

# Paris Session 2022



SCA3 – PS3 – Q14

Controlled switching technology, known for about thirty years, seems to experience a renewed interest...

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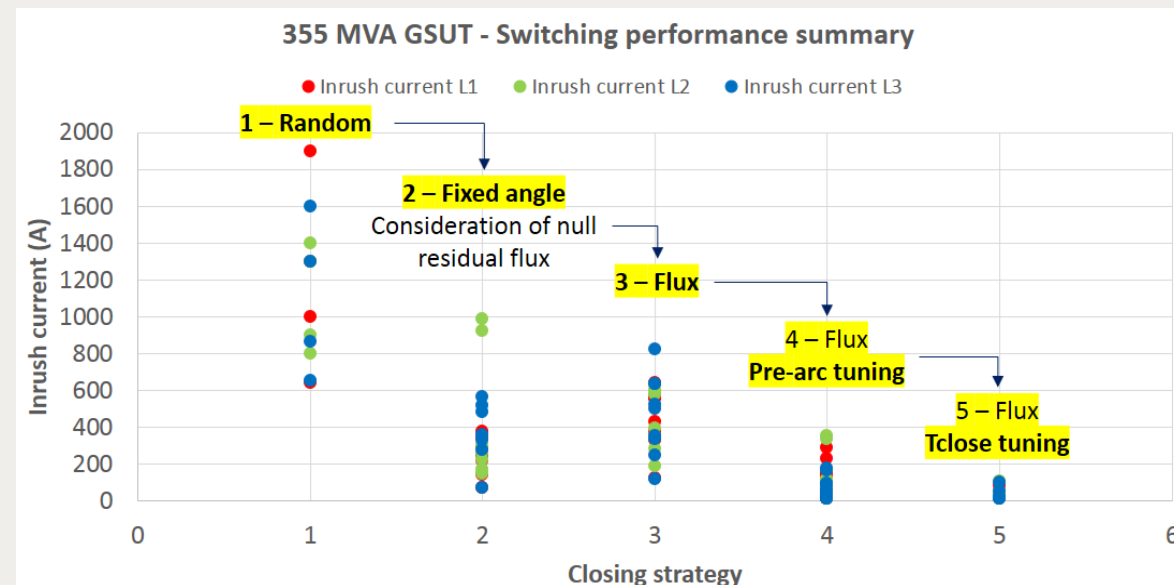


## History...

- Early ages (90's) : « zero crossing device », no transient record (very basic). Along with “historically” robust networks and switchgears.
- 2000's : line application, power transformer with residual flux (increased processing power) + « light » transient records
- Nowadays : full range of applications, extremely accurate transient records, performance indicators. Networks and switchgears “at the limit”

## Pedagogy...

- The **relevant performance indicators** are better understood.
- Not an easy technology to understand. In the past, the actual benefits were not explained correctly.



## By application...

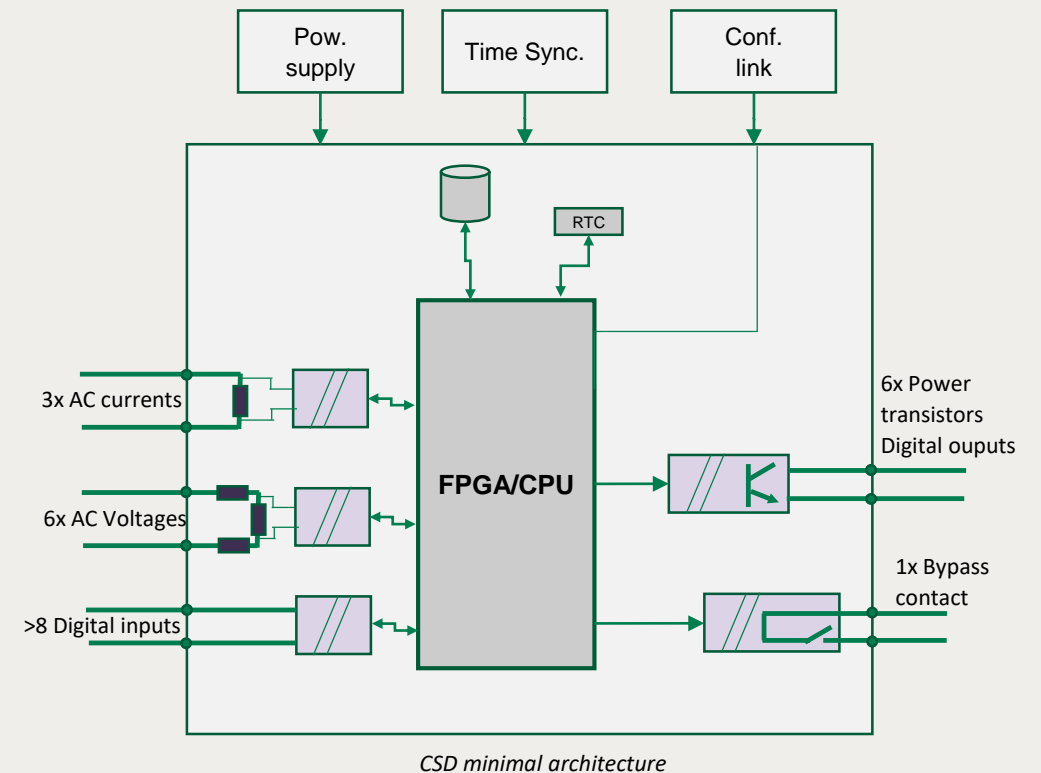
- Shunt reactor : CSD or SA
- Power transformer : CSD
- Line / Cable : CSD or PIR
- Cap bank : CSD (PIR ?)

## Value chain...

- Standard electronics
- R&D and industrialization : tremendous effort
- Commissioning, expertise

## By REX...

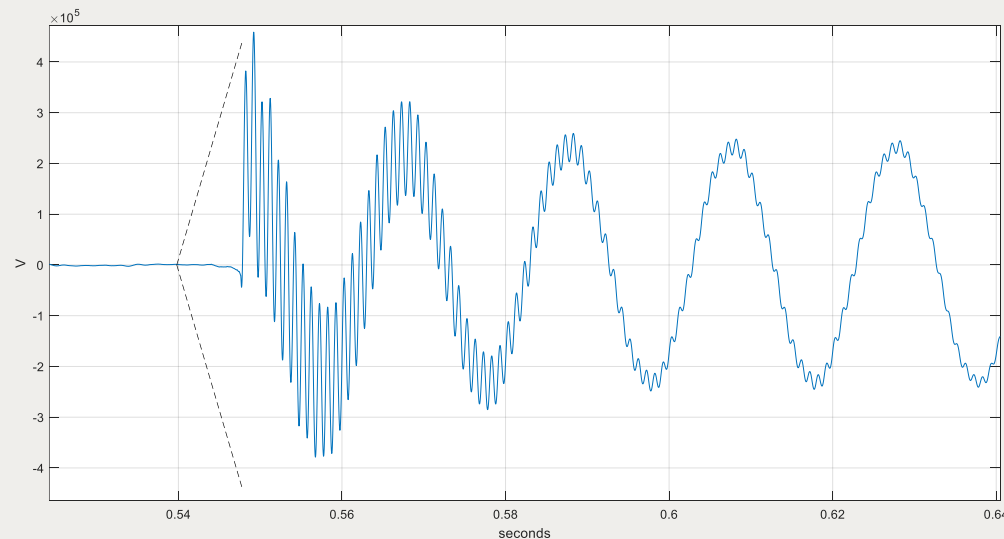
- Commissioning is the key to success.
- CB + CSD as an infrangible device (same manufacturer)
- Reliability of the CSD itself is not a concern.
- IEC 61850 : so far, rare applications :
  - MMS, to publish measurements and alarms.
  - Sample values for pilot applications.



## Shunt reactor...

- **Mandatory** application of synchronization (small inductive current, arcing time control).
- Site conditions more severe than IEC 62271-110 : -110 CB test report is not a guarantee or does not guarantee applicability
- Possible alternative to CSD : Surge Arrester
- Basic CSD application (fixed targets), but **monitoring of reignitions is crucial**

→ **CSD is the « de facto » solution**



Group Discussion Meeting

Reignition last opening
Reignition rate
Reignition max. cumulated
Arcing time

*Shunt reactor de-energization, CB voltage recorded by CSD, and superimposed RRDS characteristic.*

## Power transformer

- CSD is the only efficient solution (literature, REX...)
- CSD address the root cause
- PIR : not efficient (little efficiency due to lower RDDS)
- REX example : enormous inrush current (>8.7kA) with CB fitted with CSD + 400Ω PIR (error in CSD setting during commissioning...)

→ CSD is the « de facto » solution

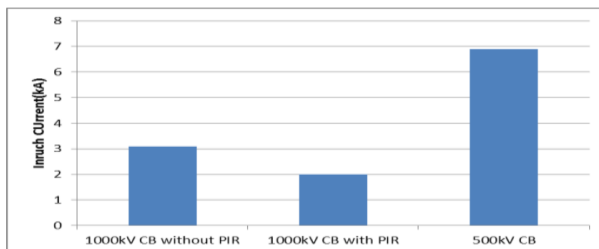
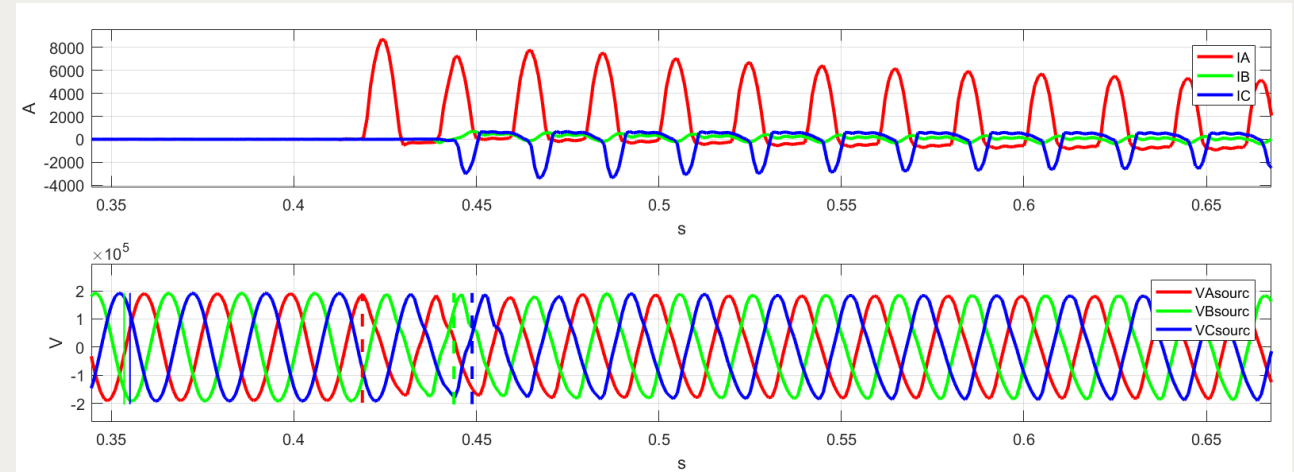


Figure 11-32: Inrush current simulation studied without using a CSD

### CIGRE A3.35 technical brochure (TB757), section 11.15.5

- Compared simulations and commissioning of CSD / PIR / CSD & PIR
- No difference or very limited difference

Table 11-7: Test results of inrush current with CSD

CB	Number of energisation	Maximum Inrush current(kA)
1000kV CB without PIR	5	1.2
1000kV CB with PIR	6	1.4
500kV CB	6	3.7

## Summary...

- Technology is more and more trusted and mature.
- Only efficient solution for several applications
- Growing demand
- Common remaining concerns:
  - Quality of commissioning. Training is crucial.
  - Who's in charge of CSD maintenance/follow-up at customer side, during service life ?
  - No standard (ANSI codes for protections...)
  - IEC61869 not finalized

