

## 420 kV C4-FN CB – successful series connection of interrupters

A3 - High Voltage Equipment  
PS2 + Q10

Can post-arc current complicate series  
combination of C4-FN interrupters?

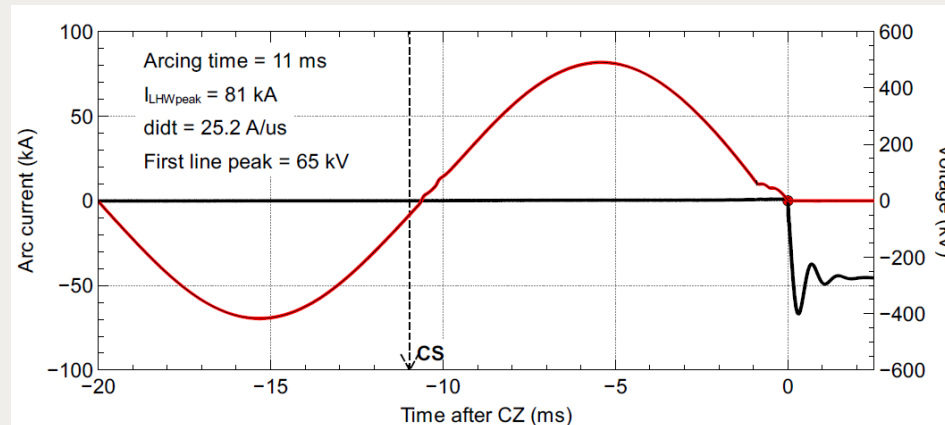
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# Post-arc currents do not present a challenge to using series interrupters in C4-FN circuit breakers

- Short-line fault (L75 and L90) tests were successfully performed on **C4-FN based double chamber breaker (CB)**, without line-to-ground capacitance in accordance with IEC and IEEE standards
- Mixture: 3.5 mol% C4-FN, 10 mol% O<sub>2</sub>, and 86.5 mol% CO<sub>2</sub>
- Ratings: 420 kV, 63 kA, 50 Hz and 60 Hz
- Standard grading capacitors were used to distribute the voltage

L90 test shot performed for 50 Hz and 100 ns time delay on the developed 420 kV C4-FN double chamber CB



Group Discussion Meeting



# Why post-arc currents did not pose an issue for the double chamber C4-FN circuit breaker?

- Vacuum circuit breakers inherently have relatively high post arc currents (around 10 A, duration of order 10  $\mu$ s; see e.g., A3\_PS2\_11068\_2022)
- In gas CBs the post-arc currents strongly depend on the technology (e.g., the gas) and the design (cooling power at current zero)
- Typically, for the same circuit breaker design, higher post-arc currents are seen for CO<sub>2</sub> based mixtures than for SF<sub>6</sub>
- Properly designed CO<sub>2</sub>-based breakers can have as low post-arc currents as properly design SF<sub>6</sub> circuit breakers
- Good arc zone designs result in very low post arc currents (< 1 A, duration of about 10-20  $\mu$ s)
- For such low post-arc currents, the maximum voltage imbalance will not exceed 5 kV, whereas the first line peak has been (in tests) up to 65 kV → the imbalance is less than the tolerance allowed by standard on the first line peak

# Post-arc current measurements

- For such low post-arc currents, measurement is challenging
- We developed internally a measurement system to improve accuracy
- The measurements with a commercial and the new system show that post-arc currents for properly designed C4-FN breakers do not exceed 1 A (maximum observed post-arc current peaks: 500-600 mA)

