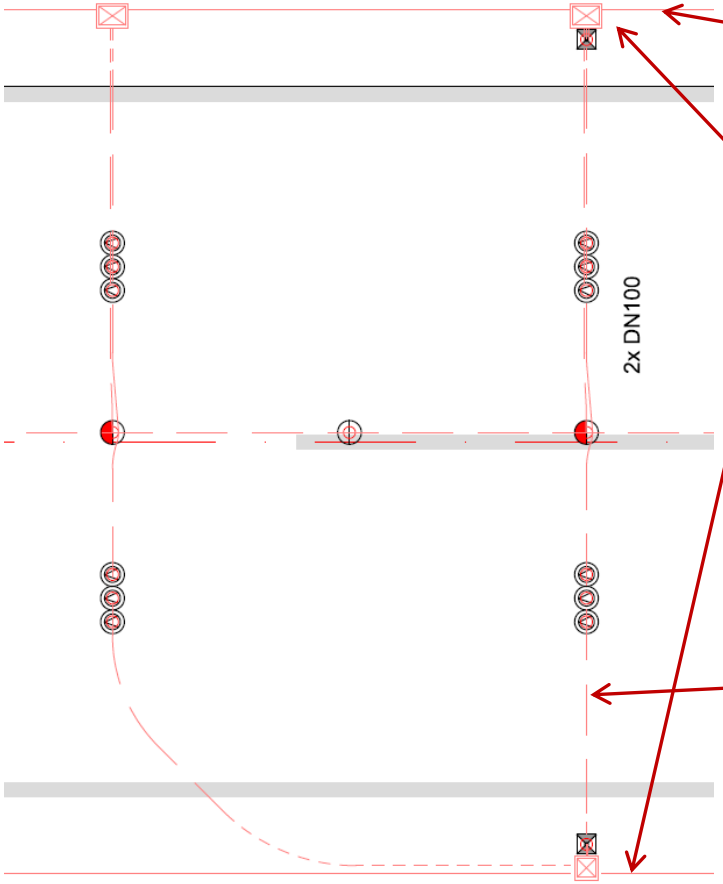
- Max. three levels of transformer’s
- Cut Out (secondary circuit)
  - **Disconnection secondary cable**
  - **Grounding**
    - **Transformer**
    - **Secondary cable**
- Result
  - **Clear separation between transformer level and secondary circuit**

## Construction details cabling

- All cabling is done under the elevated floor level
- each room has a fire separation
- Result
  - Clear room concept

# Field installation

## runway system




Cable trace on both side‘s of runway for primary cable

At each PVC pipe crossing a manhole for:

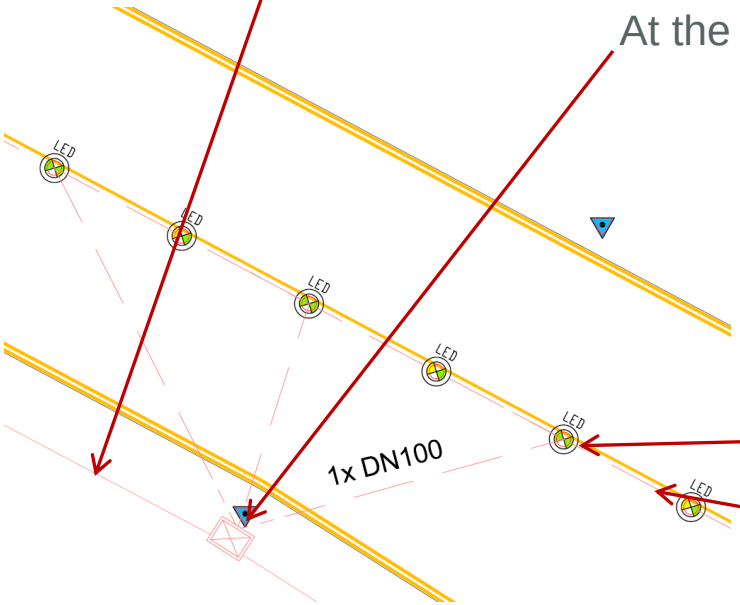
- **Primary Cable**
- **Lamp Transformer**
- **Single Lamp Control Unit**

PVC pipes for secondary cables

# New Kassel-Calden Airport

## Taxiway system

Cable trace on one side‘s of taxiway for primary cable



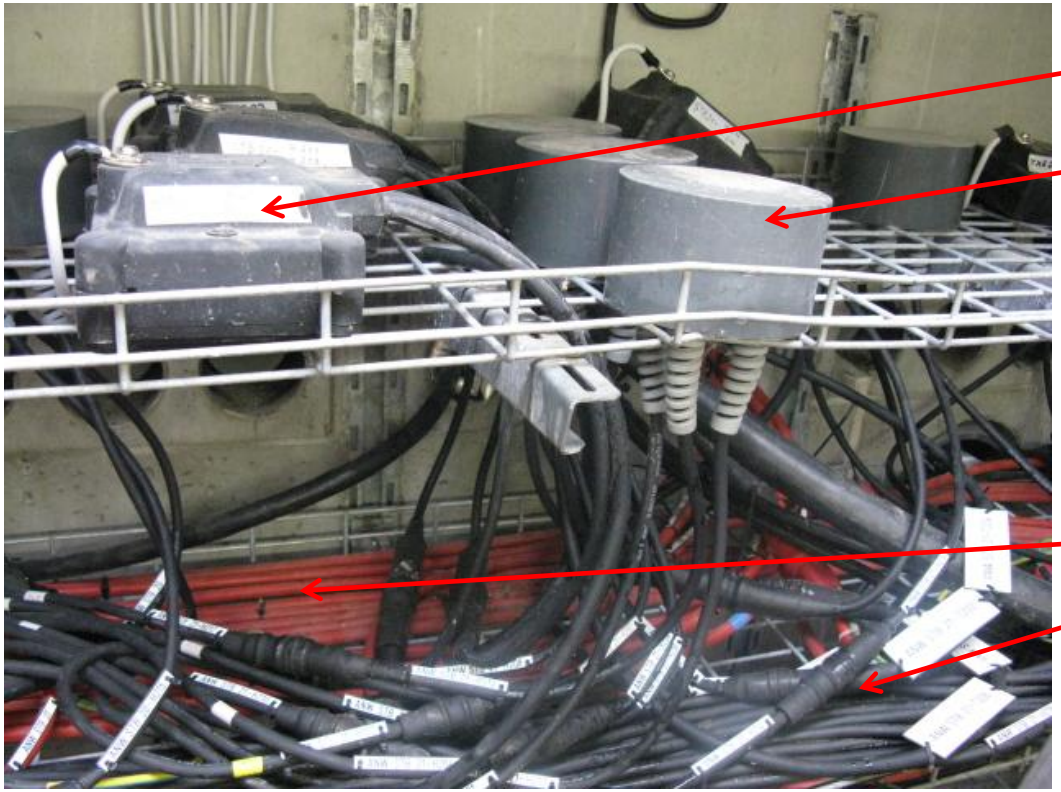

At the PVC pipe concentration one manhole for:

- **Primary Cable**
- **Lamp Transformer**
- **Single Lamp Control Unit**

PVC pipes for secondary cables:

- **From each second lamp direct to the manhole and**
- **One PVC center pipe**

# Manhole installation



- First level
  - **Lamp transformers**
  - **Single Lamp Control Units**
- Second level
  - **Primary cable**
  - **Secondary cable**

# What are the reasons to go for a new LED circuit design

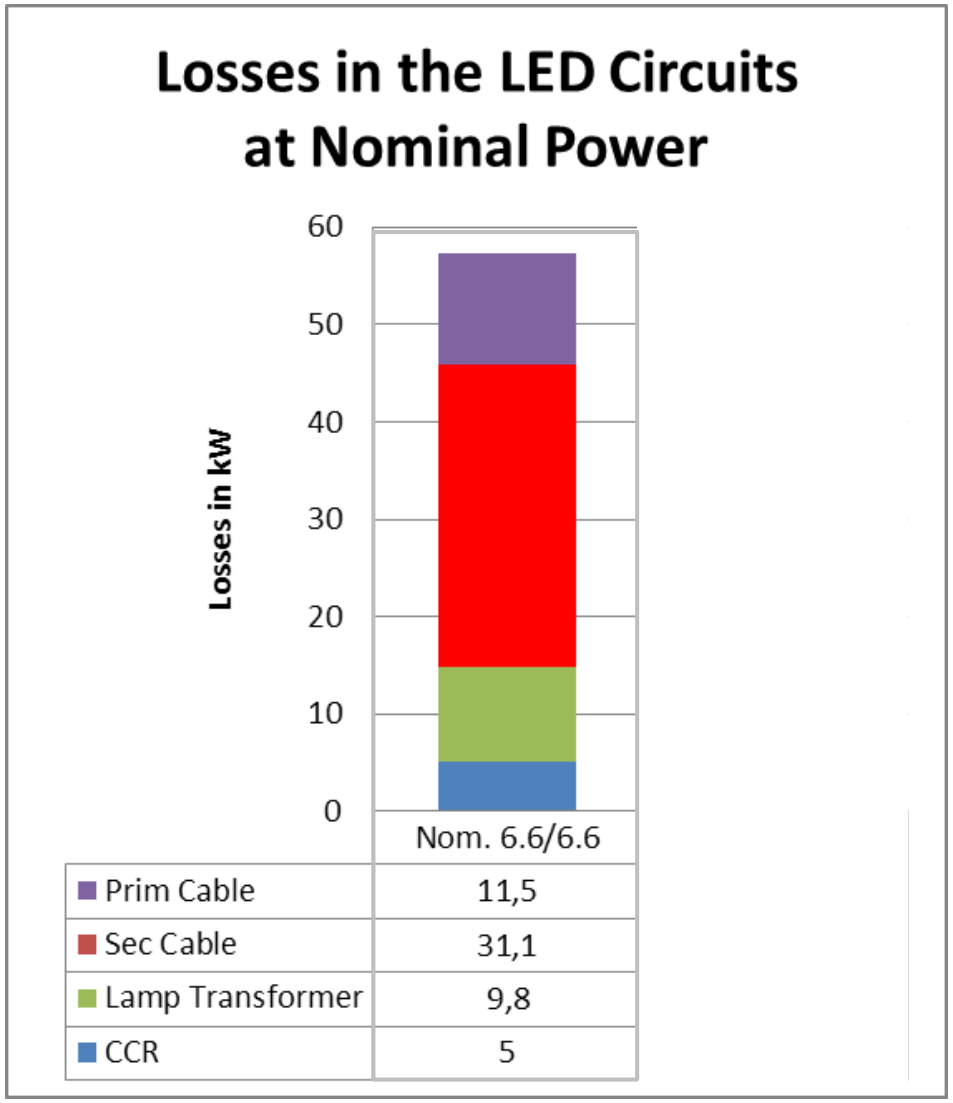
## Technical Background

# Objectives for a new LED circuit design

The aim of the system design is to get the best balance in between

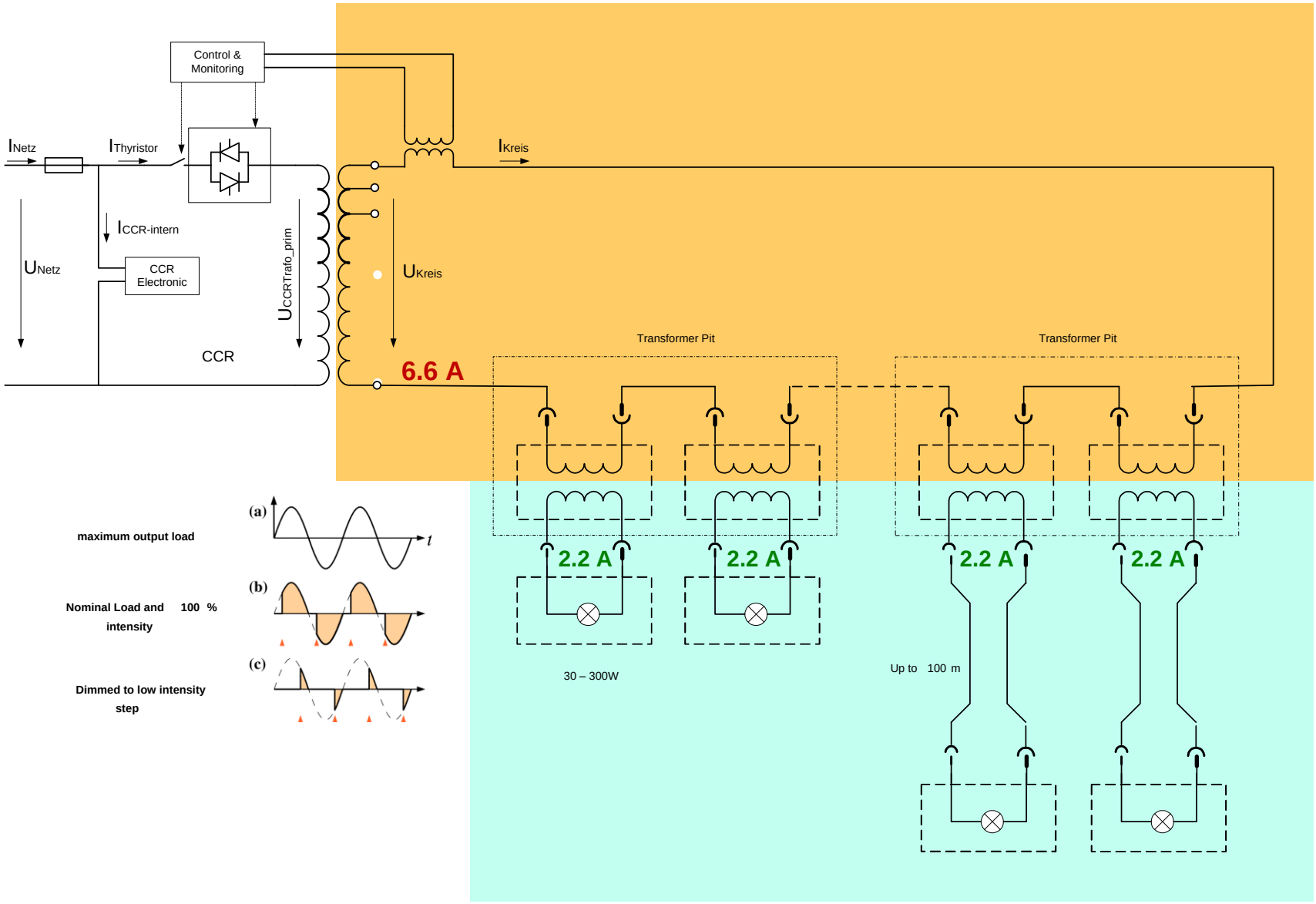
- **Energy saving**
- **Reduction of maintenance**
  - **Life time of the installations**
  - **Minimum of different spare parts**
- **High grade of work safety**

# Where are the losses in the LED circuits?

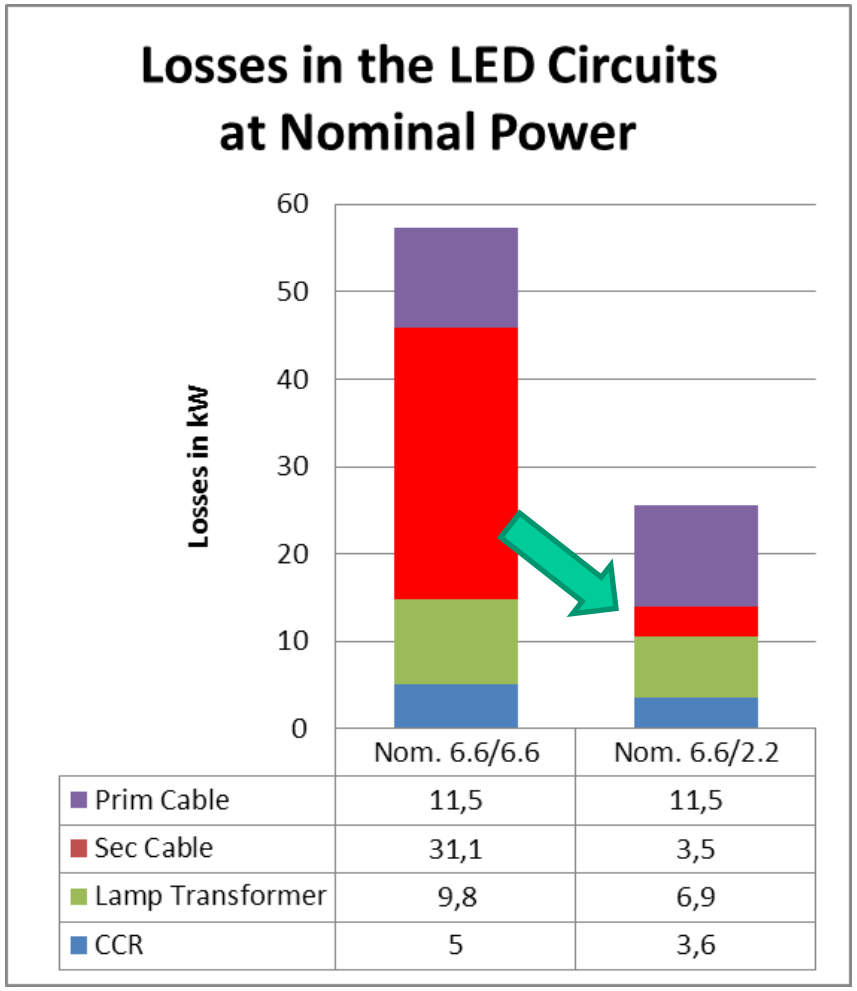



- The total losses at nominal power are ~57 kW
- The losses on the secondary cable forms with 31 kW (54%) the major portion.
- To reduce that losses it was decided to reduce the secondary current to 2.2 A

# Principle design of the 6.6 / 2.2 series circuit



# The savings in losses for the 2,2 A on the secondary



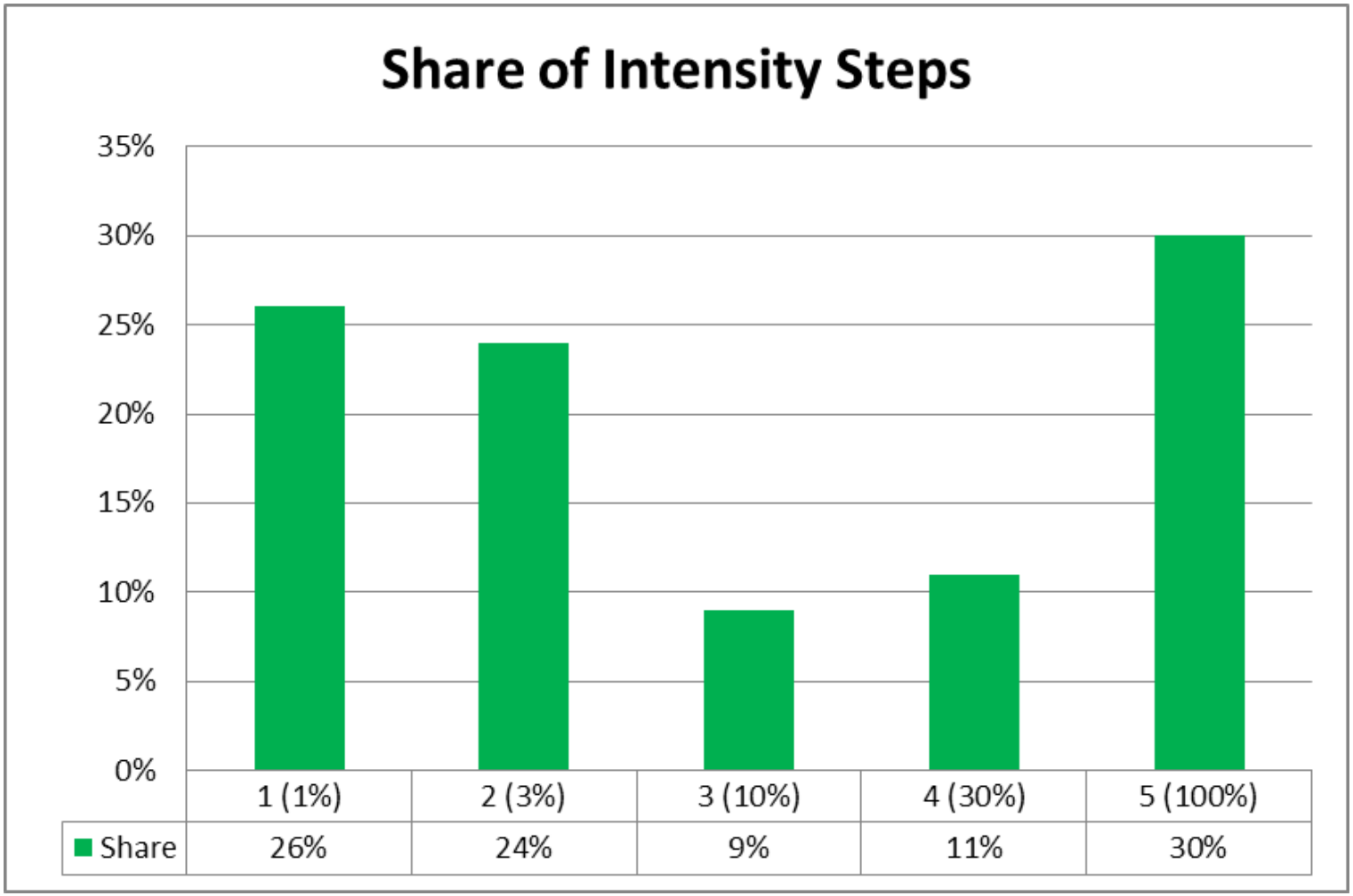

| | Nom. 6.6/6.6 | Nom. 6.6/2.2 |
|---|---|---|
| Prim Cable | 11,5 | 11,5 |
| Sec Cable | 31,1 | 3,5 |
| Lamp Transformer | 9,8 | 6,9 |
| CCR | 5 | 3,6 |

- The 2,2 A secondary current decrease the losses on the sec. cable about 89%
- The savings losses are in total ~55% at nominal power
- <u>The interesting question</u>:

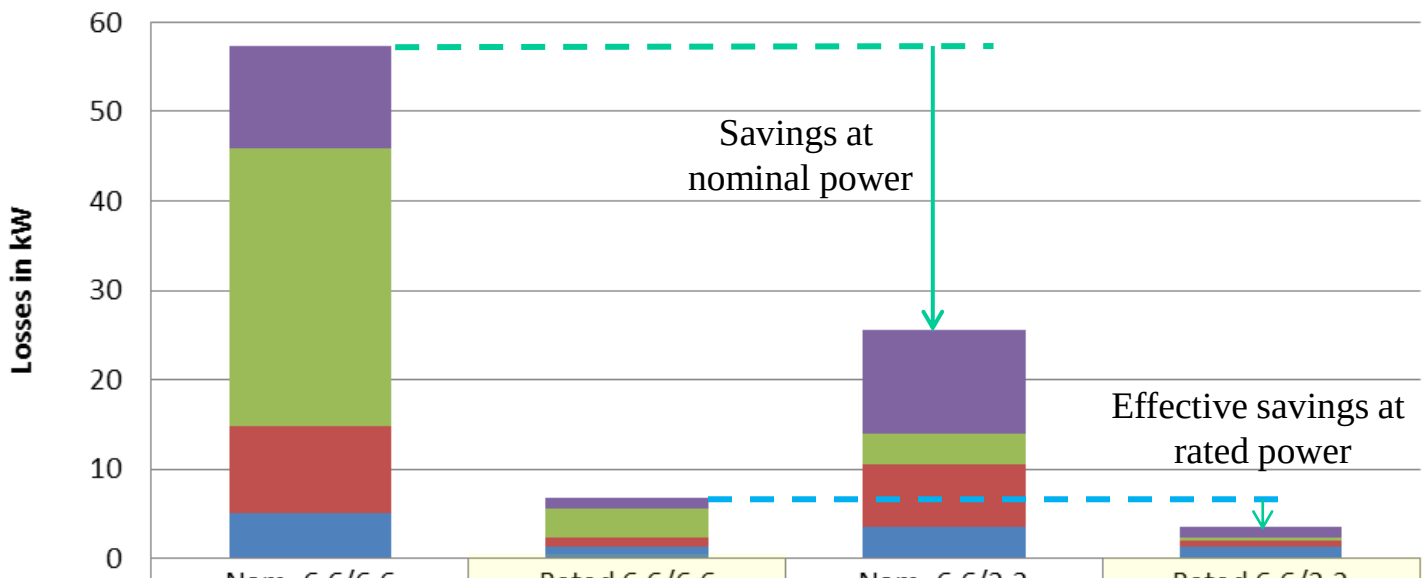
  What are the actual effective savings and how much the change of primary current could add?

# What is the share of the intensity steps in the AGL?

Statistically share for a midsize CAT III Airport in Germany



# What are finally the effective savings?

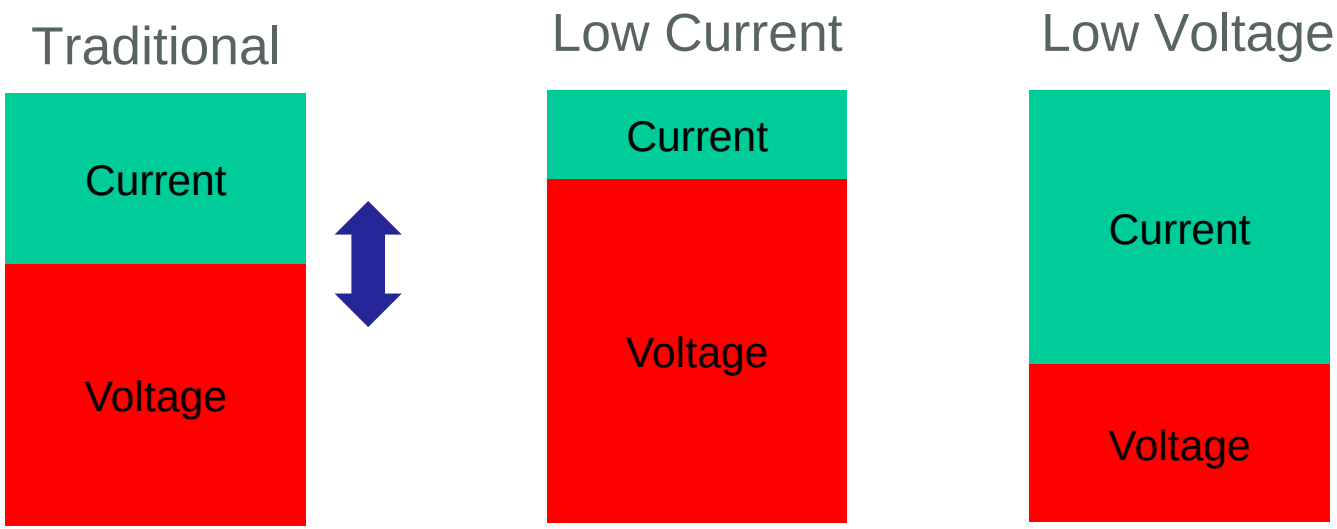



| | Nom. 6.6/6.6 | Rated 6.6/6.6 | Nom. 6.6/2.2 | Rated 6.6/2.2 |
|---|---|---|---|---|
| Prim Cable | 11,5 | 1,2 | 11,5 | 1,2 |
| Sec Cable | 31,1 | 3,2 | 3,5 | 0,4 |
| Lamp Transformer | 9,8 | 1 | 6,9 | 0,7 |
| CCR | 5 | 1,4 | 3,6 | 1,3 |

As the diagram shows the effective losses are just 1/10 of the calculated nominal losses!

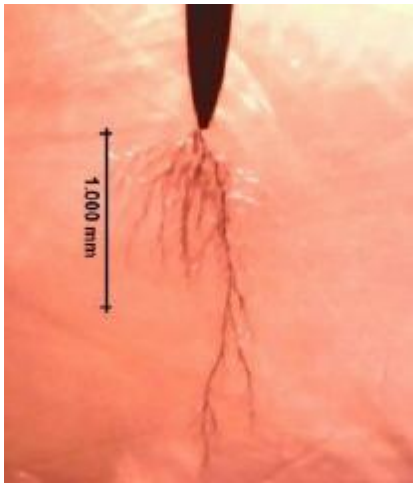
# What happened if we reduce the primary current?

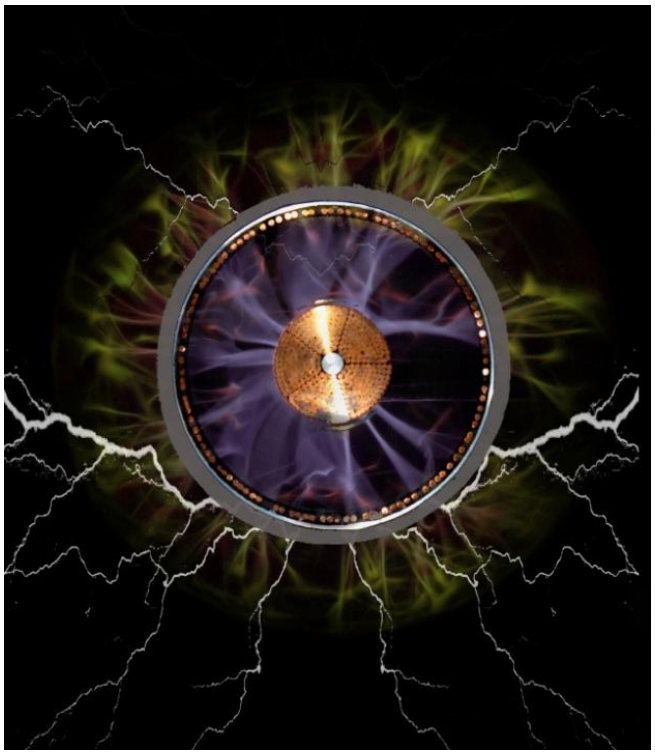
- Could there be any disadvantages to go for the additional saving by reducing the primary current?
- Decreasing the current automatically requires an increase of the voltage.



# What is the effect of the voltage to the installation?

- Voltage results an electrical field that stresses the insulation material
- Particular in areas with a high concentration of the electrical field the aging of material results a “treeing” with micro discharges

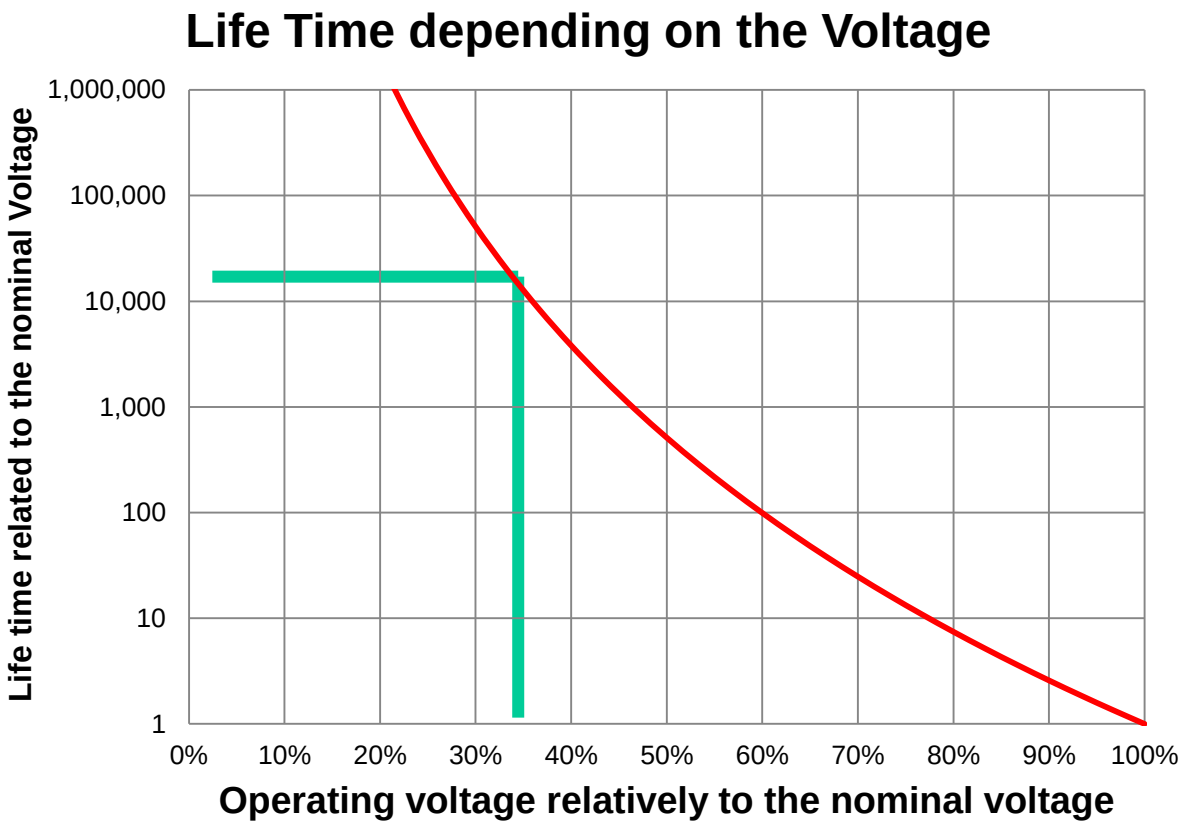


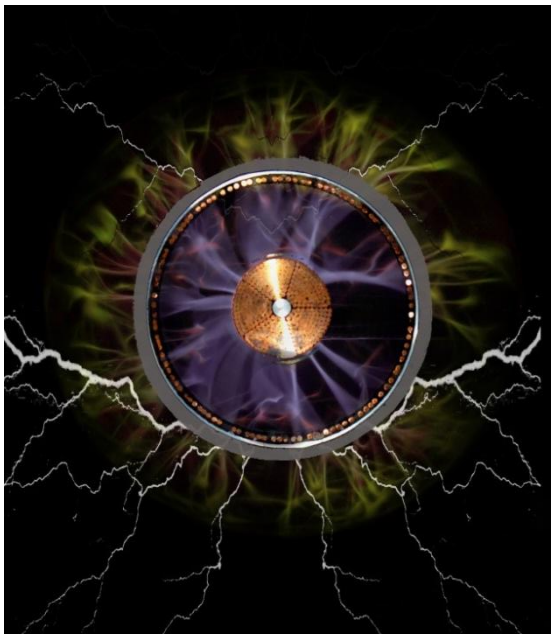



# What is the effect to the life time of the installation?

- The literature gives an empirical life time law

**Life time ~ $1/U^n$** *(n= 9 … 11) *)*



**Tilman Weiers; Diss. ETH Nr. 17363; Eine Methode zur aussagekräftigeren Bewertung von Maschinenisolierungen*

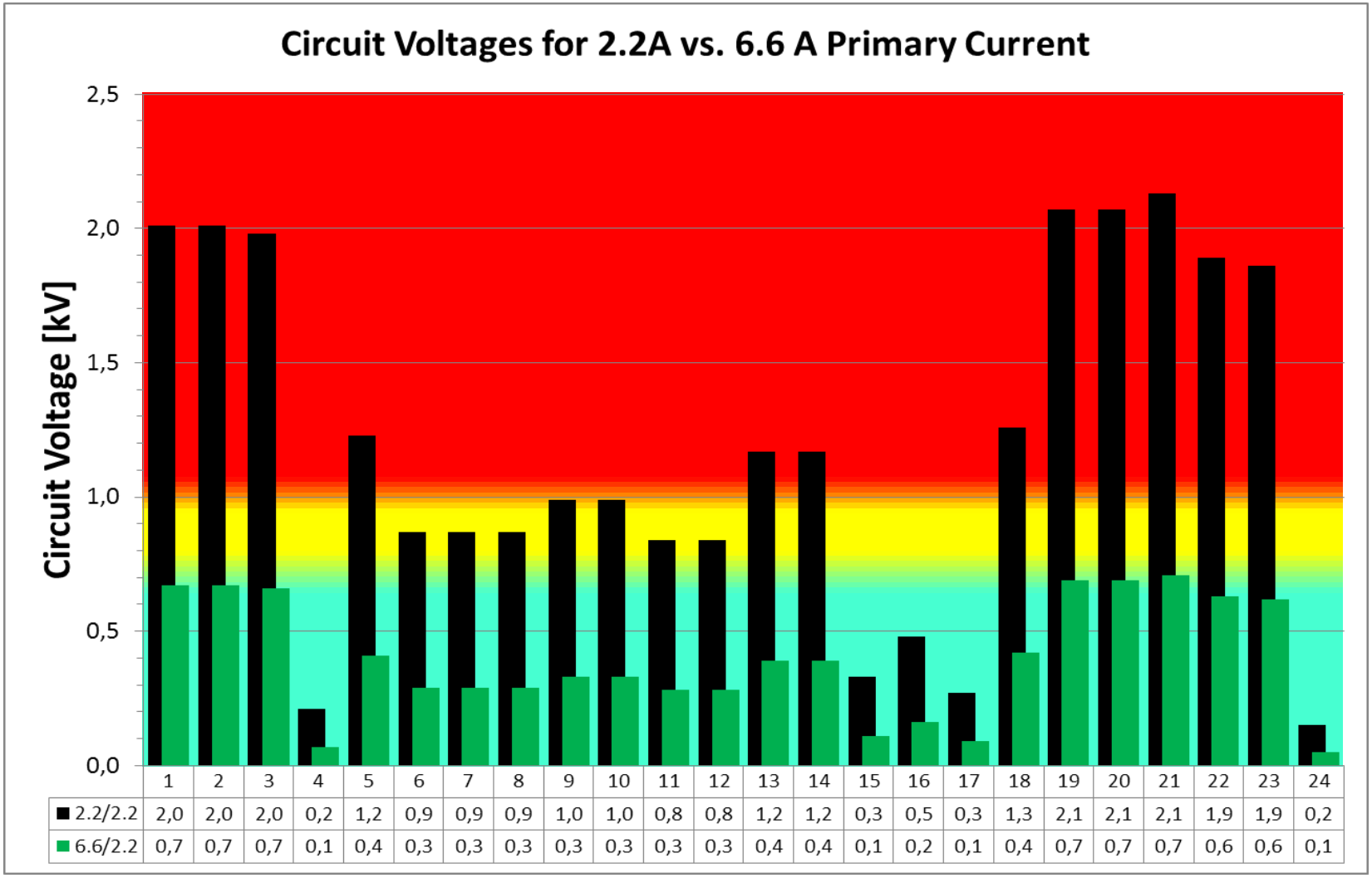
# Lower voltage compared to lower current?

- Reducing the circuit voltage provides
  - “Ever” lasting installations
    (particular for joints, connectors, transformers)
  - Higher grade of work safety with circuits less than 1000 V
  - Best support of SELV-Installations

- Reducing the primary current
  - 1,1 kW additional effective savings on the whole AGL

# The current situation at Kassel-Calden?

- The black columns are the theoretical 2,2A low current circuits




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.2/2.2 | 2,0 | 2,0 | 2,0 | 0,2 | 1,2 | 0,9 | 0,9 | 0,9 | 1,0 | 1,0 | 0,8 | 0,8 | 1,2 | 1,2 | 0,3 | 0,5 | 0,3 | 1,3 | 2,1 | 2,1 | 2,1 | 1,9 | 1,9 | 0,2 |
| 6.6/2.2 | 0,7 | 0,7 | 0,7 | 0,1 | 0,4 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,4 | 0,4 | 0,1 | 0,2 | 0,1 | 0,4 | 0,7 | 0,7 | 0,7 | 0,6 | 0,6 | 0,1 |

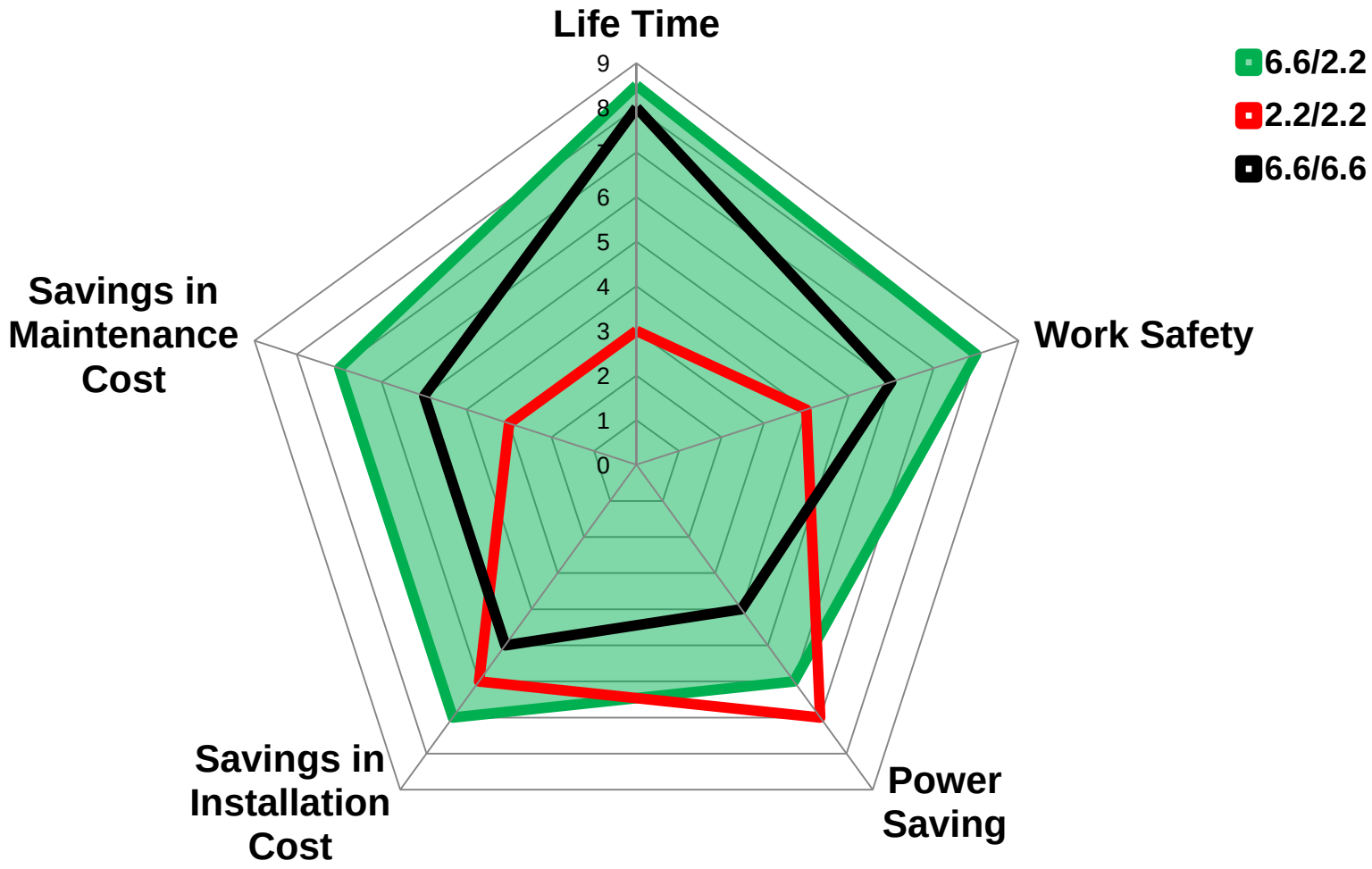
# Personal safety aspects

- The new 6.6 A / 2.2 A transformers installed at Kassel-Calden Airport fulfills already the proposed new IEC 62870 about the SELV supply for the LED-lights.
- All LED circuits are below 700 VAC and does not require high voltage certifications.
- The LED sequence flash light is powered with 35 VAC according to SELV.

# Conclusion

- Energy optimized installations will not consider automatically safety and life time aspects.
- To stay on the 6,6 A and choose for the lower voltage brings best benefits for installation life time and work safety
- The change to the SELV supply provides the first time real work safety on the airport.
- To change to 2,2 A on the secondary minimize the major losses.
- Automatically adapting light fixtures allow to operate mixed installations

# What installation provides the best ?




Considering all aspects the 6.6 A / 2.2 A installation provides the optimum in energy, life time and safety.

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## Questions?

## Thank you for your attention.

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