

COMBINED COMPETENCE UNDER ONE ROOF

DigMet ESCD

Early Short-Circuit Detection

European Metallurgical Conference
Emc 2021
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organized
by



DI Matthias Lindthaler
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Outline

- 1** Introduction
- 2** Refining electrolysis
- 3** Test setup
- 4** Mounting options
- 5** Financial benefit

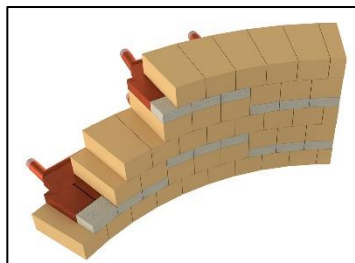


Organization Chart



Key to Mettop's position as an expert partner is the open-minded, creative spirit of our team. We develop innovations in cooperation with renowned institutes and universities and especially with YOU! This interaction with third parties constantly provides new dynamics and fresh inspiration.

Overview Products and Services



Non-ferrous metals units

Refractories non-ferrous

E-waste recycling UrbanGold

Tankhouse technology

ILTEC for vessel cooling

Products:

- ◆ PolyTBRC[®]
- ◆ HENRI[®]
- ◆ Gas Purging Systems
- ◆ Coolers



Products:

- ◆ 3D Engineering + supply
- ◆ CFD modeling
- ◆ HT-calculations
- ◆ EXP-calculations

Products:

- ◆ Project Development
- ◆ Process Engineering
- ◆ UG Technologies
- ◆ Studies

Products:

- ◆ METTOP-BRX[®] Technology
- ◆ Cathode spacers
- ◆ Complete Tank house
- ◆ ESCD

Products:

- ◆ IL-B2001[®]
- ◆ Ionic Liquid Technology for vessel cooling
- ◆ Furnace integrity optimization

Overall Process & Technology Consulting

Field Studies & Trainings

Process and 3D Plant Engineering

Research & Development & Innovation

DigMet



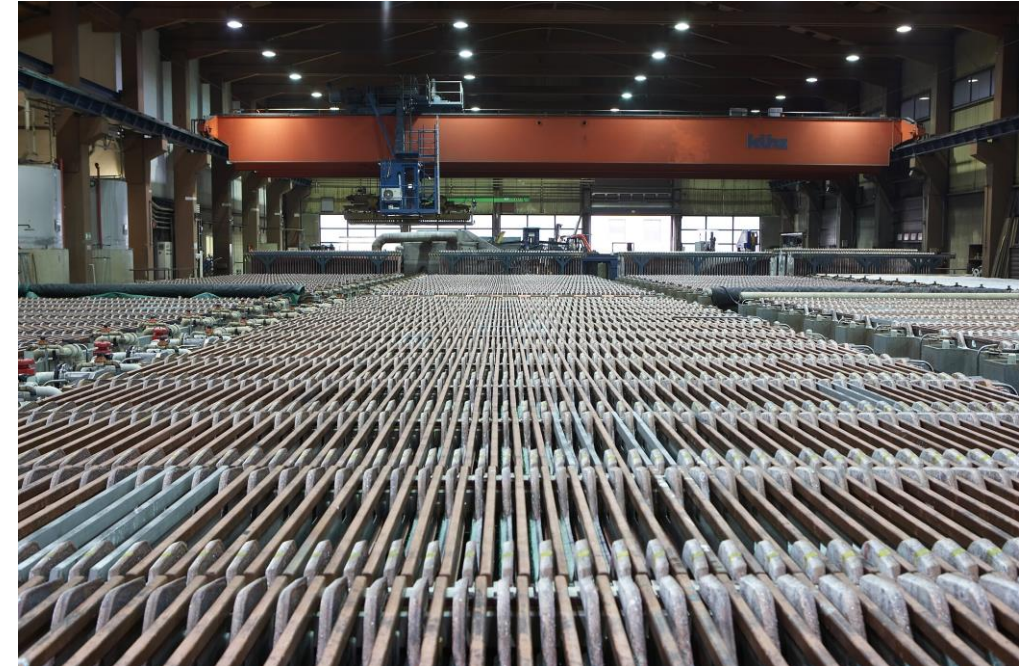


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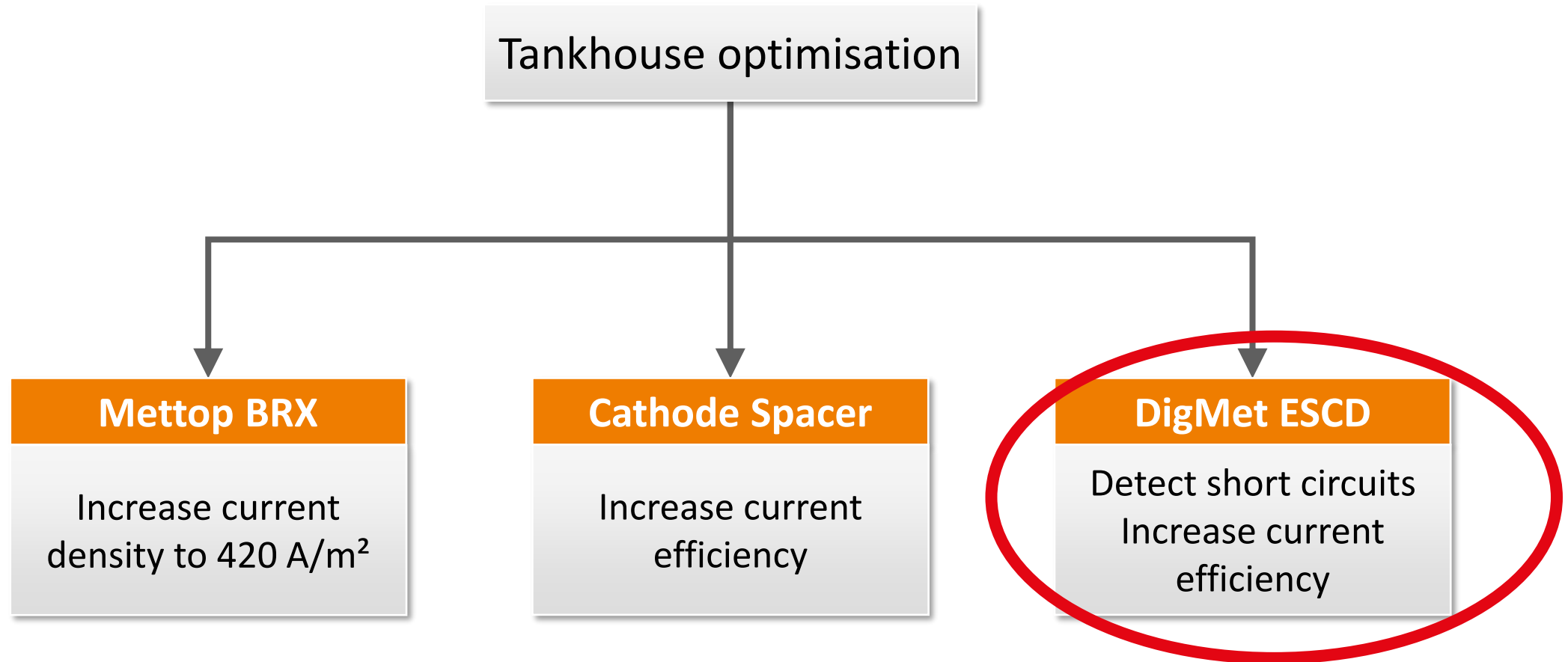
Early Short-circuit detection

Refining electrolysis

- Refining
 - Copper anodes with a purity of **98.5%-99.5%** -> copper cathodes with a purity of at least **99.99%**
- Refining process
 - Continuous process
 - 4-10 days cathode cycle
 - 12-21 days anode cycle
- Main parameters
 - Current density
~300 - max. **420 A/m²** with **METTOP BRX**
 - Current efficiency
88-99%



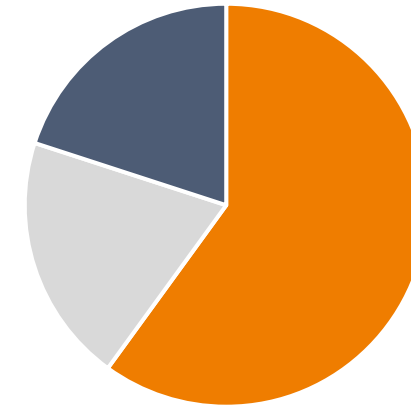
Tankhouse optimisation



Introduction

- Reasons for short circuits
 - Inaccurate hanging of the electrodes
 - Bent cathodes
 - Irregular anodes
 - Solid particles in the electrolyte
- Methods to detect short circuits
 - Gaussmeter
 - Special electrode arrangements
 - **Thermal imaging**

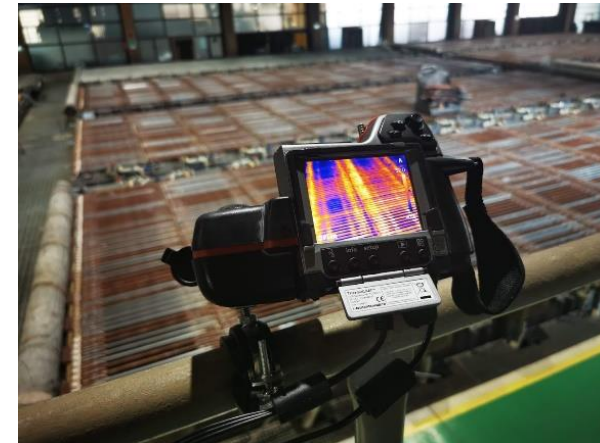
Current losses



■ Short circuits ■ Stray current ■ Reoxidation of copper

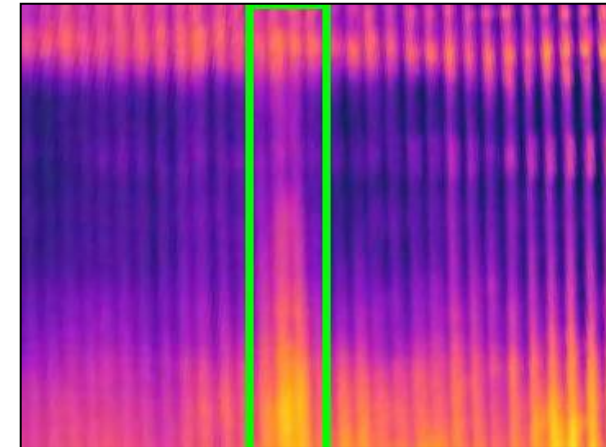
Setup

- Used thermal camera:
 - Flir T360
 - Mounted diagonally above the cell
 - No access to the raw data
- Measurement period: 26 days and 13 hours
- 31 anode/cathode pairs observed
- Object detection algorithm: YOLOv3
- Modell accuracy above 98%



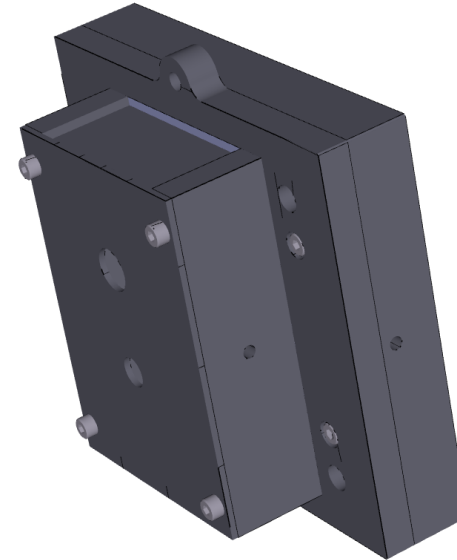
Evaluation of the results

- 41 % of the time, there was at least one short circuit
- 458 hours short circuit time
- Mean duration of shorts above 12 hours
- Average short percentage was 2.32%
- 36 short circuits

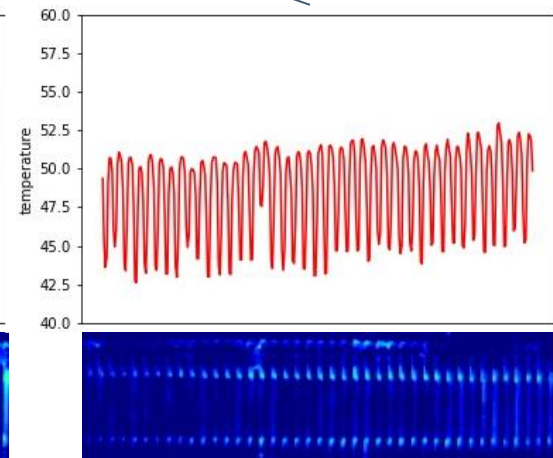
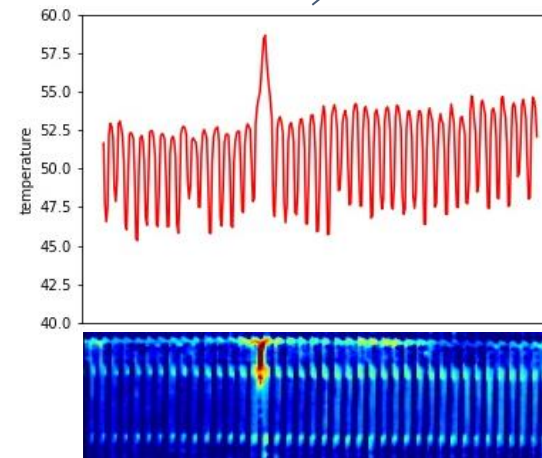
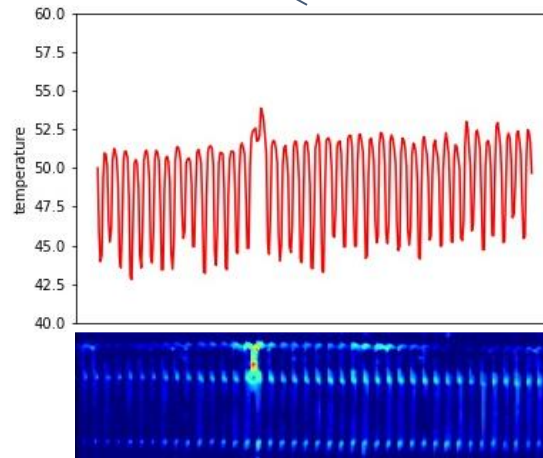
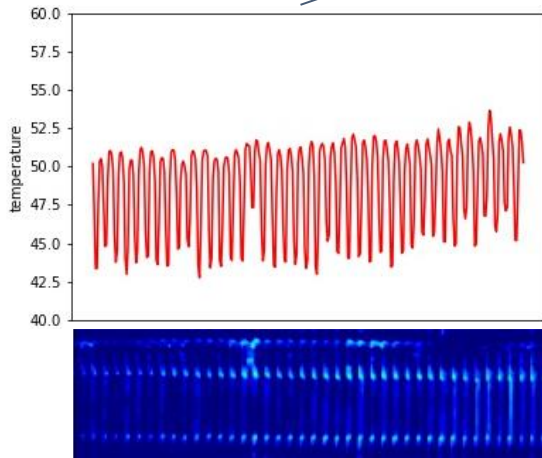
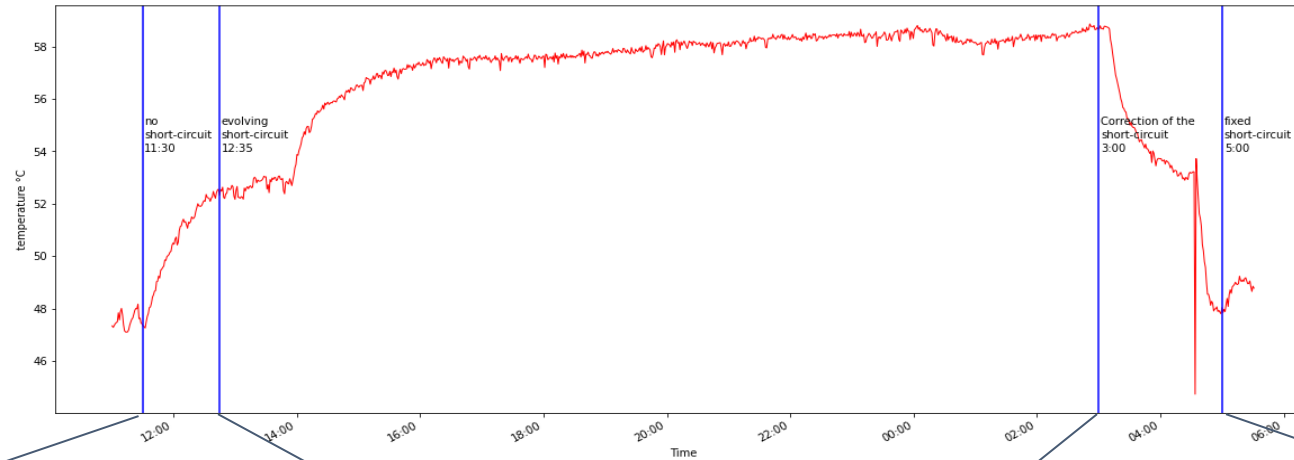


Setup

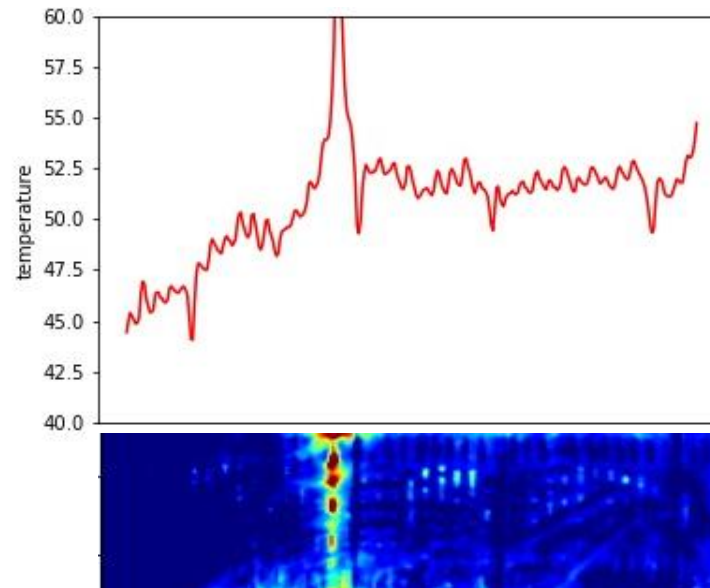
- Specially developed thermal camera
 - Resists acid and temperatures above 70°C
 - Cooling and purging air
 - 320x240px resolution
- Mounted on the ceiling
- Similar results to the first test



Evaluation of one short-circuit

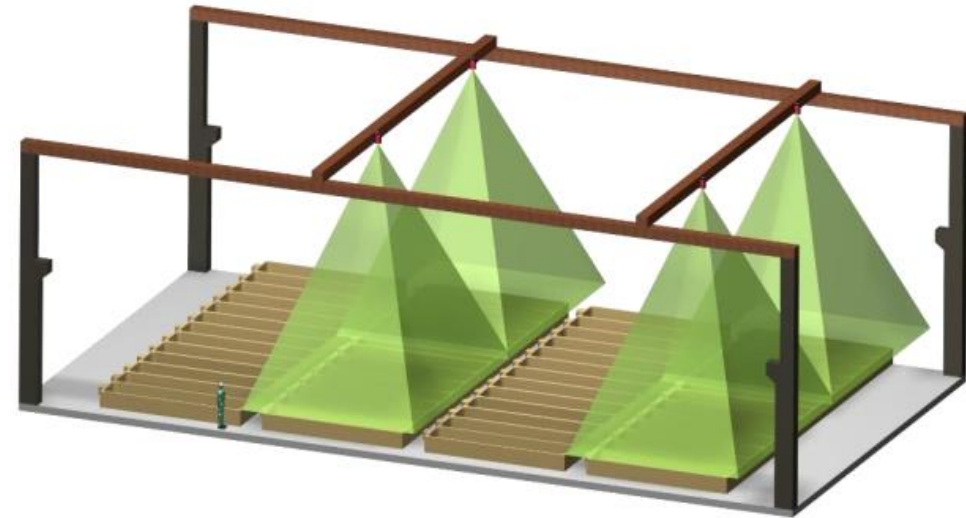


Evaluation of one short-circuit under a cell cover



Industrial applications

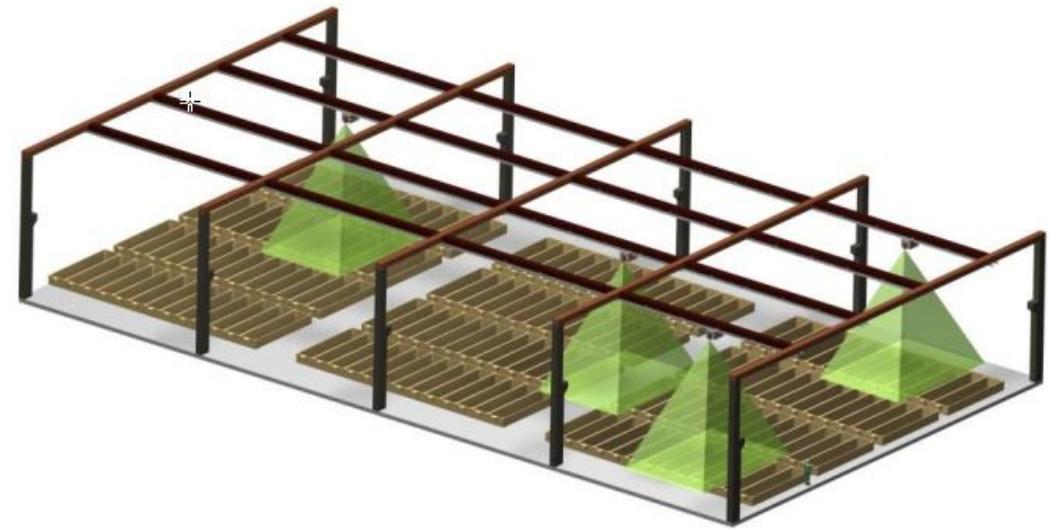
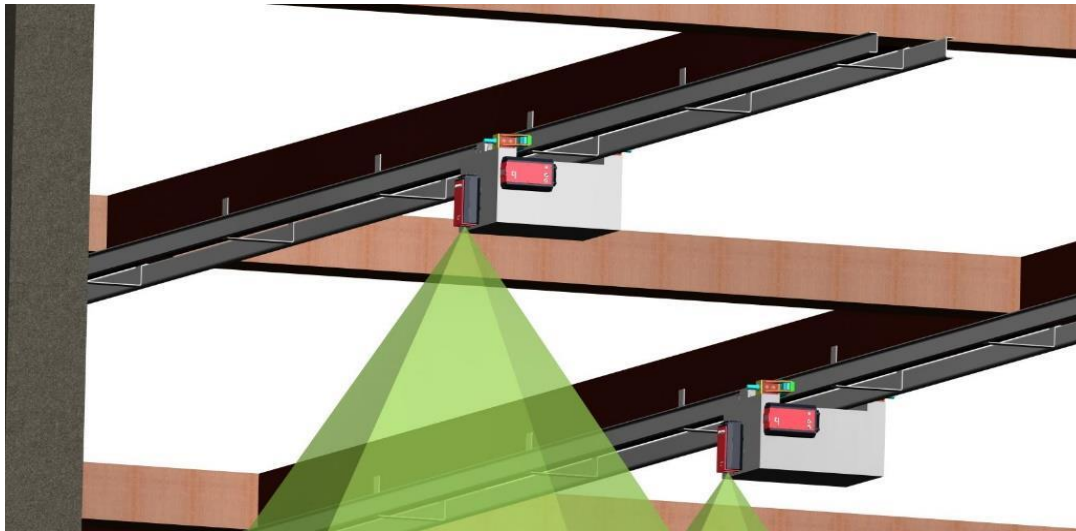
- **Stationary cameras**
- Movable systems
- Crane mounting
- Drone mounting (in evaluation)



- + Complete monitoring of cells
- + No moving parts
- Large numbers of camera
- High maintenance effort

Industrial applications

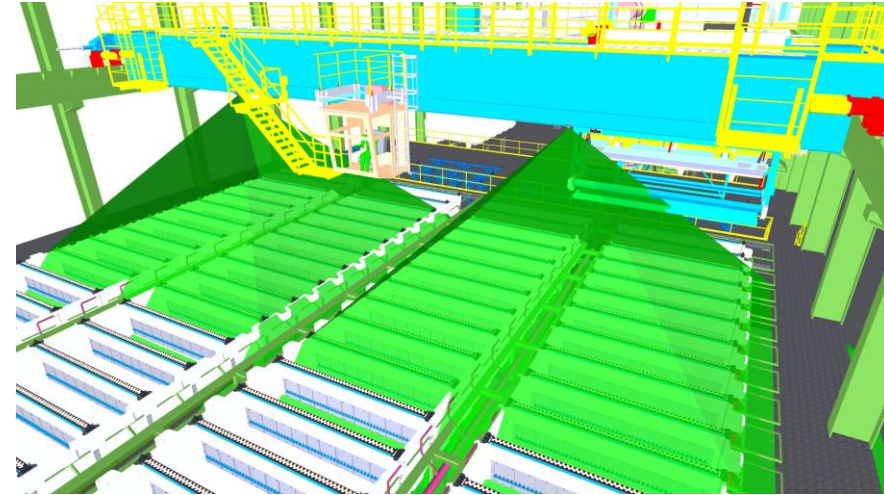
- Stationary cameras
- **Movable systems**
- Crane mounting
- Drone mounting (in evaluation)



- + Smaller amount of cameras
- Higher installation effort
- No continuous monitoring

Industrial applications

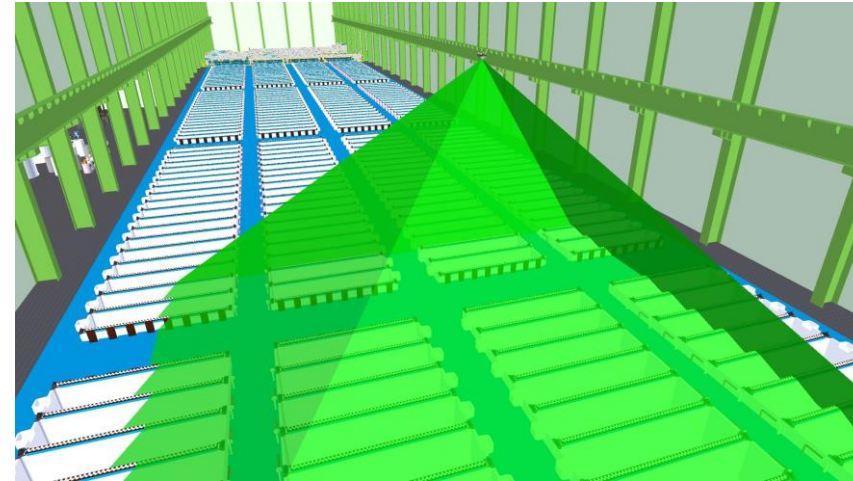
- Stationary cameras
- Movable systems
- **Crane mounting**
- Drone mounting (in evaluation)



- + Smaller amount of cameras
- + Low installation effort
- + Use existing infrastructure
- No continuous monitoring

Industrial applications

- Stationary cameras
- Movable systems
- Crane mounting
- **Drone mounting (in evaluation)**



- + Smaller amount of cameras
- + Low installation effort
- Magnetic fields cause problems
- No GPS-navigation
- Safety concerns

Benefit

- Increase in current efficiency
- Energy savings
- Lower fixed costs
- Lower reworking costs
- Less local overheating of the electrolyte

Financial Benefit

Assumptions

- Tankhouse of 200.000 tons per year
- Anode weight remains the same
- Casting costs for remelting: 150€/t
- Fixed costs of 80€/t
- Power consumption 360 kWh/t copper
- Electricity price: 0.0877 €/kWh

Savings

- Reworking costs: ~300.000€
- Power savings: ~60.000€
- Fixed costs: ~160.000€

Annual savings of **520.000 €/year**
for a production quantity of **200.000 t/year**

Summary and Outlook

- Short circuits can be detected up to 12 hours earlier
- No adjustments to the cell must be made
- Annual savings of **520.000 €/year** for a production quantity of **200.000 t/year**



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