

Sensitive ground fault detection in compensated systems

What is influencing the sensitivity

Author	Company	Email	Presenter
Gerd Kaufmann	A. Eberle GmbH & Co. KG	gerd.kaufmann@a-eberle.de	✓
Ramūnas Vaitkevičius	Energijos skirstymo operatorius (ESO),	Ramunas.Vaitkevicius@eso.lt	

- Network overview – fault location
- Simplified diagram
- Fault detection methods
 - Wattmetric method ($\cos\varphi$)
 - Admittance method
 - Transient method
 - Classical transient
 - qu2 transient algorithm
- Measurement example

We take care of it.

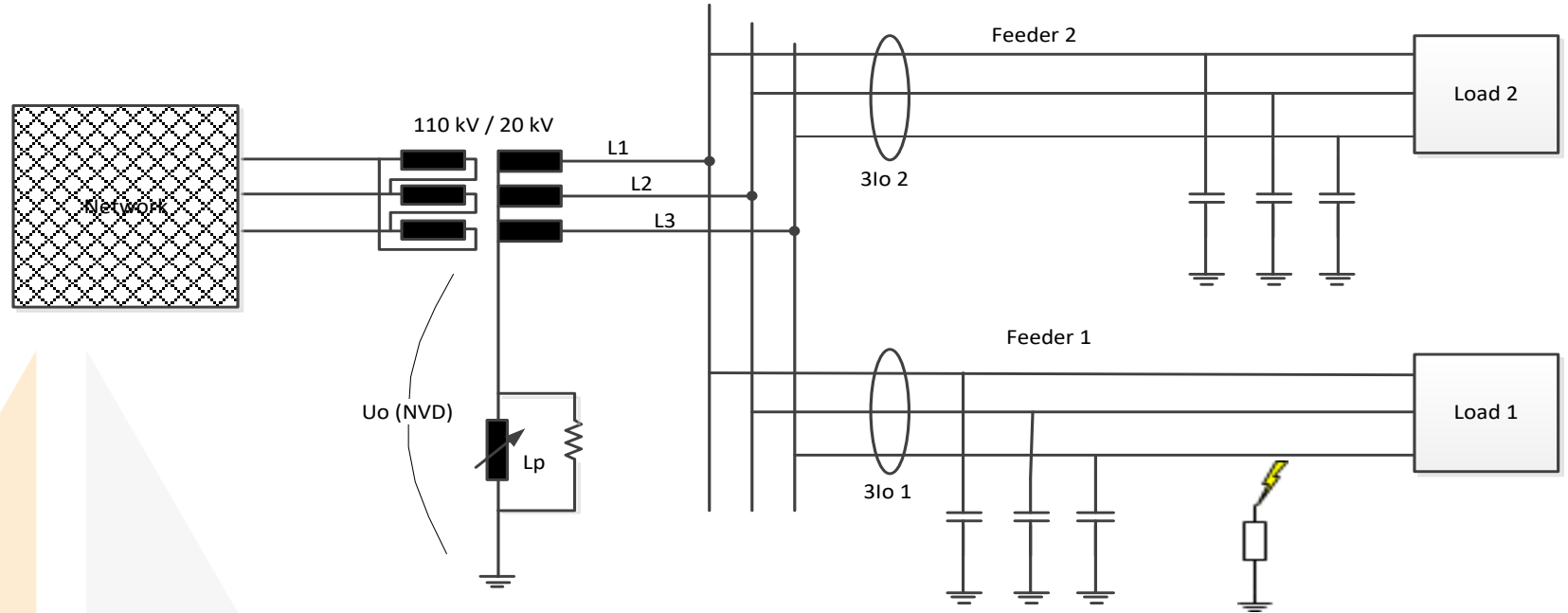
Fault location

- Test with different tuning positions of the arc suppression coil
- Different NVD effects



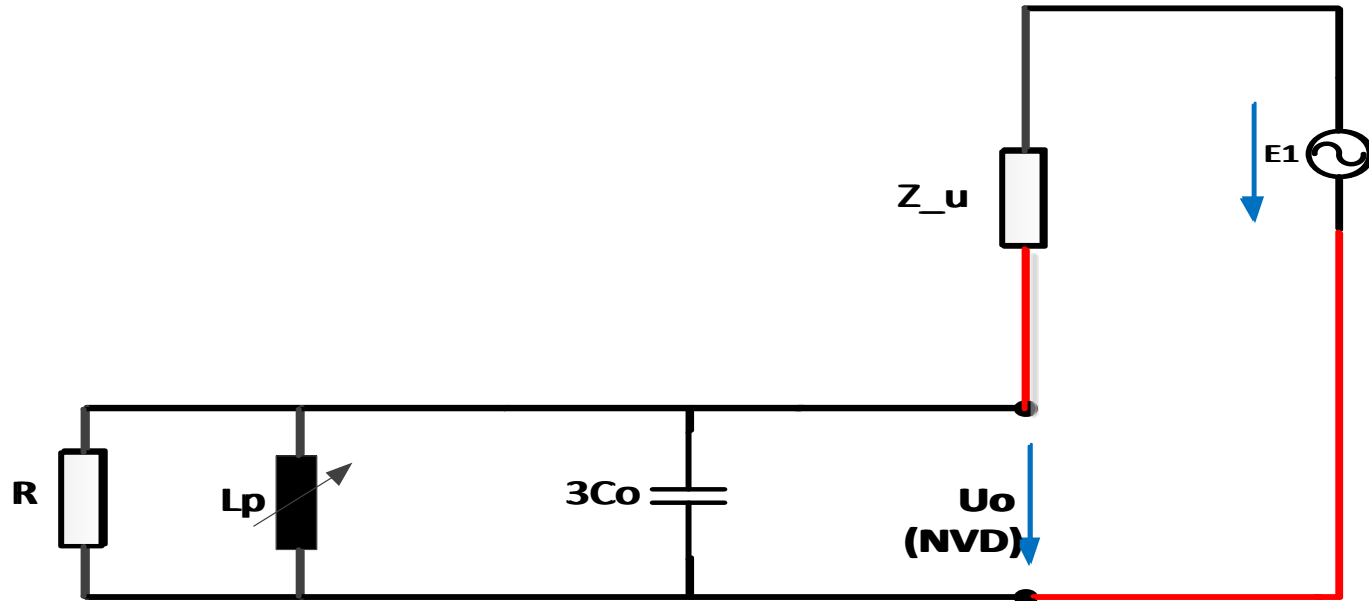
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Three phase power system



ASC connected to transformer neutral

Simplified diagram

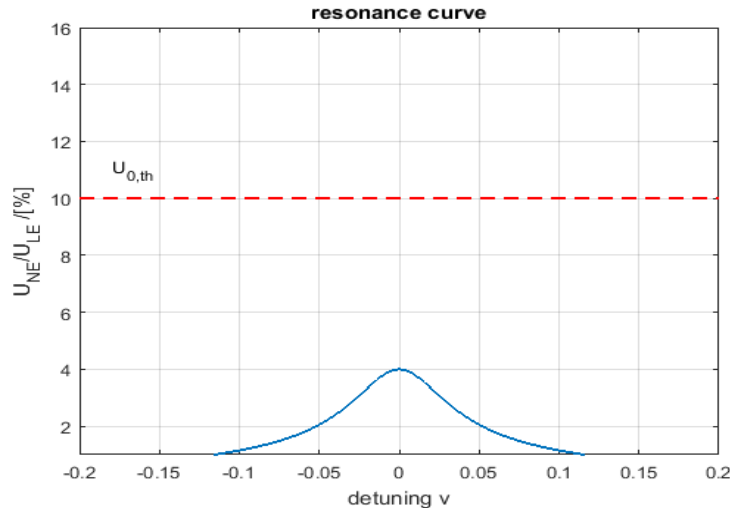


$X_{L_p} = X_{C_o} = \text{maximum sensitivity for } U_o$
Detuning $v = 0$

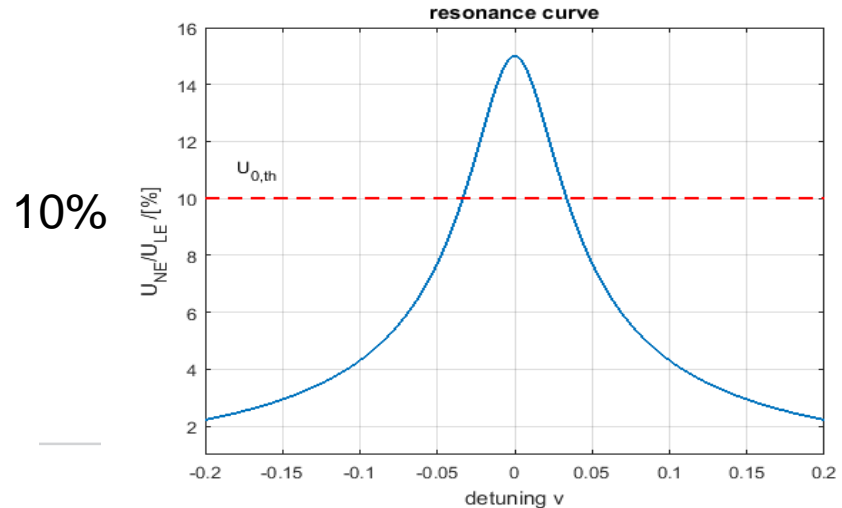
Capacitive unbalance influencing the sensitivity

Natural unbalance depending on unbalance of the line to neutral capacitances

- 4 % U_0 at resonance point



- 15 % U_0 at resonance point



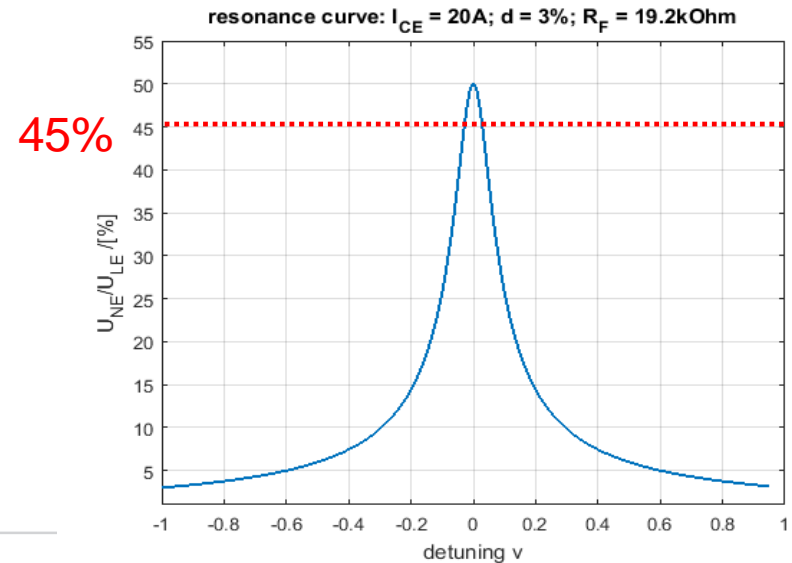
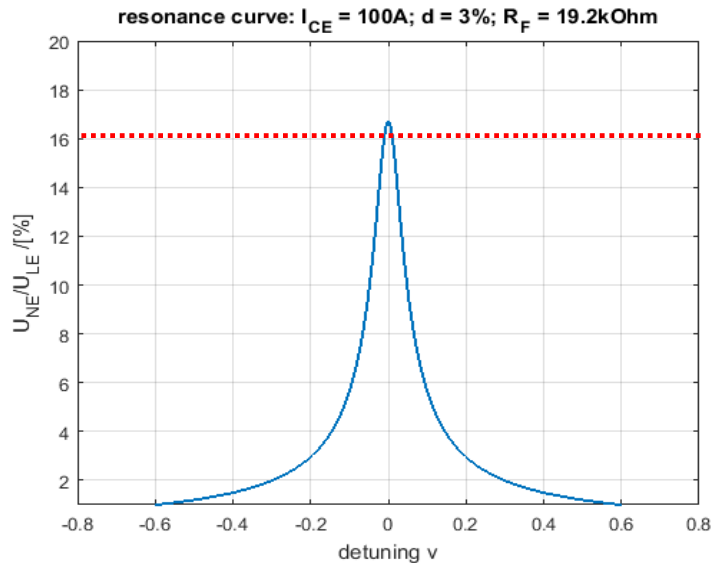
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Capacitive network size influencing the sensitivity

- Fault impedance 19 kOhm

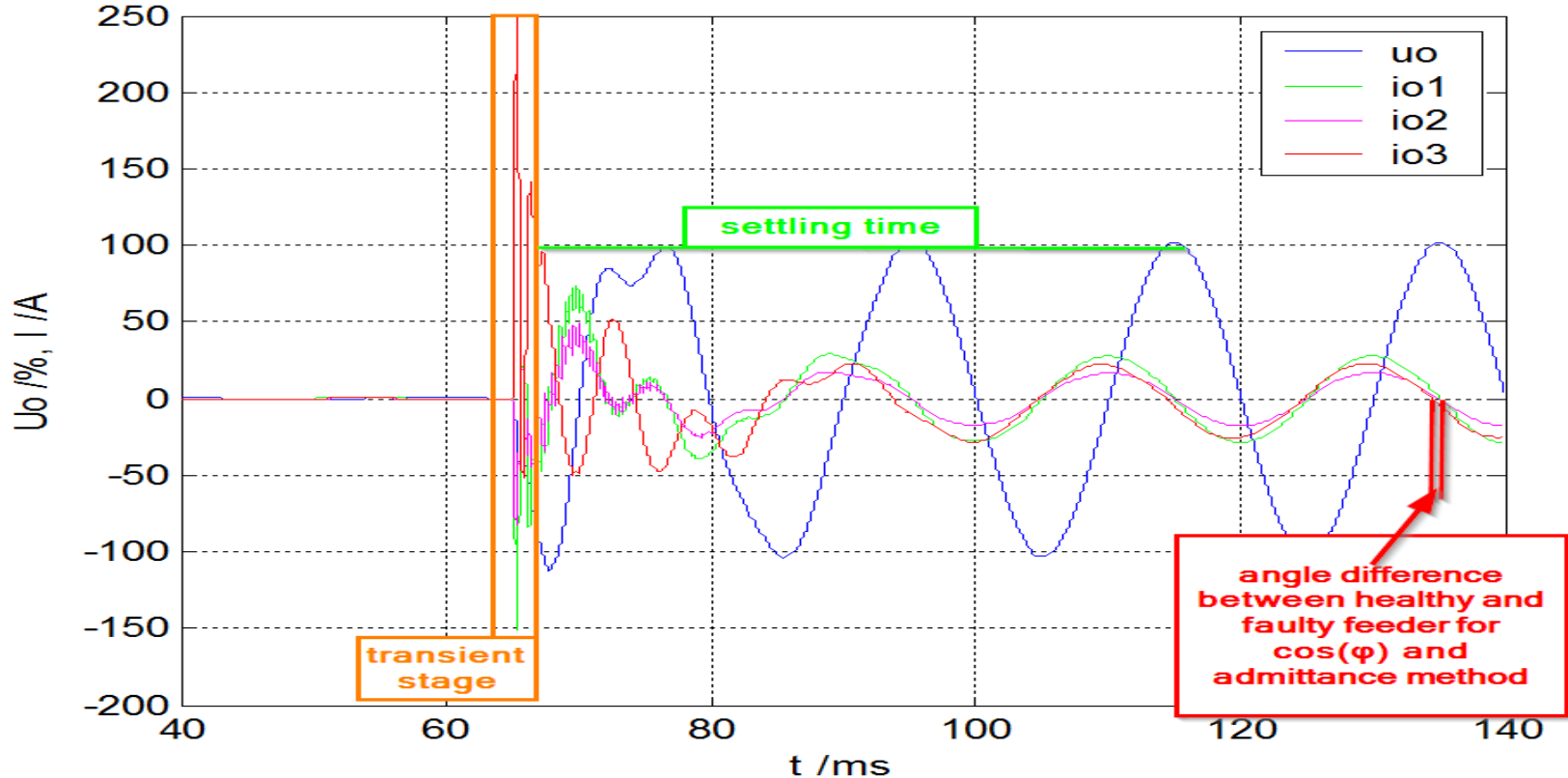
- $I_{CE} = 100 \text{ A}$; $d = 3 \%$

- $I_{CE} = 20 \text{ A}$; $d = 3 \%$



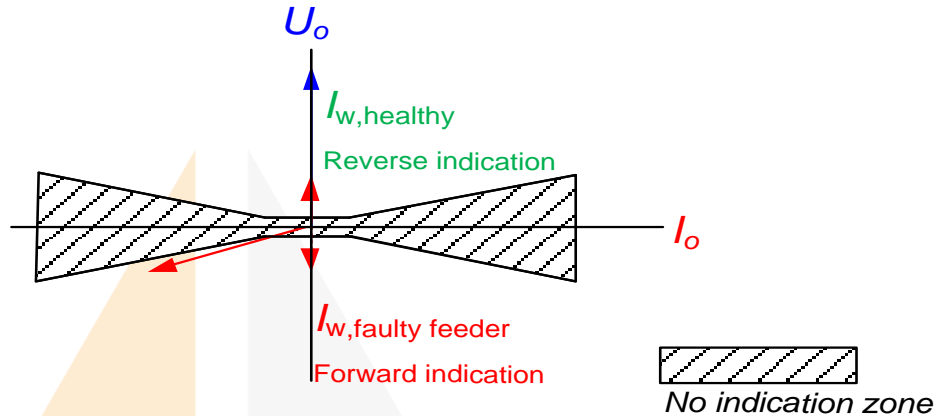
- Same fault impedance different U_0 response
- Higher sensitivity for smaller networks

Fault stages

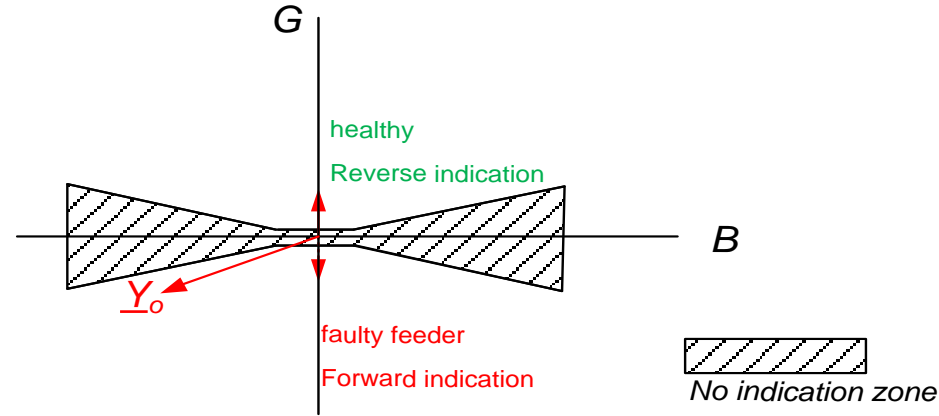


$\cos(\varphi)$ vs. Admittance detection method

- Cos(φ) method



- Admittance method

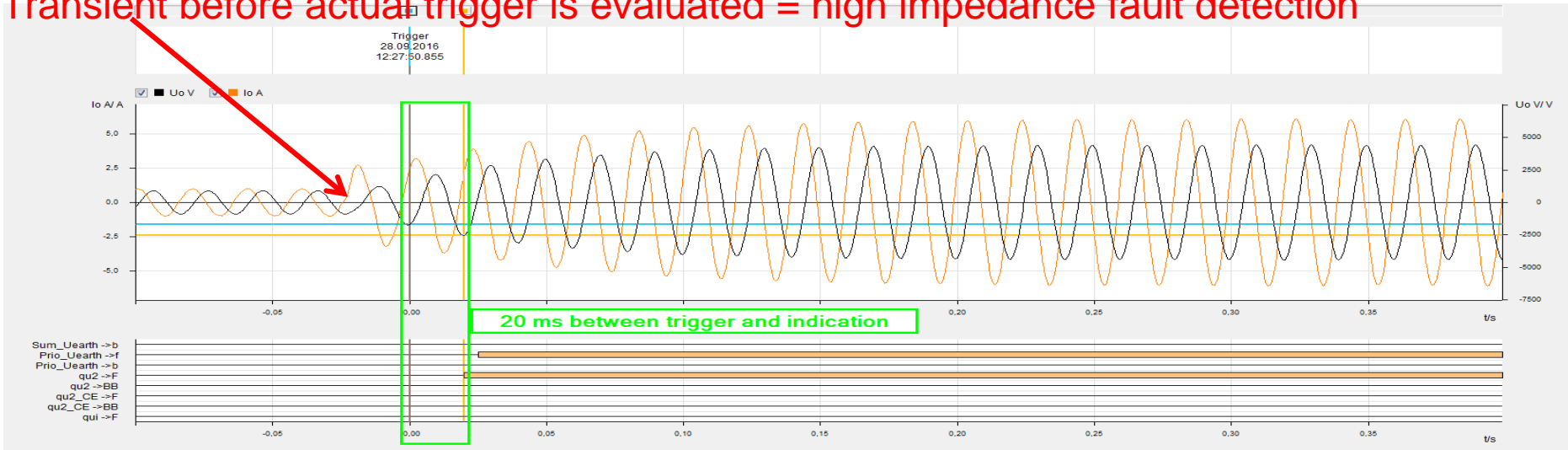


- Very high requirements on measurement accuracy
- Long averaging time to filter disturbances (200 ms to 1 s)

We take care of it.

qu2 transient detection method

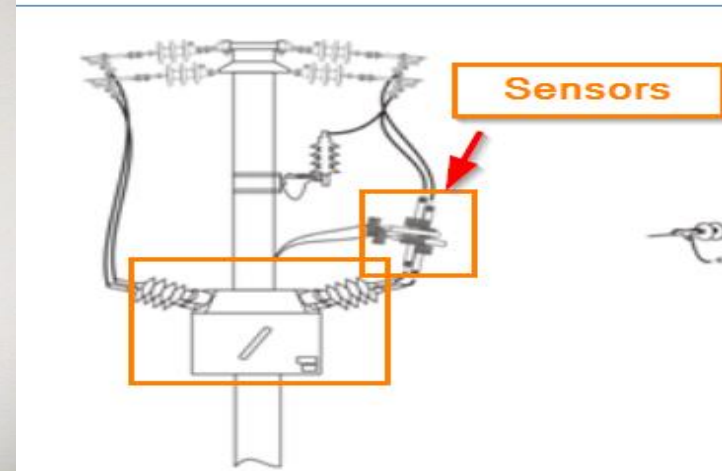
Transient before actual trigger is evaluated = high impedance fault detection



- Automatic adaptation of the settings for higher fault impedances
- Low requirements on the measurement accuracy
- Very fast response time
- Could be used for selective tripping on radial feeders

We take care of it.

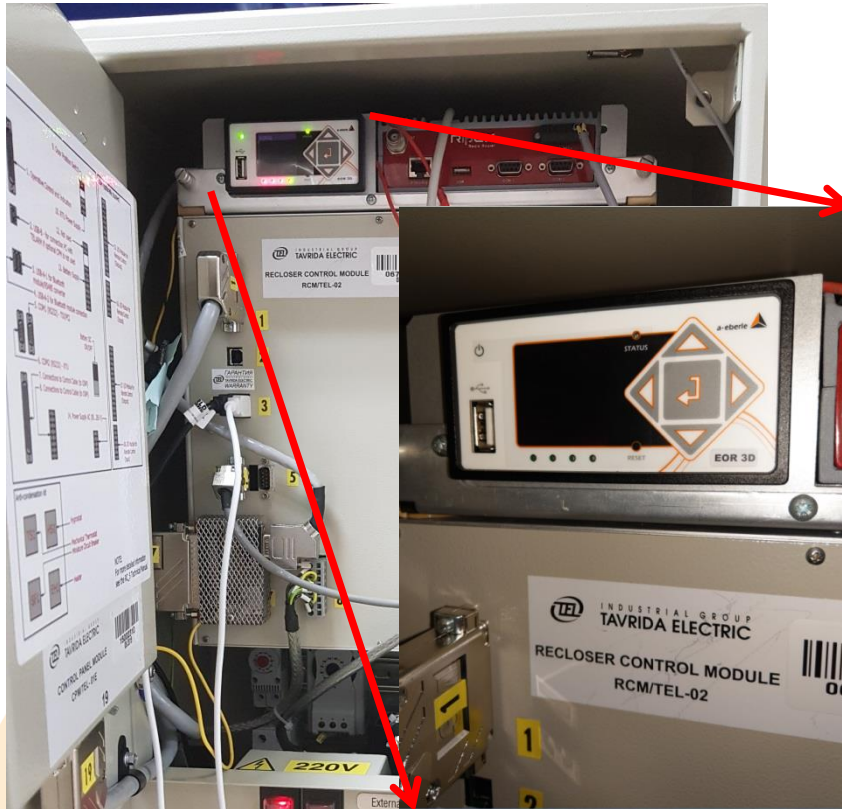
Measurement example for overhead line application



- Combined voltage and current sensors
- Capacitive and resistive voltage divider connectable
- Rogowski coil current measurement

We take care of it.

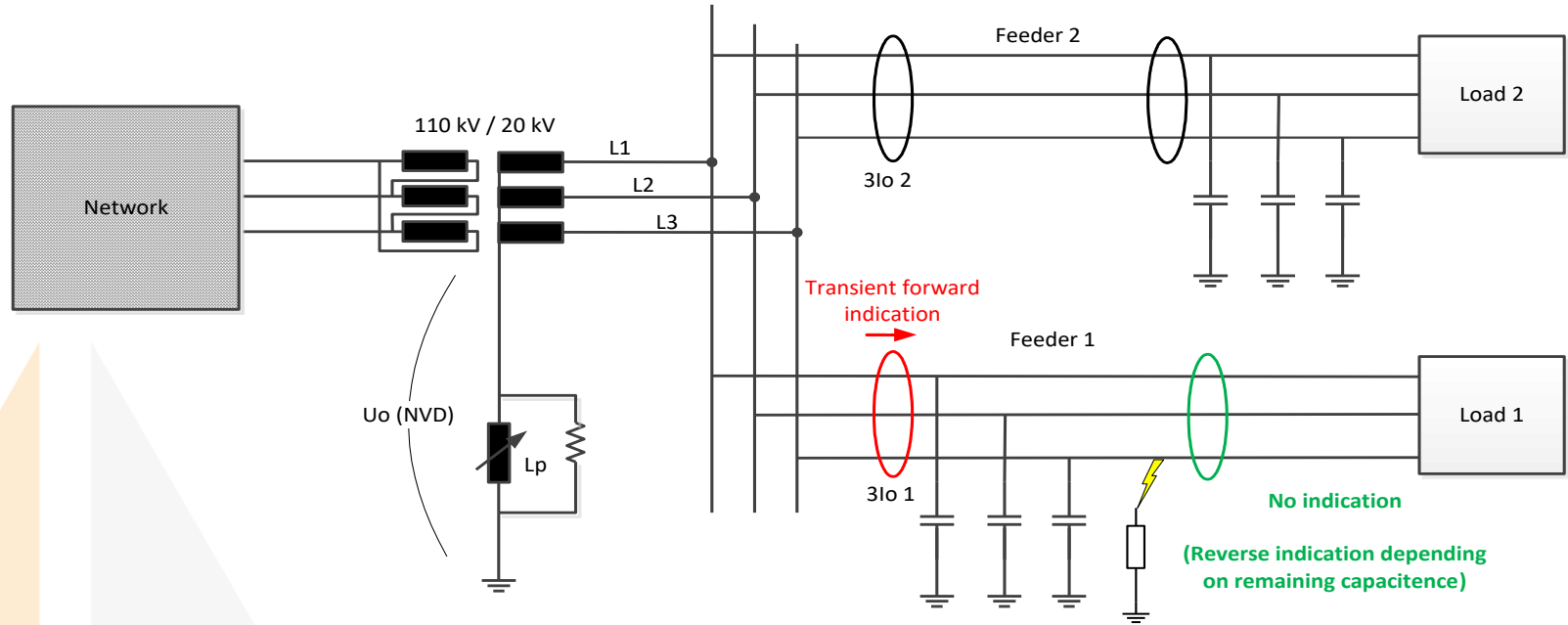
Measurement example for overhead line application



- Using Auto Recloser Protection measurement signals
- Capacitive voltage divider
- Rogowski coil current measurement

We take care of it.

Transient algorithm for selective tripping



ASC connected to transformer neutral

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Thank You!

Gerd Kaufmann

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