Kurzvorträge über die

25. CIRED – Internationale Konferenz für Stromverteilung

von 3.-6. Juni 2019
in Madrid, Spanien

Session: 1 – Komponenten für den Netzbetrieb

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Klaus Trentler – Schneider Electric

Details Session 1

- 152 Berichte in der Session 1 – Komponenten für den Netzbetrieb

- Berichte aus Österreich:

  Paper 1837: Benchmarking Linear and Non-linear Behavior of Power Inductors for Switched Mode Power Supplies (RIF).

  - 4 Blöcke
  - 24 Vorträge in der Main Session (je Block 6 Sessions)
  - 3 Round Tables (RT)
  - 1 Research and innovation Forum (RIF)
  - Poster Session & interactive Poster Session

4 Blöcke Session 1

- **Session 1 – Komponenten für den Netzbetrieb**
  - Block 1: Anlagenmanagement und Zustandsbewertung von Netzkomponenten – Kabel, Freileitungen und assoziierte Komponenten (40 Beiträge)
  - Block 2: Anlagenmanagement und Zustandsbewertung bei Komponenten/Produkten für den Netzbetrieb – Netzstationen, Schaltanlagen und Transformatoren (40 Beiträge)
  - Block 3: Innovationen bei Netzkomponenten – Kabel, Freileitungen und neue Komponententypen (34 Beiträge)
  - Block 4: Innovationen bei Komponenten/Produkten für den Netzbetrieb – Netzstationen, Schaltanlagen und Transformatoren (38 Beiträge)

Organisation Session 1

Chairman:

- **Christophe BOISSEAU (France)**

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Rapporteure:

- **Arnaud ALLAIS (France)**

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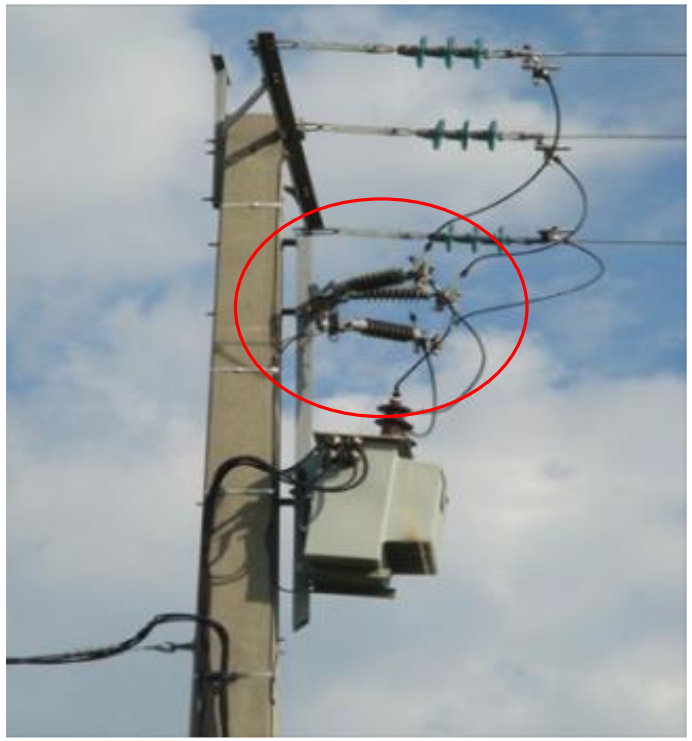
1. Block Session 1

- Block 1: Anlagenmanagement und Zustandsbewertung von Netzkomponenten – Kabel, Freileitungen und assoziierte Komponenten (40 Beiträge)

  - Neue Lösungen für die optimierte Installation und Wartung von Kabeln und Freileitungen (11 Papers)
  - Zustandsmonitoring (15 Papers) und
  - OpEx/CapEx Optimierung (14 Papers).

1. Block Session 1

- Paper 0940 :Distribution Surge Arrester Monitoring



- 350.000 km MSP Freileitungen, 2 Mio. Überspannungsableiter
- Spezifisch: Verbleibender Kurzschluss wenn sie außer Betrieb sind
- Netzbetreiber muss das Netz abfahren um den fehlerhaften Überspannungsableiter zu finden

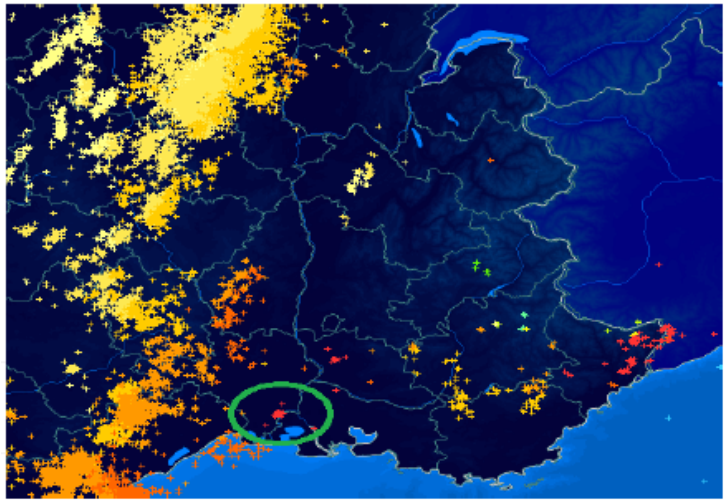
SAIDI (System Average Interruption Duration Index) wird durch Überspannungsableiter beeinflusst:

- Jedes Jahr fallen 400 Ableiter aus
- Im Durchschnitt 61 Minuten Unterbrechungsdauer je Fehler

<u>Enedis and DERVASIL entschieden sich ein Wireless Surge Arrester Monitoring device (WSAM) zu entwickeln und zu testen.</u>

1. Block Session 1

- Paper 0940 :Distribution Surge Arrester Monitoring



- WSAM Leckstrommessungen korrelieren sehr gut mit hoher Blitzaktivität
- Induzierter Leckstrom durch Blitzimpuls wird gleichzeitig bei einigen Ableitern beobachtet (Gebiet in der Nähe des Bitzeinschlags)

- Mit Leckstrommessungen wird der Status der Ü-Ableiter bestimmt und im Fehlerfall ein Alarm gesendet (µA bis kA)
- Feldtest 11 WSAM Prototypen (2 Jahre), parallel Prüflabortests (Hochstromprüfung, Funktionsprüfungen)

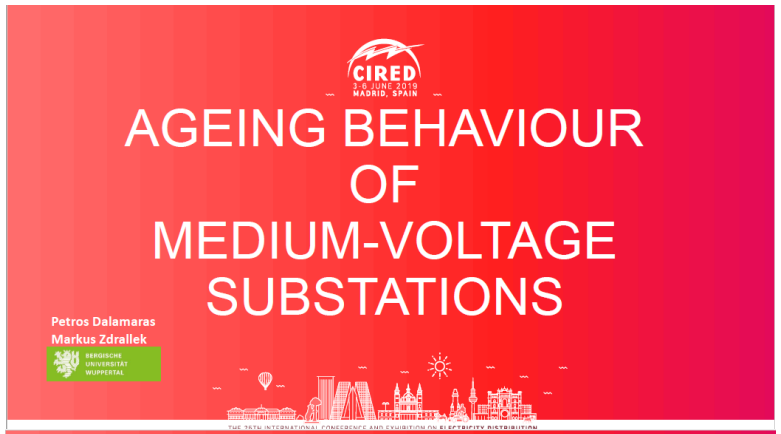
1. Block Session 1

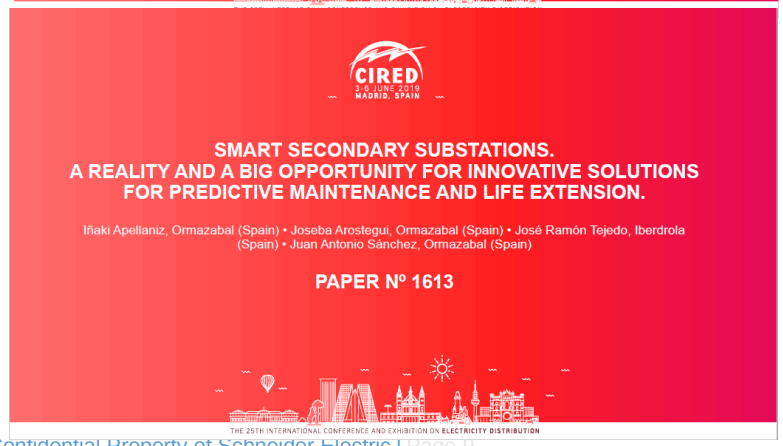
- Paper 0940 :Distribution Surge Arrester Monitoring

- WSAM Gerät bringt Kostenvorteile für VNB (SAIDI-Verbesserung)
  → Zeitreduktion von 30% beim Prozess den Fehlerort zu lokalisieren, den Fehler vom MSP-Abzweig zu separieren und den gesunden Teil des Abzweigs wieder in Betrieb zu nehmen.
- DERVASIL propagiert eine Lösung die in allen MSP-Netzen implementiert werden kann.
- Das WSAM Gerät könnte auch für das Monitoring von anderen MSP-Komponenten wie Transformatoren und Verbundisolatoren eingesetzt werden

2. Block Session 1

- Block 2: Anlagenmanagement und Zustandsbewertung bei Komponenten/Produkten für den Netzbetrieb – Netzstationen, Schaltanlagen und Transformatoren (40 Beiträge)





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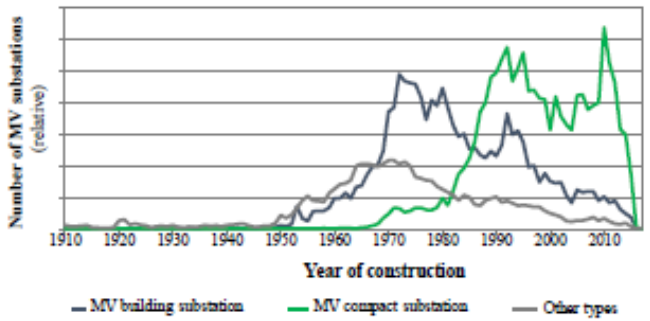
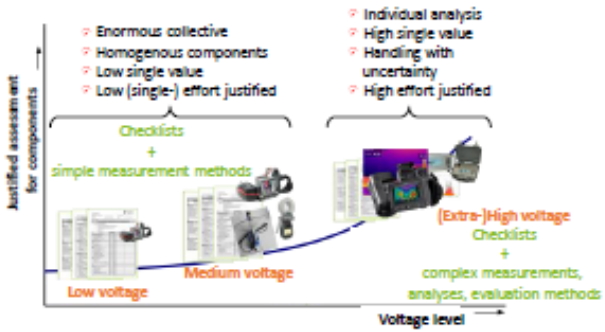
Challenges for DSOs

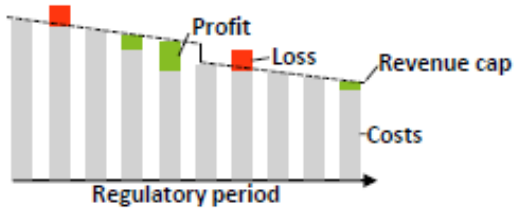
- Electrical components have a greatly **increased age**



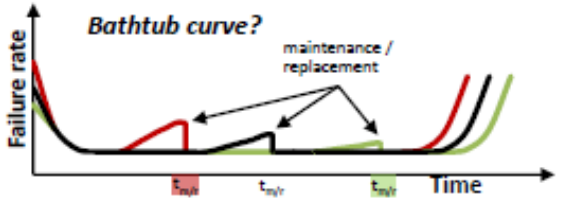
- Justified **effort** depending on the voltage level



- Optimized strategies to reduce **OPEX** & **CAPEX**



- Optimized strategies to ensure **reliable** energy **supply**



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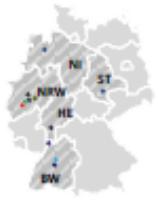
A new systematic assessment approach

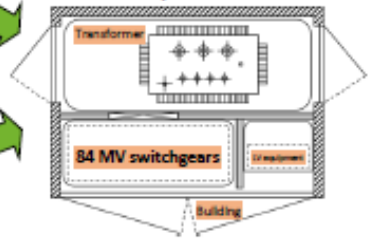
Inspection checklists (soft facts)

Measurement methods (hard facts)

11 DSOs

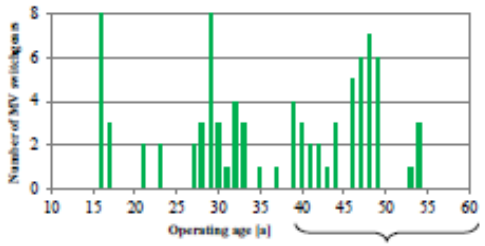


100.000 inspection checklists

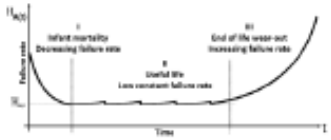


18.000

Evaluation of each inspection point → Weighting of each inspection point → Weighting of main inspection point → Condition index



46 %



Ageing behaviour for asset simulation

Strategic planning

[2] Johae, C.; Beerboom, D.; Zdrallek, M.: Zustandsorientierte Bewertung elektrischer Industrienetze als Basis für moderne Anlagen- und Instandhaltungsstrategien, Fachtagung TÜV SÜD "Zustandsbewertung in der Energie und Anlagentechnik", München (2016)

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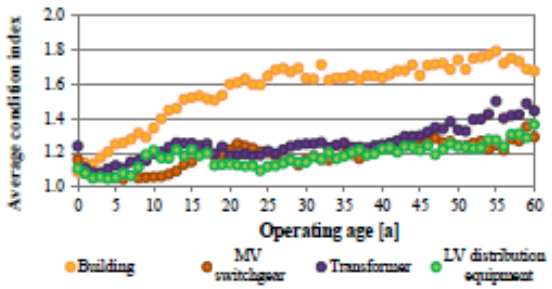
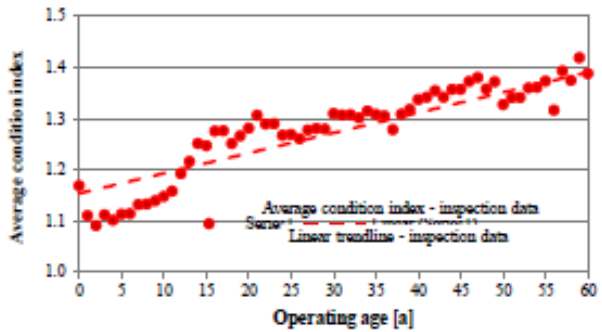
Condition-dependent ageing curves

Analyses of the inspection results

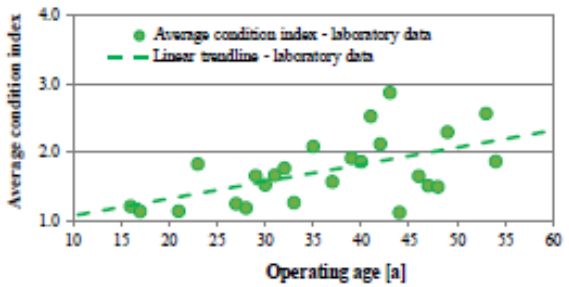


Ageing behaviour of the **main components**



Ageing behaviour of the **MV substations**

Analyses of the measurement results



Ageing behaviour of the **MV switchgears**

Conclusion: **No indication for a bathtub curve!**

Project results show a **linear ageing behaviour** for the electrical components of the MV substations

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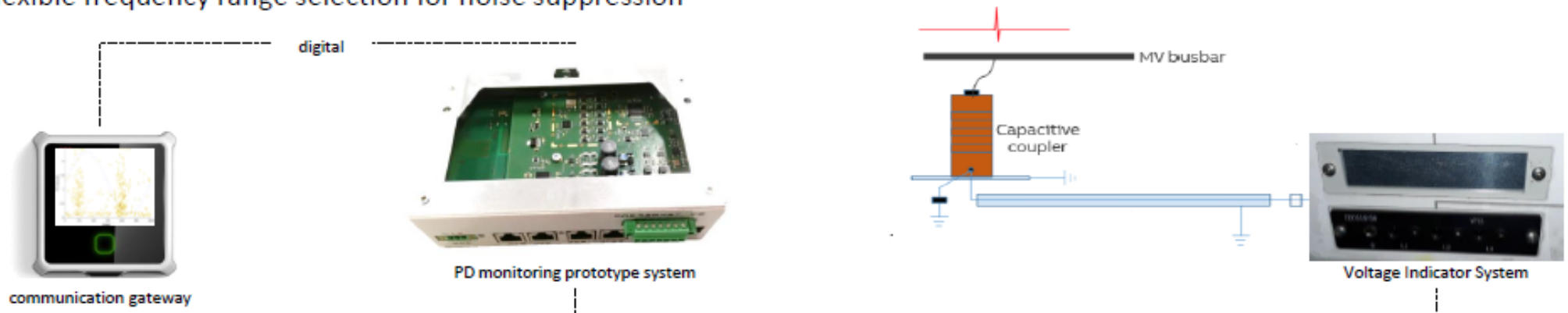
PD monitoring – prototype system for retrofit

- On-line PD monitoring prototype system
- Use the existing connection to HV: piggy-back to the "voltage indication system (VIS)," and re-use already installed coupler in order to avoid accessing the HV switchgear compartment
- Enable PD measurement **without** removing the VIS functionality
- The three phases are measured separately and simultaneously
- Flexible frequency range selection for noise suppression



4 Carlo Gemme, Federico Gallesi, Francesco Guastavino, Kai Hencken, Andrej Krivda, Yannick Maret, Marco Testa – 383

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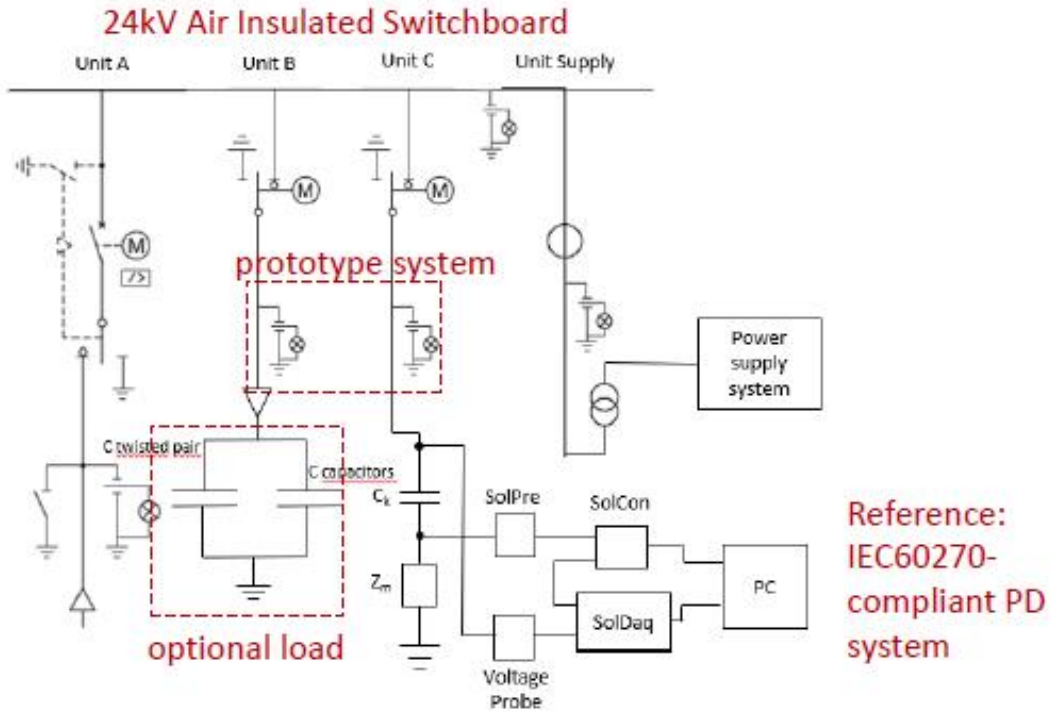
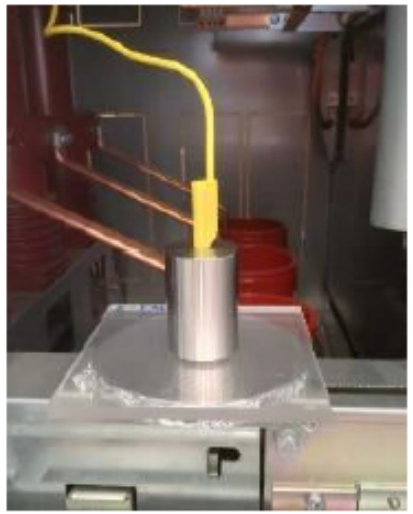
Performance – test installation

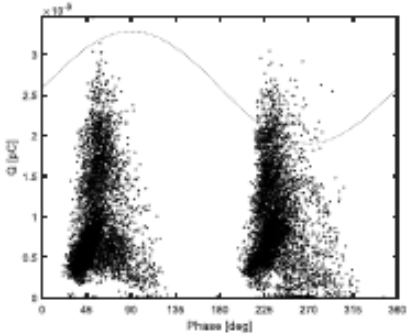


Reference: IEC60270-compliant PD system

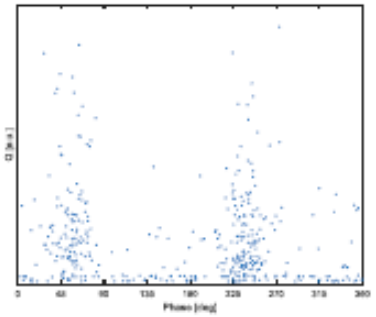
Performance – PD source & results



a laboratory surface discharge producing device



surface discharge pattern recorded by the reference system



surface discharge pattern recorded by the prototype system

- 100pC calibration: reference and PD monitoring prototype system have both sensitivity much better than 100pC.
- Real PD: information content and the sensitivity are similar between the reference and prototype systems.
- Note: The PD monitoring prototype system captures less PD events due to the intermittent acquisition schedule, which is needed for keeping the VIS functionality.

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Commission Regulation 548/2014

- Limits on losses for distribution transformers (up to 3 150 kVA)
- Limits on Peak Efficiency Index (PEI) for power transformers (above 3 150 kVA)
- Tier 1 from July 2015: A_0 / C_k
- Tier 2 from July 2021: A_0-10% / A_k

Regulation aim: Reduction of environmental impacts (emmissions) from use phase of transformers

Philosophy behind: Force limits on losses or efficiency → Encourage use of new technologies, materials, solutions for reducing transformer losses

Conclusions

- **New transformer complies with size limitations based on original transformer**
- Reduced footprint and weight
- Lower Total Ownership Cost (increased energy efficiency), when considering the typical, relatively low loading pattern
- Extended insulation life
- Improved overload capability
- Reduced sensitivity to high ambient temperatures or malfunctioning ventilation or cooling systems in substations
- Reduced environmental impact by reduced consumption of raw materials
- Reduced impact on environment by use of vegetable and biodegradable oil
- Improved fire safety if class K ester is used

3. Block Session 1

- Block 3: Innovationen bei Netzkomponenten – Kabel, Freileitungen und neue Komponententypen (34 Beiträge)
  - Neue Designs (13 Papers)
  - Dynamische Lastanpassung und thermische Modellierung (3 Papers)
  - Intelligente Zähler – Energiefluss und Qualität (8 Papers) und
  - Ausblick (10 Papers).

3. Block Session 1

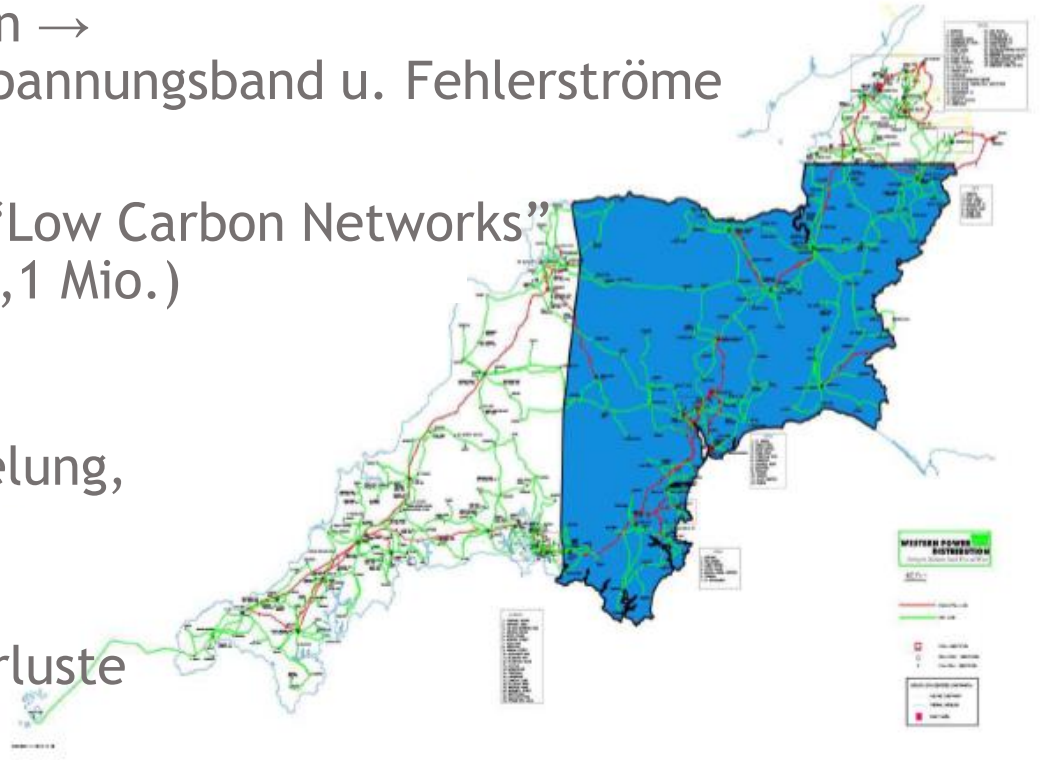
- Paper 1617:The Operational Performance and Benefits of an MVDC Device Integrated Within a 33kV Distribution Network (Project NETWORK EQUILIBRIUM South-West UK 03/2015-06/2019)

  - Thema: fluktuierende dezentrale Erzeugungsanlagen → therm. Komponentenüberlastung, Überschreitung Spannungsband u. Fehlerströme

  - gefördertes Pilot-Projekt: £13 Mio.(EUR 15,3 Mio.) “Low Carbon Networks” Einsparung (nach Pilot): £15 – 5,6 = 9,4 Mio.(EUR 11,1 Mio.) im Vergleich zu konventionellen Lösungen

  - Weitere Vorteile: schnelle Umsetzungszeit, PQ-Regelung, Entkopplung über DC

  - Herausforderungen: Schutztechnik, Optimierung Verluste



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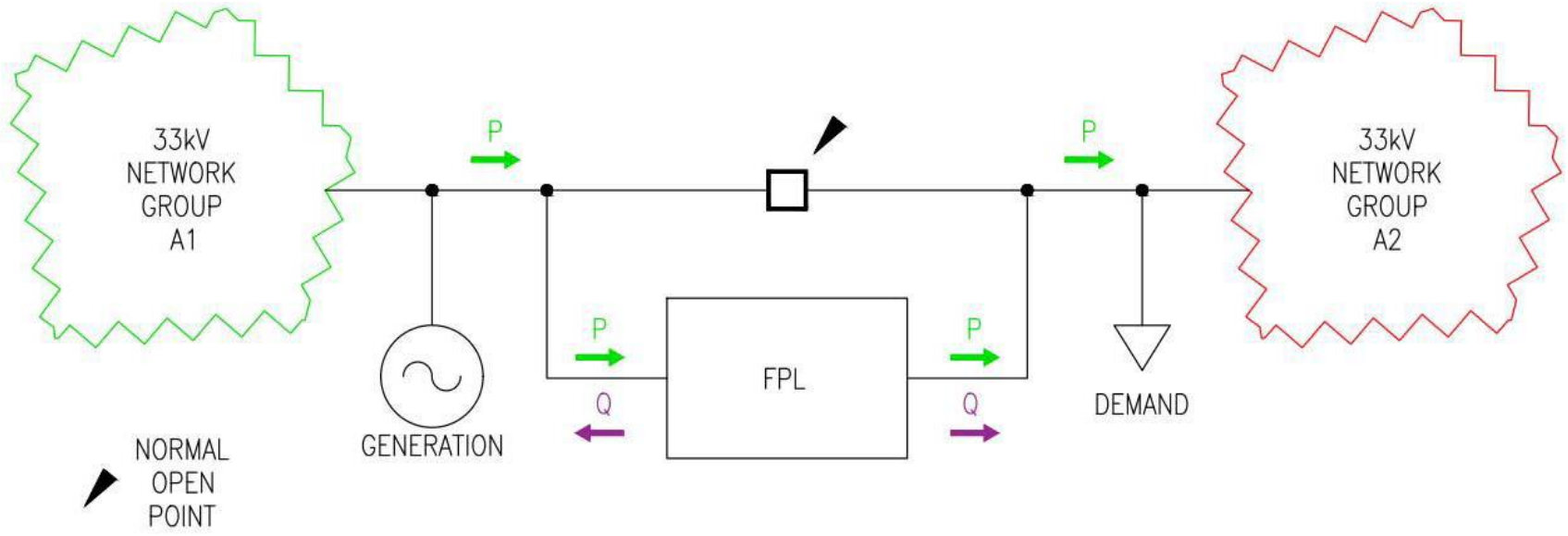

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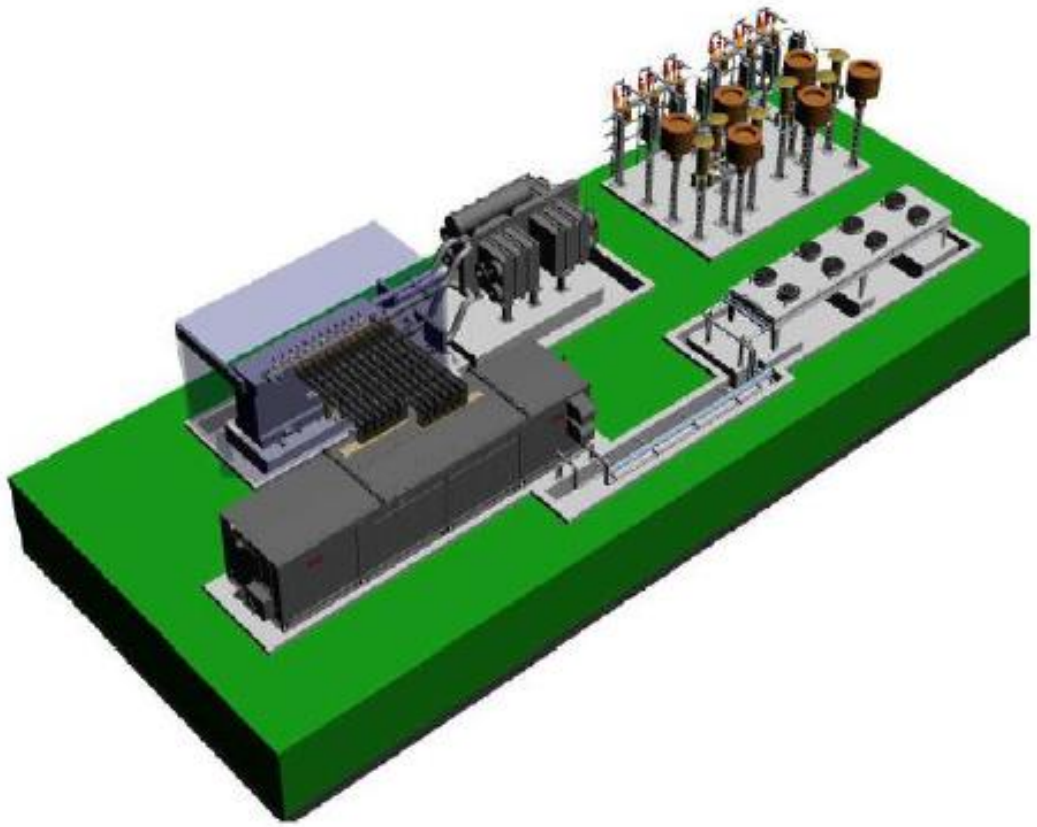

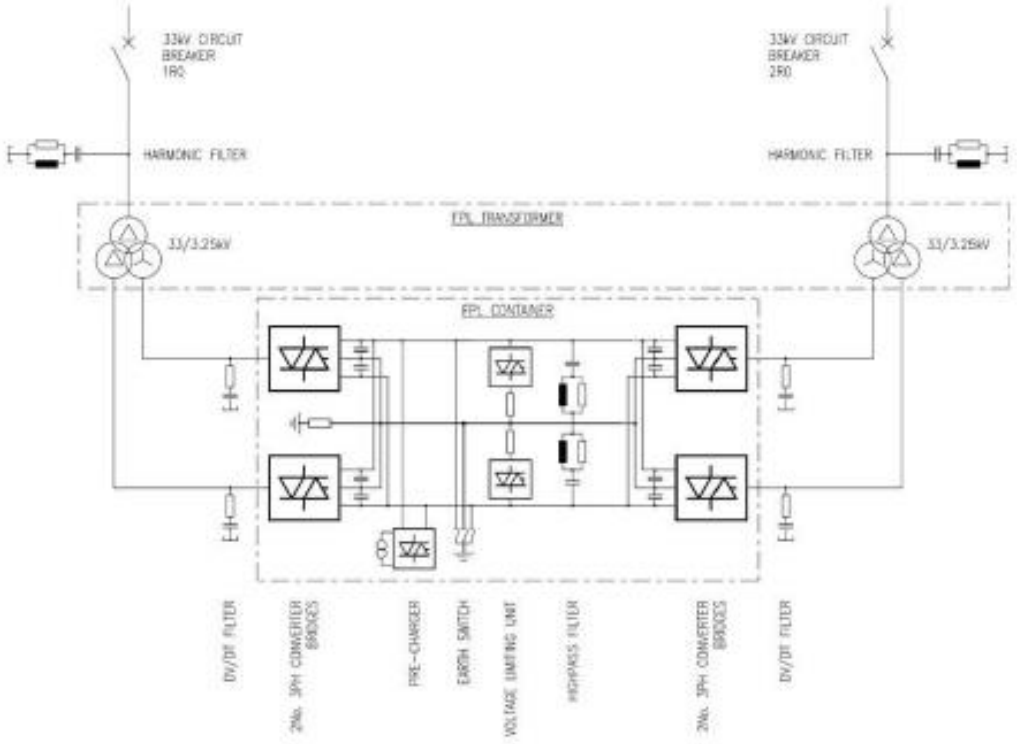

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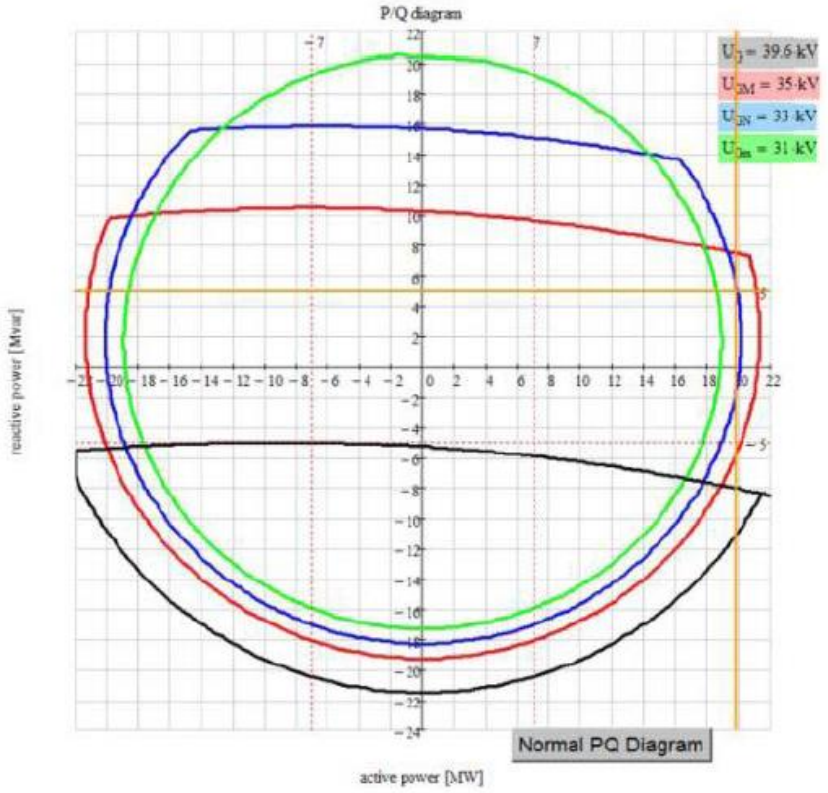
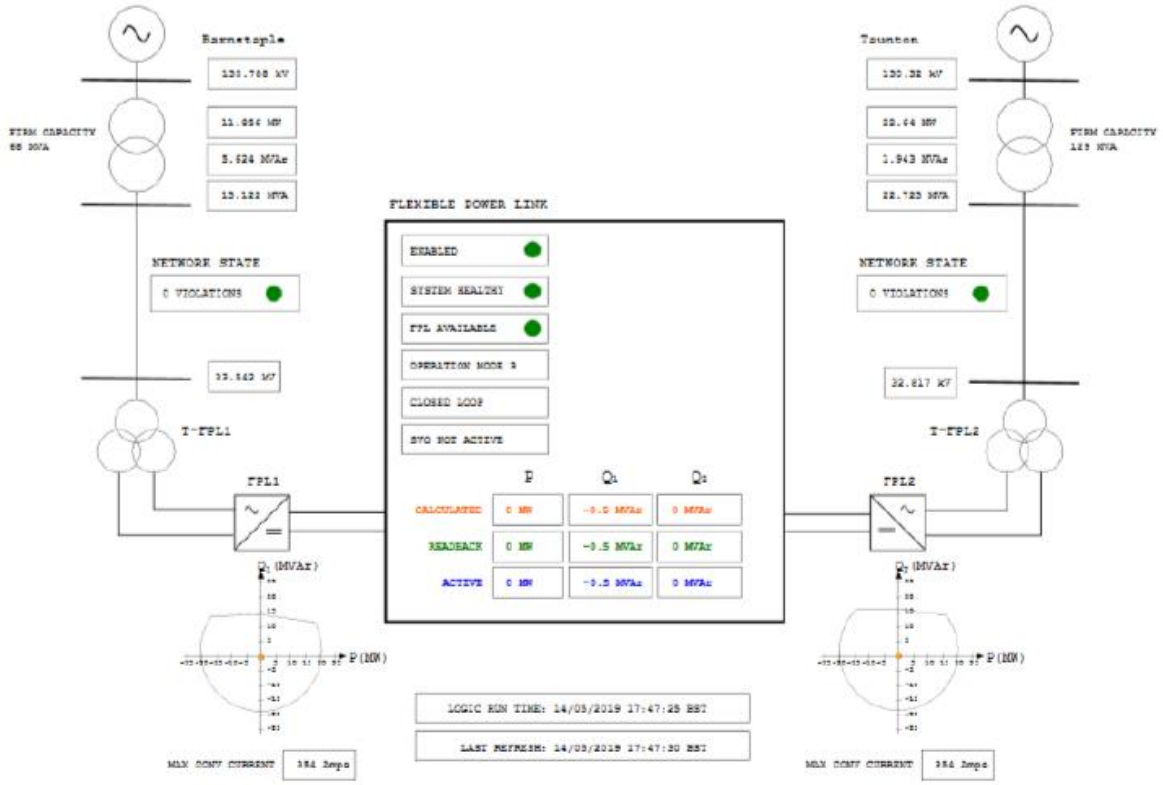
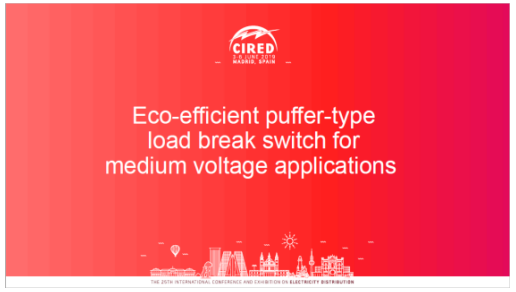




4. Block Session 1

- Block 4: Innovationen bei Komponenten/Produkten für den Netzbetrieb – Netzstationen, Schaltanlagen und Transformatoren (38 Beiträge)

- 6 Präsentationen: Hauptfokus:
  - Alternativen zu SF6-Gas – 3 Vorträge
  - SF6 Schaltanlage – Unterwassereinsatz
  - Transformatoren – 2 Vorträge



Performances and safety properties of alternative gases for load break switch

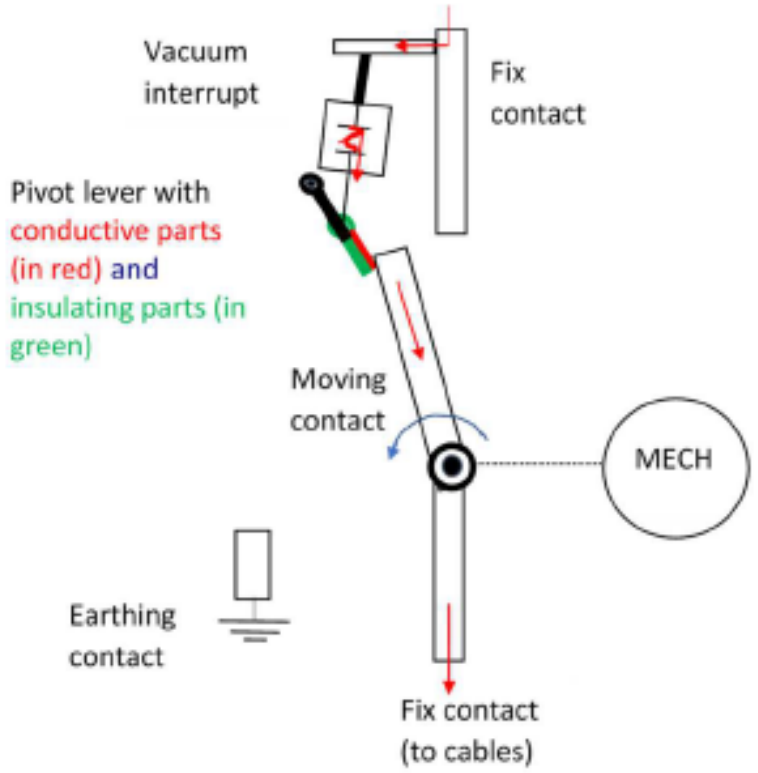
	SF6 (1.3 bar abs)	C4F7N (0.75 bar) dry air (0.55 bar)	C5F10O (0.18 bar) dry air (1.12 bar)	CO2 (1.3 bar abs)	HFO1234 zeE (1.3 bar abs) + vacuum interrupter	air (2.5 bar abs) + vacuum interrupter
dielectric performances	100 % (ref)	120%	90%	40%	100%	100%
switching performances (630 A / 24 kV)	+ +	+	-	- -	+ + +	+ + +
fuse switch performances at 24 kV	+ +	+	- -	- - -	+ + +	+ + +
CMR risks	No	not demonstrated	not demonstrated	No	No	No
LC50 (4h) rat of the pure fluorinated gas	> 80 %	0.16 %	1.23 %	NA	> 21 %	NA
LC50 (4h) rat of gas mixtures	> 80 %	0.28 %	8.88 %	> 16 %	> 21 %	100 %
LC50 (4H) rat of the gas mixture after breaking	2.6 % < < 3.8 %	< 0.02 %	0.21 %	NA	> 21 %	100 %
handling and end of life	-	- - -	- -	+ + +	+	+ + +

→ **Pressurised air with vacuum interrupter is the best alternative**

Innovative SF_6 free switch with shunt vacuum interruption technology

3-positions load break switch with shunt vacuum interruption technology …

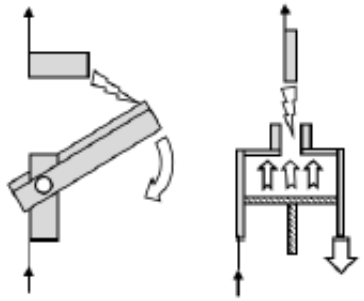
- Vacuum Interrupter used for breaking operation:
  - Innovative breaking principle with a vacuum interrupter set in parallel of a 3-positions disconnector.
  - Breaking operation: the current is commuted to the VI
- Disconnector with air gap
- Traditional 3-positions switch operation



→ … enables to have a compact and cost effective solution

Load Current Interruption

SF6 LBS

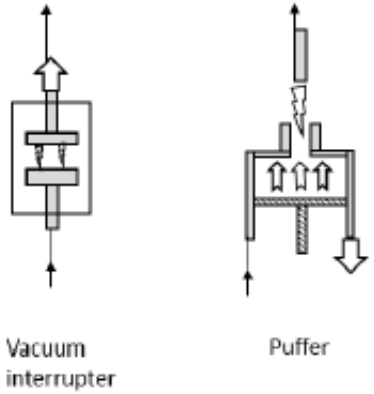


State of the art

- **Knife switch:** cost effective, simple and user friendly solution for SF6 load break switches
- **Puffer switch**: especially used for higher voltages load break switches

SF6-Free LBS

(paper 0614 - CIRED 2017)



State of the art

- **Vacuum switching technology** require an additional disconnector/earthing switch, more costly and change the operation scheme

New solution

- **The puffer switch** is reliable , cost effective and user friendly solution which the downsides of vacuum switching can be overcome

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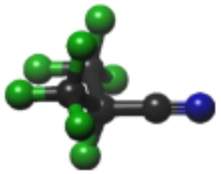
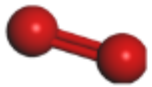
g^3 as an alternative to SF_6

A gas mixture made of :

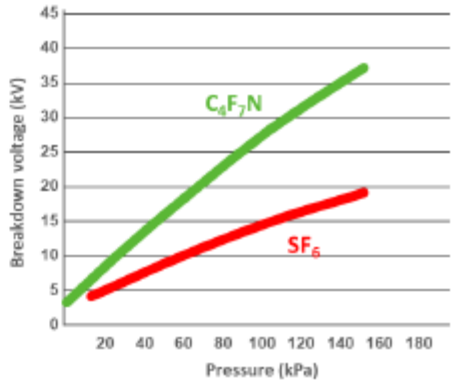


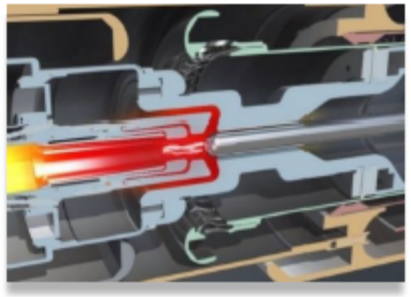
- $(CF_3)_2CFCN$, 3M™ Novec™ 4710 Insulating Gas: provides the dielectric strength (nitrile triple function combined with fluorine). 3 to 10%vol.

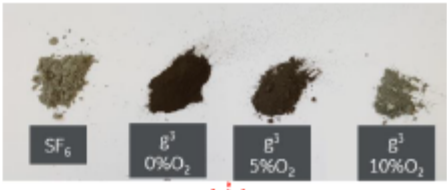
- CO_2 handles the arc interruption process. Main gas.



- O_2 Oxygen helps reducing carbon generation in arcing condition. Graphite and CO are significantly reduced. Up to 13%vol.







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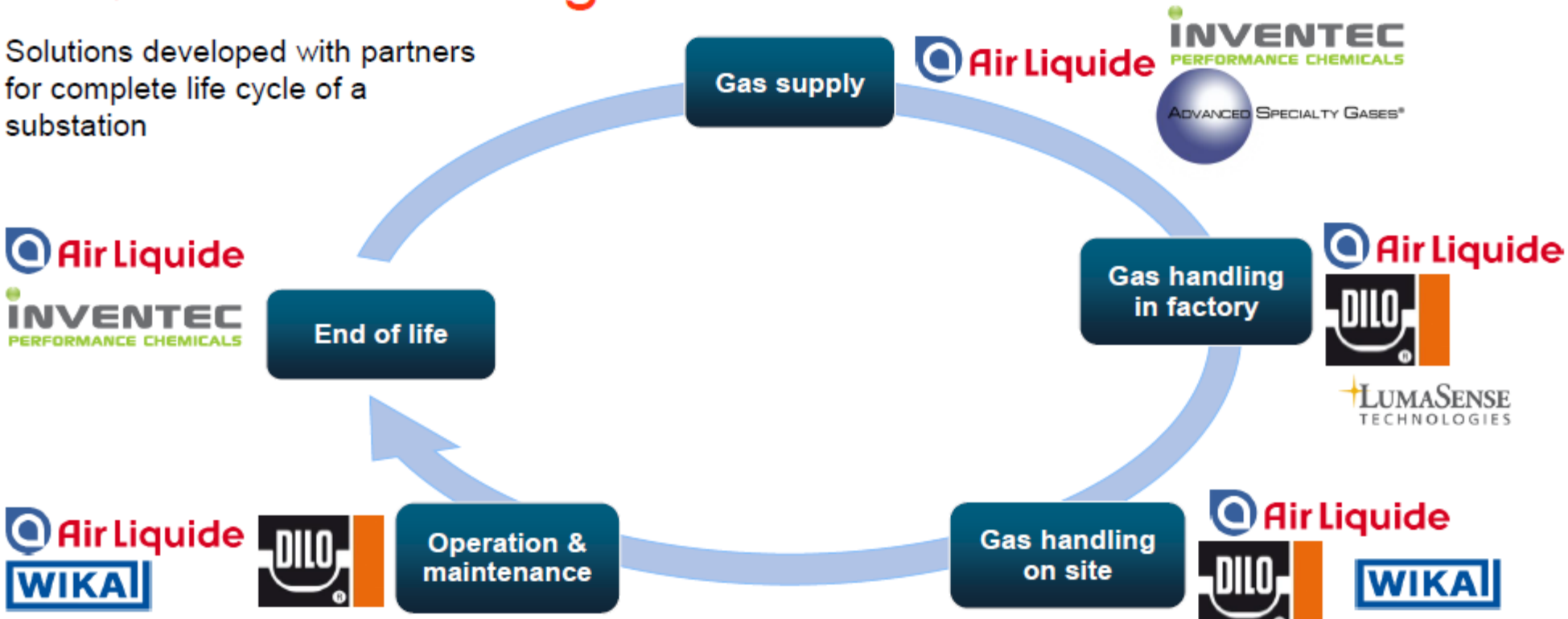
Gas management

Solutions developed with partners for complete life cycle of a substation



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Gas handling tools

Gas carts for gas filling, recovery and topping-up

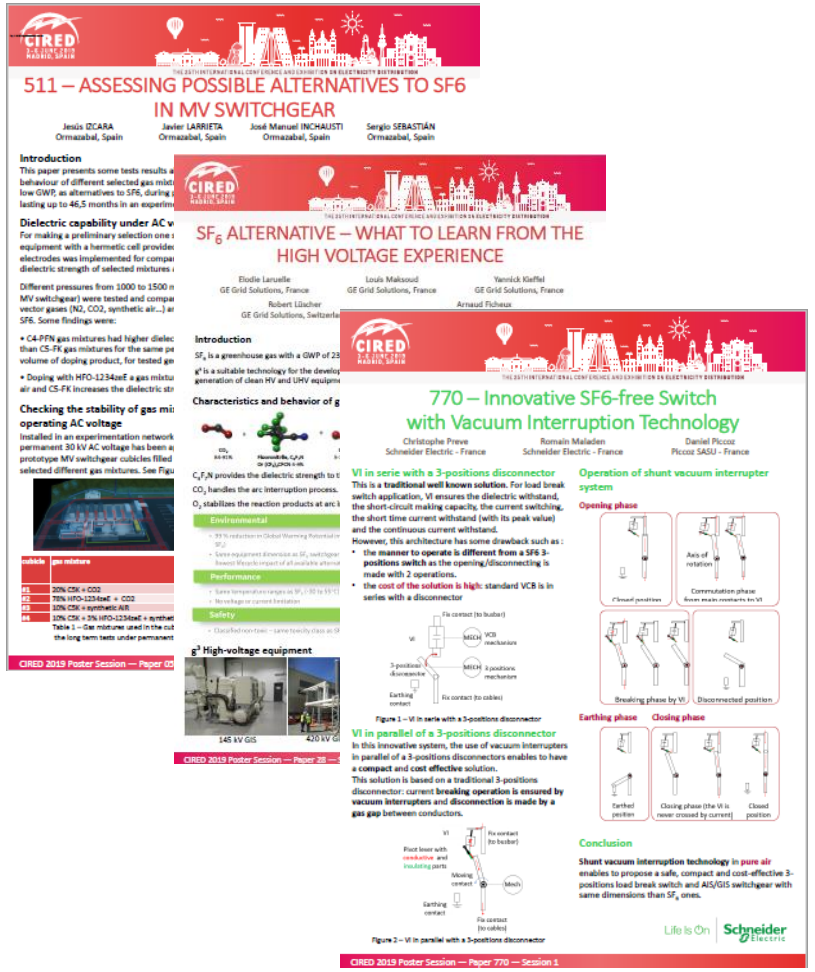
Gas quality check (humidity, ratio)

Gas leakage detection

PPE

Poster Session

- Poster Session:
  - 590 e-posters
  - Jede Session hat einen Tag Postertour



Besten Dank für die Aufmerksamkeit!

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