Transformer protection with fuses

IN THE LINE OF POWER



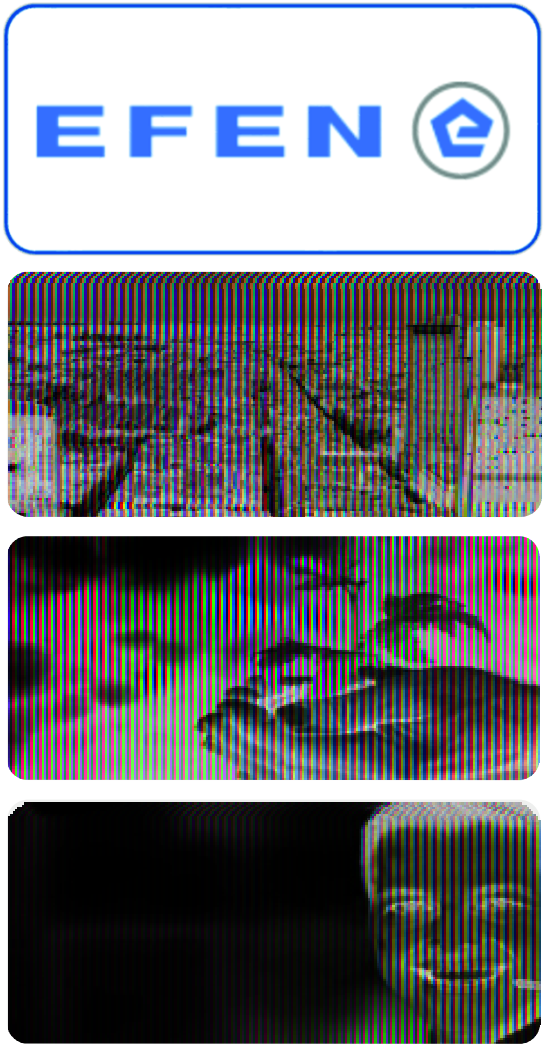
- Electro Sistem Days 2017
- Mr Albert Vladimir / Mr Ottó Mayer

EFEN - Solutions Integrated

Transformer protection with fuses

IN THE LINE OF POWER

1. Company EFEN
2. Fuse standards LV, HV
3. Fuses categories LV, HV
4. Transformer protection with HV fuses
5. Transformer protection with LV fuses
6. Discrimination HV/LV fuses
7. Transformer protection with MCCB compare to fuses



Transformer protection with fuses

Company EFEN







Transformer protection with fuses

We are the specialist for safety interfaces in power distribution networks according to IEC-/DIN-standard

Our systems distribute electric power, protect people and investments and ensure a smart power grid.







Transformer protection with fuses

Infrastructure:

airports, railway stations, buildings

Power:

power supply, power distribution grids, renewable energies

Industry:

production sites, office buildings etc.



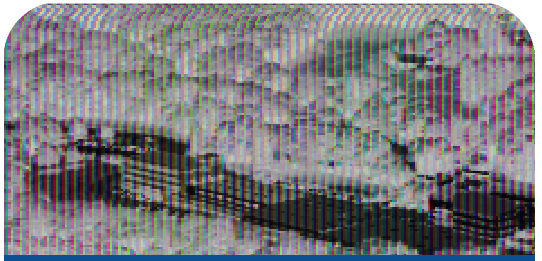




Transformer protection with fuses

IN THE LINE OF POWER

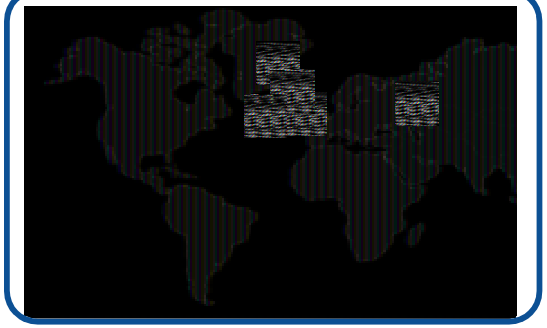
- 1922 Company is founded by Otto Frees
- 1937 Relocation to new headquarters in Eltville
- 1992 Opening of production plant in Uebigau
- 1997 Founding of EFEN Hungary – fuse production
- 2000 Founding of EFEN Poland / EFEN China / EFEN Slovakia
- 2006 EFEN becomes member of Hager Group
- 2015 Distribution cabinets and house service systems



Eltville

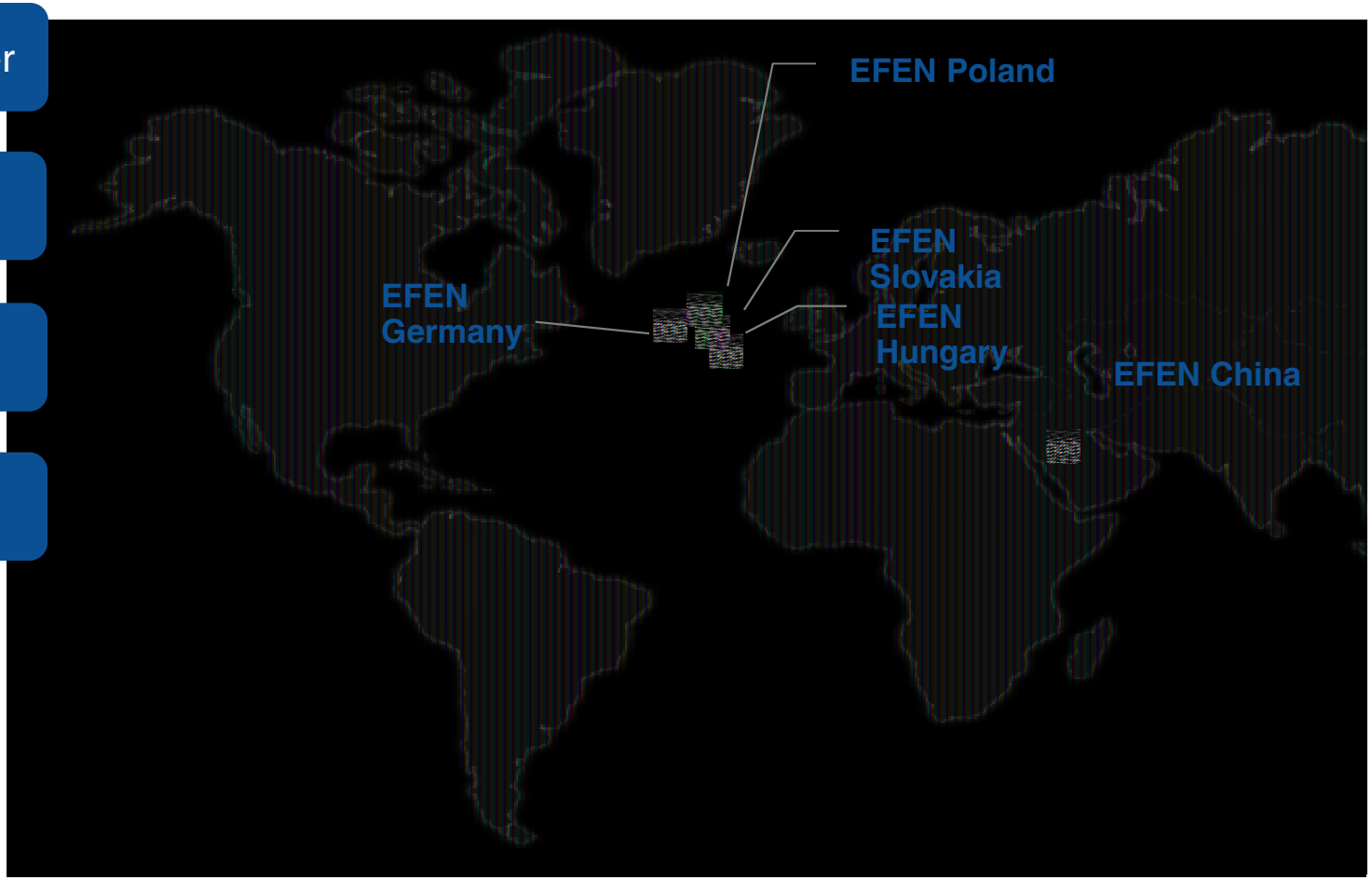


Production + logistics in Uebigau



Transformer protection with fuses

- 42,3 million Euro turnover
- 220 employees
- 5 proprietary sales organizations
- Sales partners in 66 countries



Transformer protection with fuses

Fuse standards







LV Fuse Standards

IEC	VDE	Content
60269-1	0636-1	General requirements
60269-2	0636-2	Fuses for use by authorised persons • Examples of standardized fuse systems (e.g., NH system)
	0636-21	National Supplement 1: Protection of special electrical installations (gTr, gB and aM AC 1.000 V)
60269-3	0636-3	Fuses for use by unskilled persons • Examples of standardized fuse systems (e.g., D0 system)
	0363-31	National Supplement 1: U = AC 690 V and U = DC 600 V
60269-4	0636-4	Fuses for the protection of semiconductor devices
TR 60269-5	0636-5	Guidance for the application of low-voltage fuses
60269-6	0636-6	Protection of solar photovoltaic energy systems
	0635	D type fuses E 16 up to 25 A, 500 V; D type fuses up to 100 A, 750 V; 500 V
	0638	Switch-fuse units; D0 system
60947-3	0660-107	Fuse-combination units

HV Fuse Standarts

IEC	VDE	Content
60282-1	0670-4	High-voltage fuses
60644	0670-401	Requirements for high-voltage fuse-links for motor circuit applications, High-voltage fuses – current-limiting fuses
60549	0670-404	High-voltage fuses for the external protection of shunt power capacitors
TR 62655	0670-402	Selection of high-voltage current-limiting fuse-links for transformer circuits
62271-105	0671-105	Alternating current switch-fuse combinations
62271-107	0671-107	Alternating current fused circuit-switchers

Transformer protection with fuses

Fuse Categories







LV Fuse Categories

Utilization category	Application (characteristic)
gG	Full-range breaking capacity fuse-link for general application, mainly for cable and line protection
aM	Partial-range breaking capacity fuse-link for short-circuit protection of motor circuits
gR	Full-range breaking capacity fuse-link for the protection of semiconductor devices (quicker than gS)
gS	Full-range breaking capacity fuse-link for the protection of semiconductor devices for increased line utilization
aR	Partial-range breaking capacity fuse-link for short-circuit protection c semiconductor devices
gB	Full-range breaking capacity fuse-link for mining application
gTr	Full-range breaking capacity fuse-link for transformer protection, rated in transformer apparent power (kVA) instead of rated current (A
gPV	Full-range breaking capacity fuse-link for the protection of photovoltaic energy systems

LV Fuse Categories

Utilization category	Application (characteristic)
gM	Full-range breaking capacity fuse-link for motor circuit protection, dual rated (widely used in the United Kingdom)
gN	North American general application fuse, mainly for cable and line protection
gD	North American general application time-delay fuse, mainly for motor circuit protection
gU	General purpose fuse-link with wedge tightening contacts, similar to gG
gK	Full-range cable protection up to very high rated currents
gI	Former IEC time-delay fuse, replaced by gG
gII	Former IEC fast-acting fuse, replaced by gG
gL	Former VDE fuse for conductor protection, replaced with gG
gRL	Manufacturer-specific designation, meanwhile standardized as gS
gGR	Manufacturer-specific designation, meanwhile standardized as gS
gT	Former VDE time-delay fuse, replaced by gG
gF	Former VDE utilization category (quick-acting), replaced by gG
gTF	Former VDE time-delay / fast-acting fuse, replaced by gB

HV Fuse Categories

Utilization category	Application (characteristic)
Back-up fuses	Protection from I3 up to I1(I1= breaking capacity)
Full range fuses	Protection from melting current up to I1
General Purpose fuses	Breaking all current which cause them to melt in one hour up to breaking capacity
HVMT Fuses	Protection of measuring voltage transformers
Back-up with ULA	Protection from I3 up to I1

Transformer protection with fuses

Transformer Protection

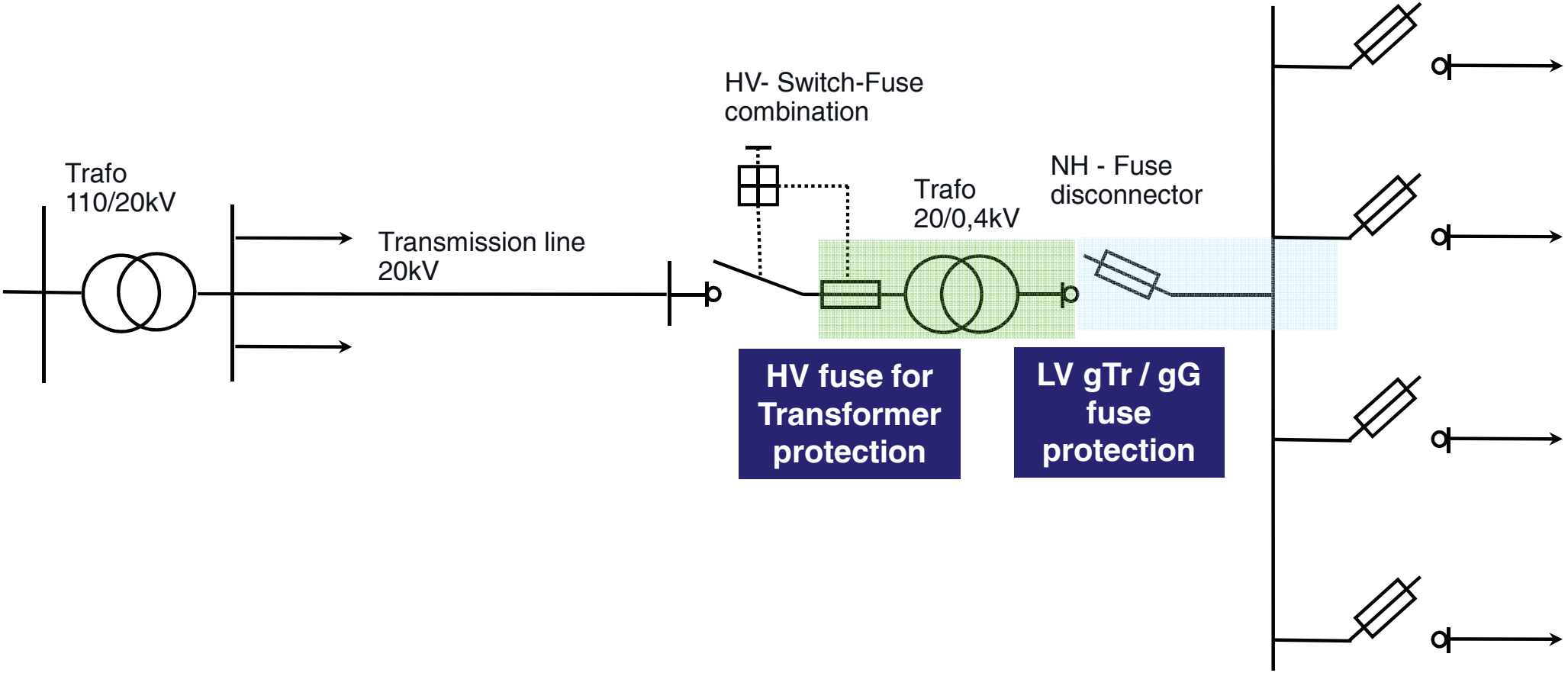






Transformer protection with fuses

Distributions network



Transformer protection with fuses

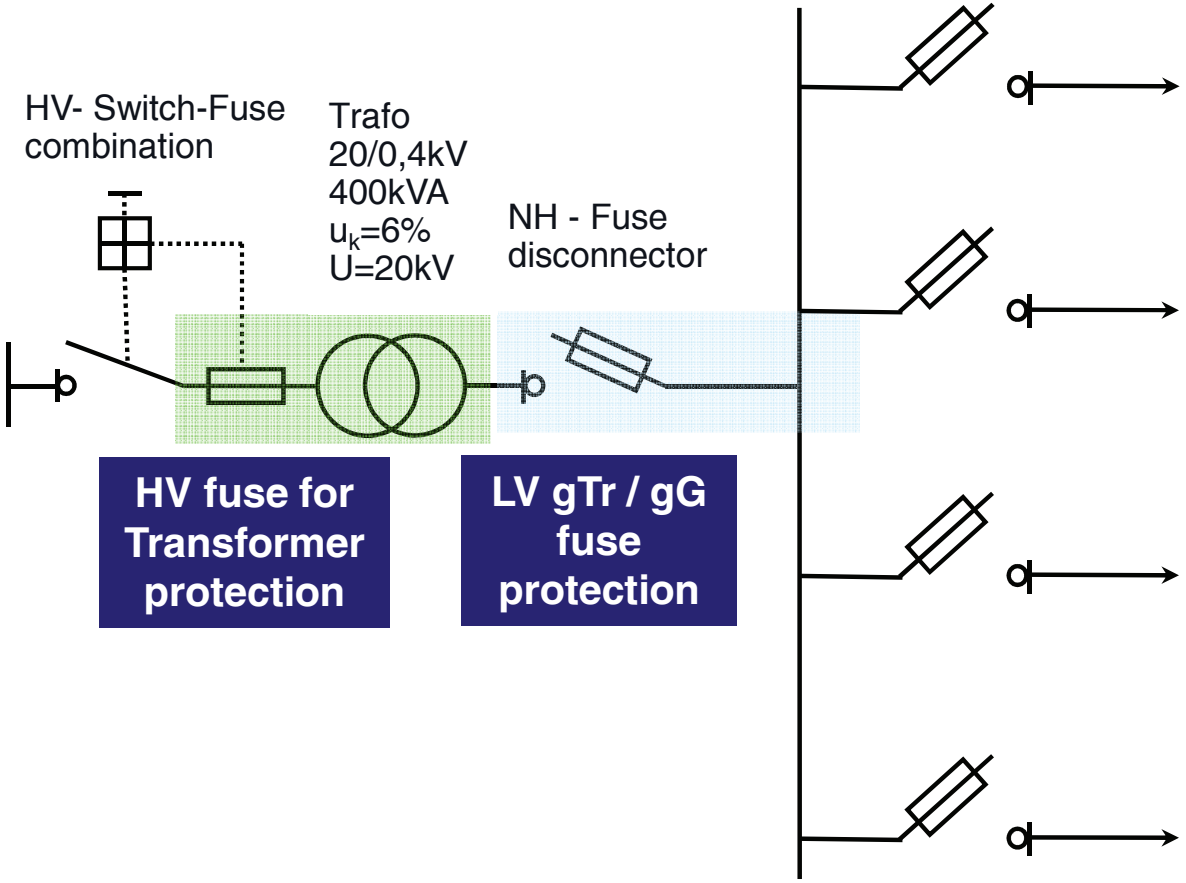
Transformer protection

The following should be observed for HV Fuse-Link selection:

a) Transformer ratings
– Service voltage (U) = 20 kV
– Rated output (S) = 400kVA
– Relative short-circuit voltage uk % = 6%
– Inrush current (8...12 IN)

b) Time-current characteristic of HV Fuse-Links

c) Secondary devices/selectivity



Transformer protection with fuses

Transformer protection according to IEC TR 62655

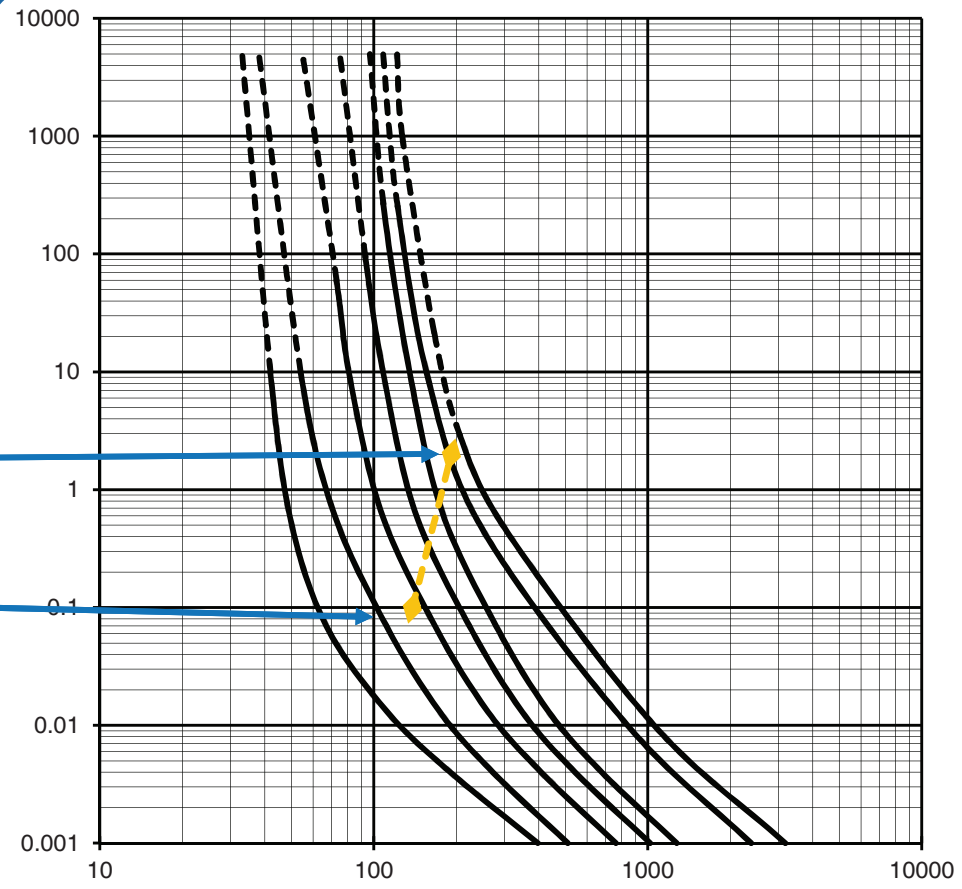
Rated output (kVA):	400
Relative short circuit voltage uk (%):	6
Rated current of transformator on 20kV (A):	11,5
Rated current of transformer on 0,4kV (A):	578

1. The min. short-circuit current on secondary terminal is given from the relative short-circuit voltage. The ransformer must be designed to withstand this current for time =**2 seconds**.
Ik=100xIn/uk= 100x11,5/6 = 192 A

2. Inrush current calculation – **time t=0,1s**

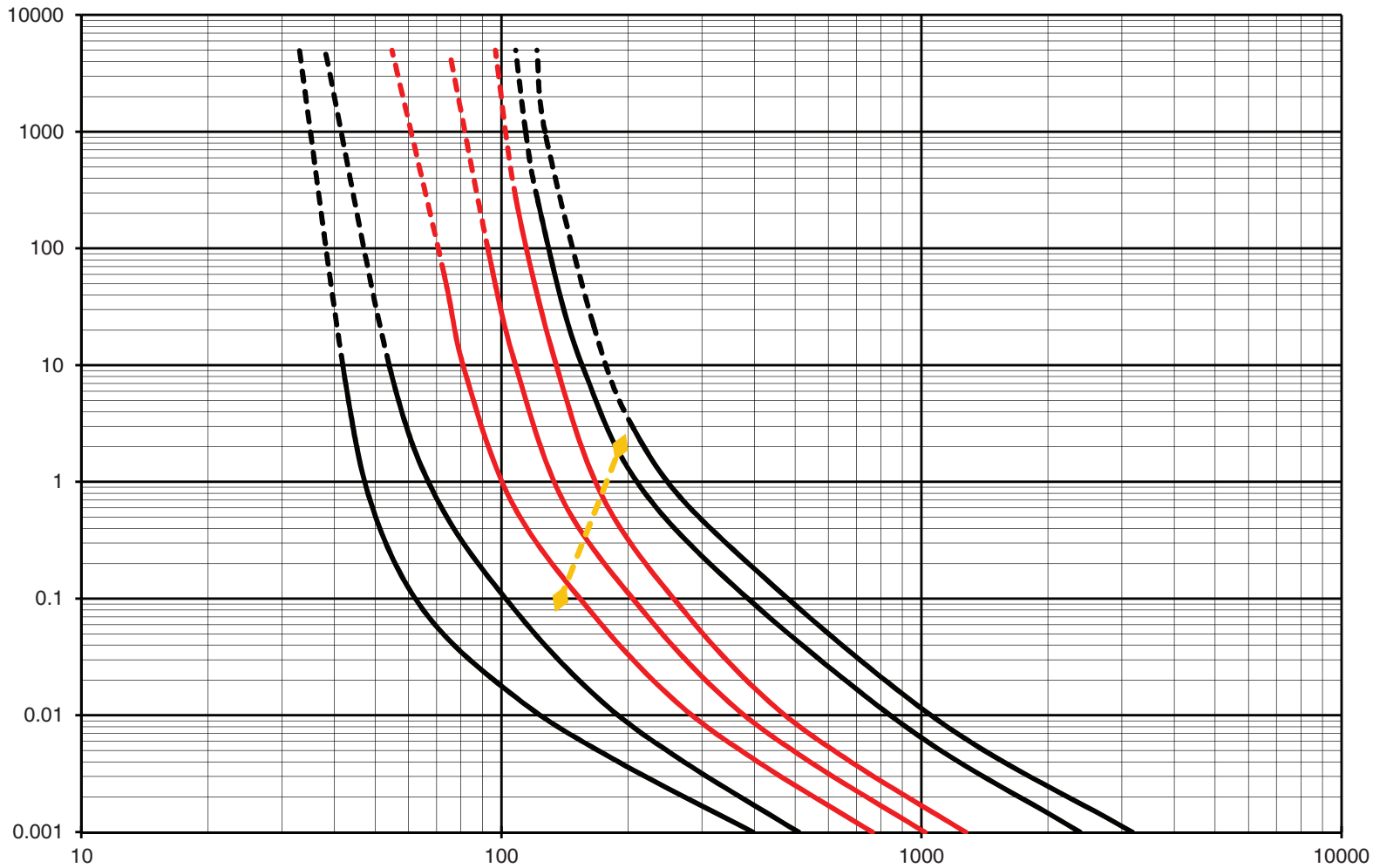
Inrush 0,1s = 12xIn = 12x11,5 = 138 A

This inrush current must not melt the fuse-link.



Transformer protection with fuses

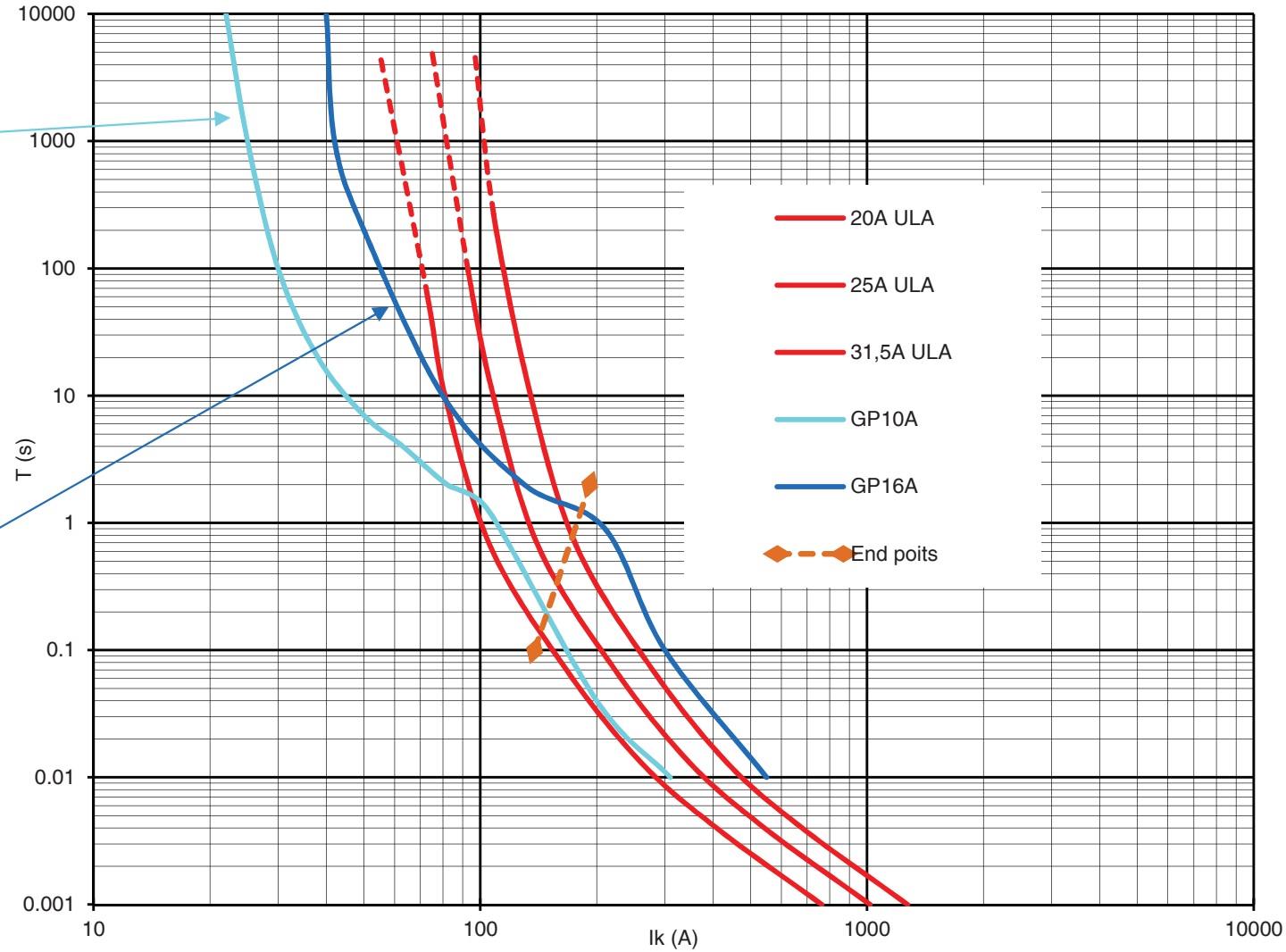
IN THE LINE OF POWER



Transformer protection with fuses

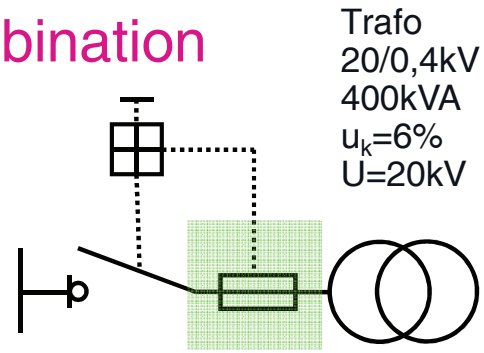
10A , 24kV GP	
t	I (A)
0,01	310
0,04	200
1,25	105
2	82
4	63
7	50
20	38
100	30

16A , 24kV GP	
t	I (A)
0,001	1250
0,01	550
0,1	300
0,9	220
2	140
10	80
200	50



HV-Switch-Fuse combination

HV- Switch-Fuse combination

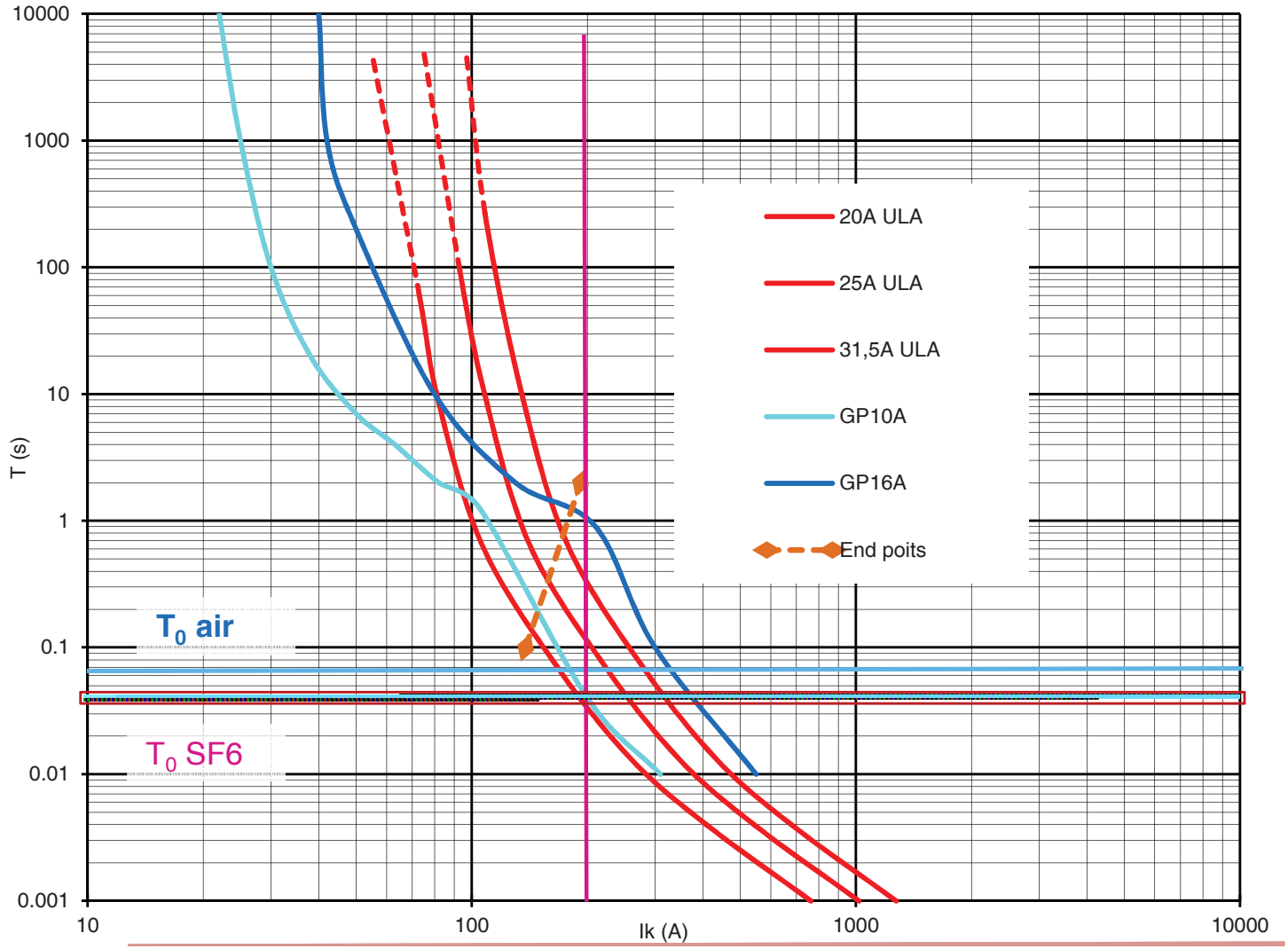


HV-Switch-Fuse combination

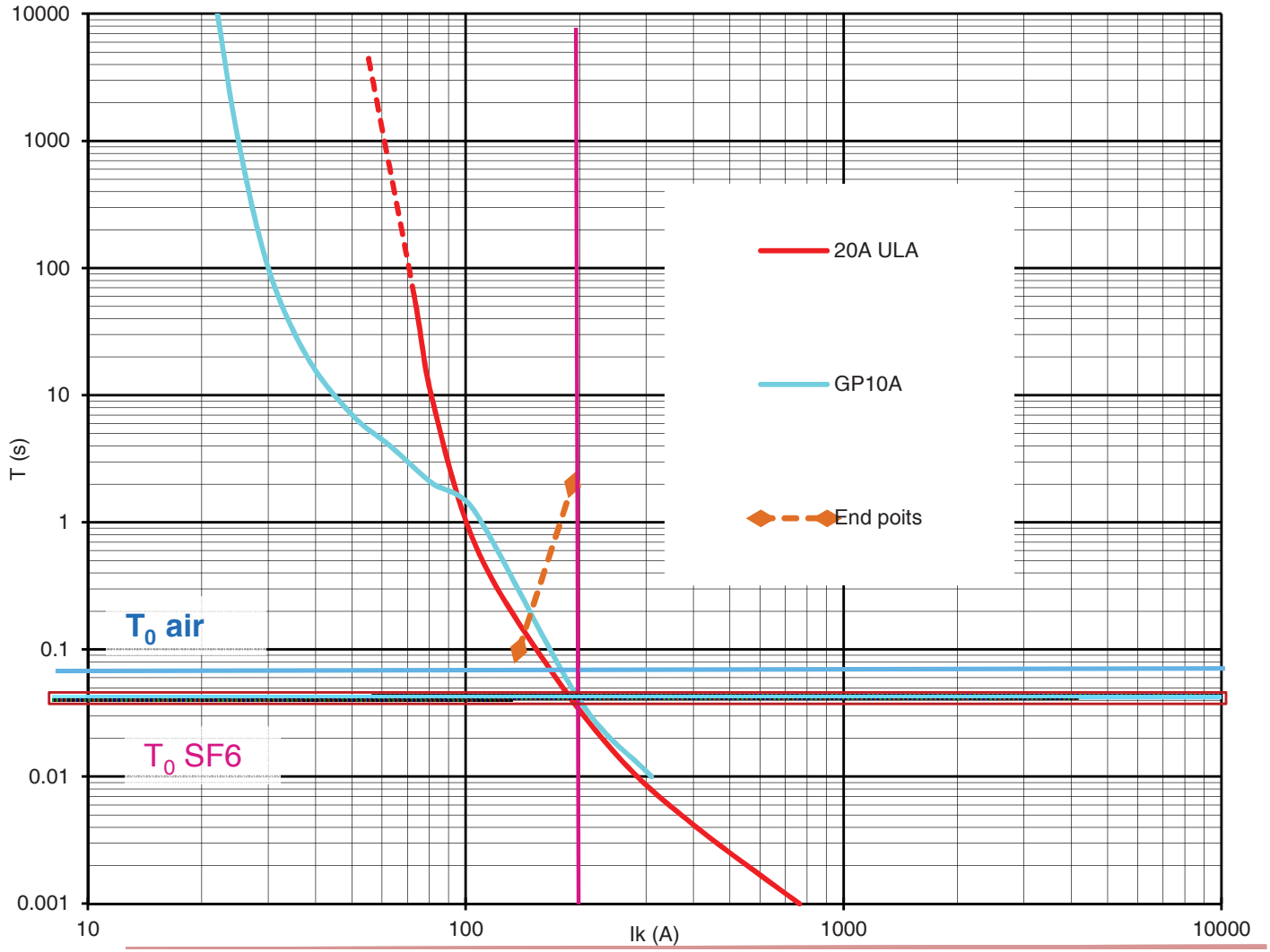
$T_{0\,air}$ = 0,65ms

$T_{0\,SF6}$ =0,35 ms

Short circuit / 2s

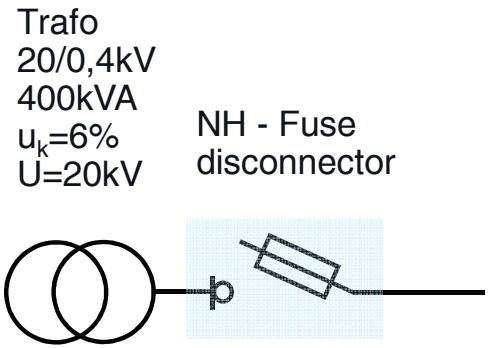


HV-Switch-Fuse combination
Passed fuses



Transformer protection with fuses

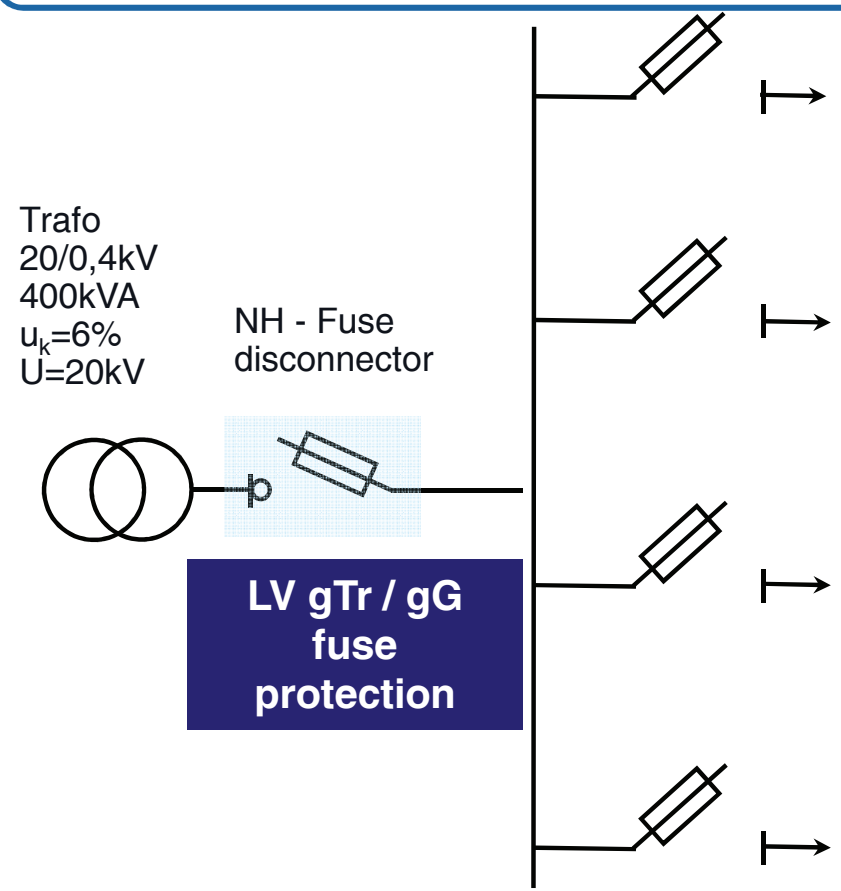
LV Fuses for Transformer protection

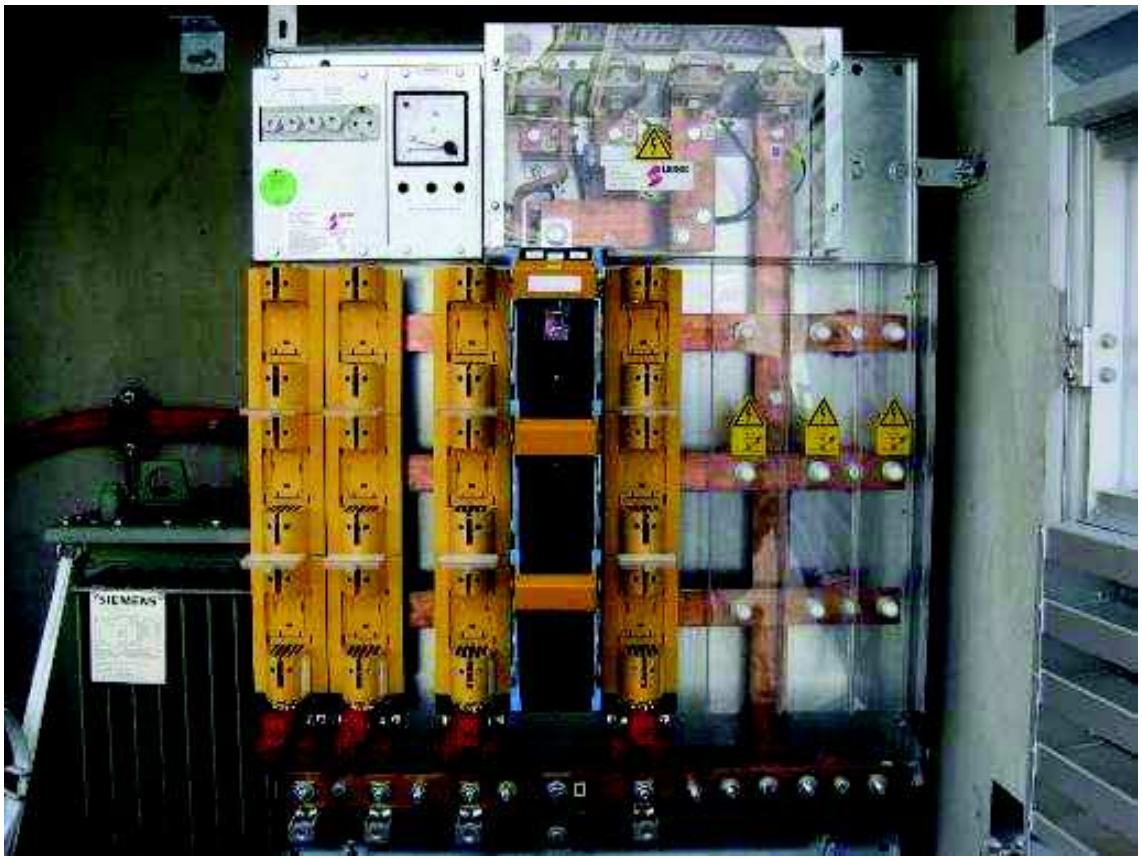


LV gTr / gG fuse protection

Transformer protection with fuses

LV Fuses for Transformer protection





Transformer protection with fuses

LV Fuses for Transformer protection

gTr Fuse



gG Fuse



LV Fuses for Transformer protection

gTr Fuse

- developed and standardized in Germany
- fuses are aligned to the thermal capacity of the transformers
- allow maximum loading of distribution transformers having a secondary voltage of 400 V
- able to carry a current of 1,3 times the rated current over a period of 10 hours
- will operate within two hours at a current of 1,5 times the rated current
- “gTr” fuses are specified in VDE 0636-2, rated voltage of 400 V and a rated breaking capacity of 100 kA



LV Fuses for Transformer protection

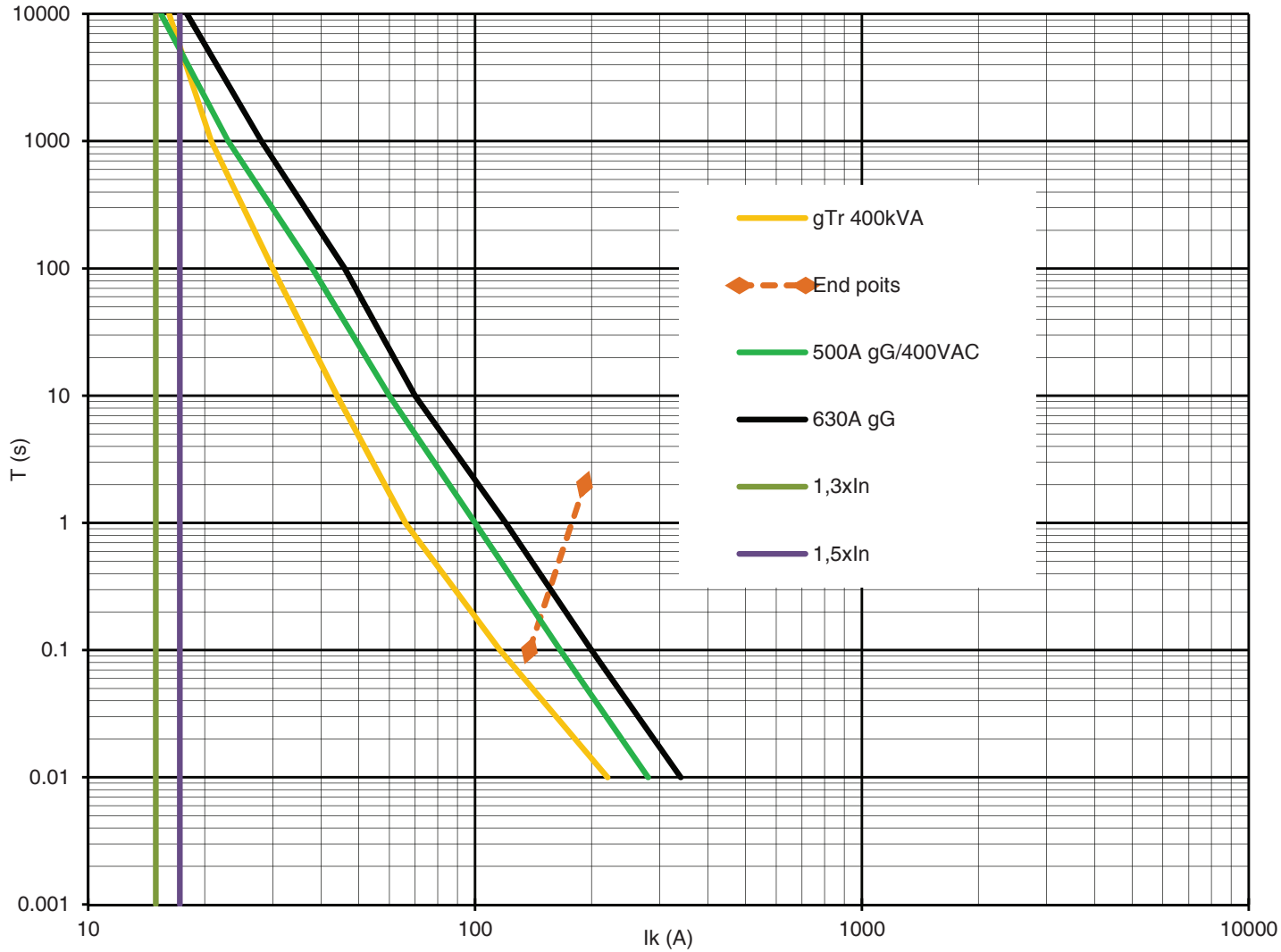
gG Fuse

- Standard Fuses
- 400V or 500V
- Breaking capacity up to 120kA
- „slower“ than gTR



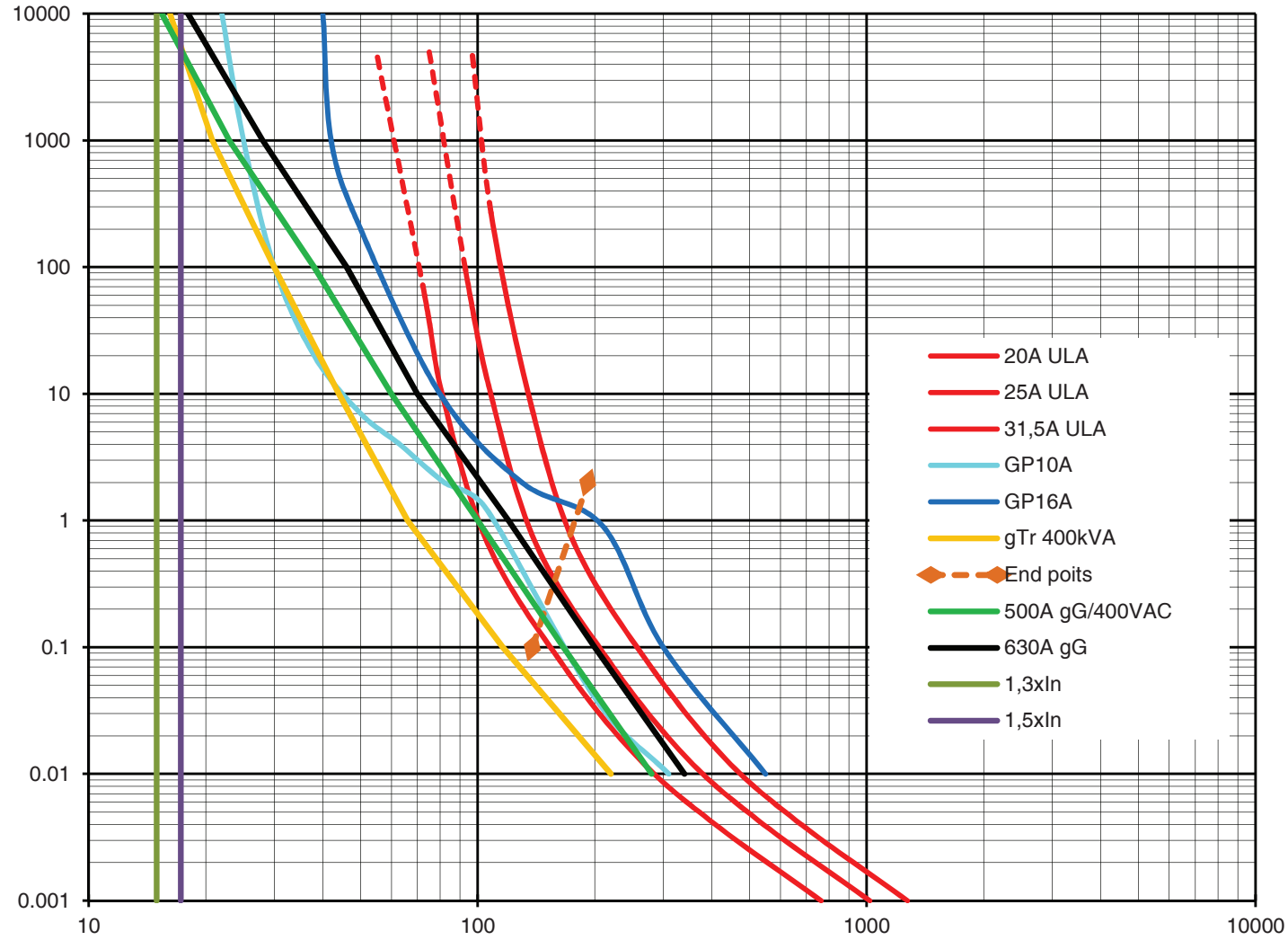
Transformer protection with fuses

Characteristics of LV-fuses inputted in to 20kv



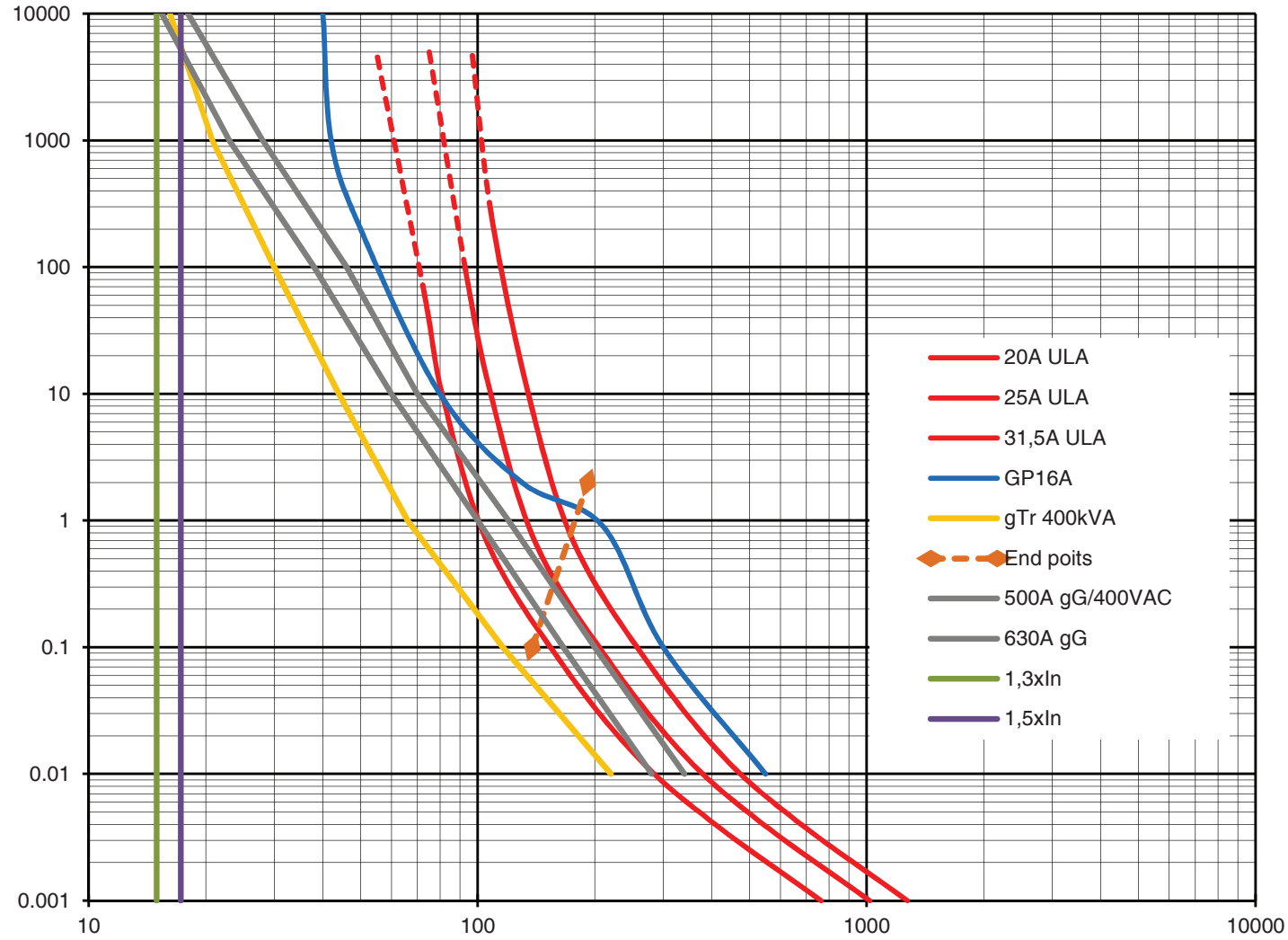
Transformer protection with fuses

Discrimination HV and LV fuses



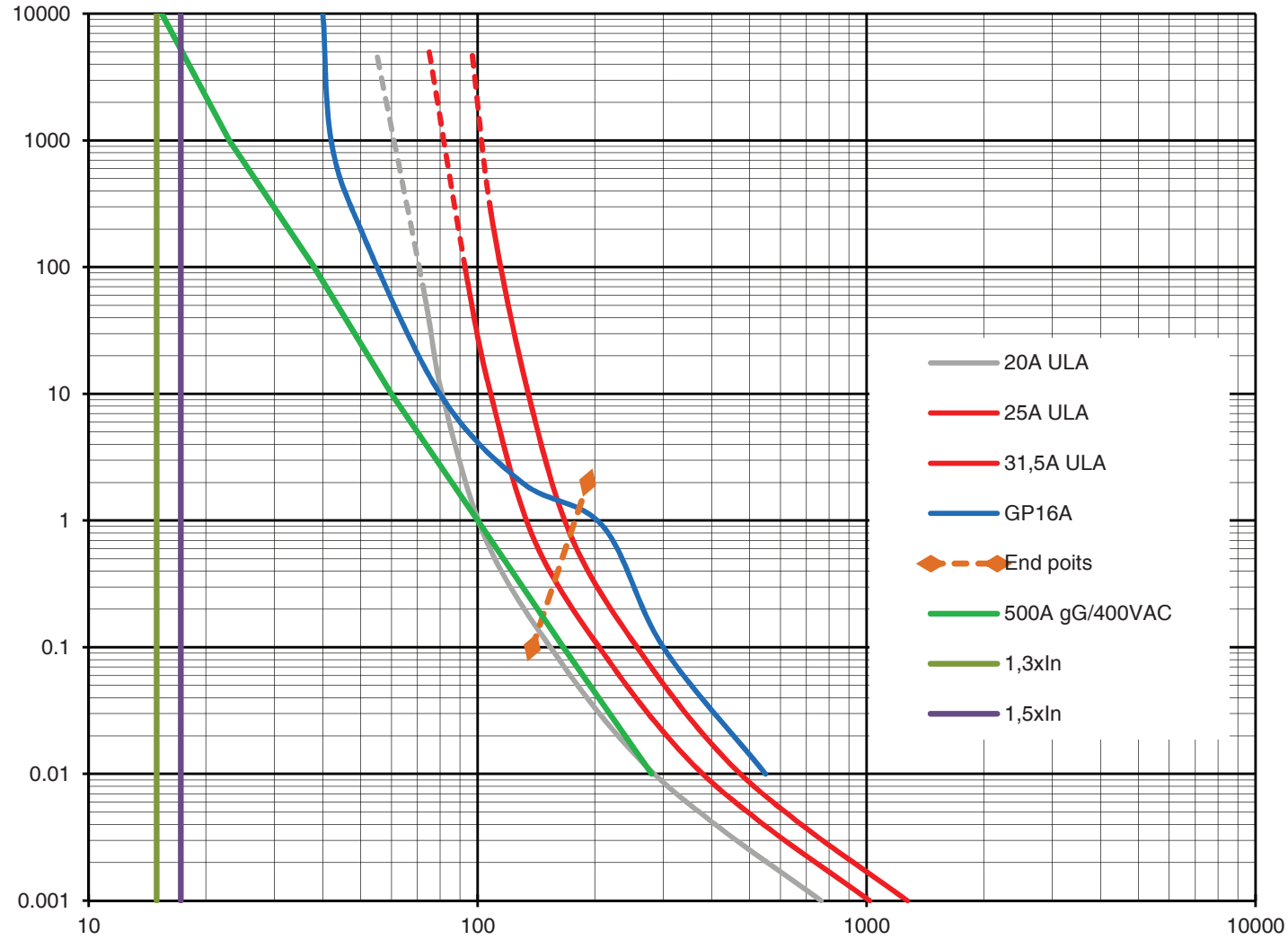
Transformer protection with fuses

Discrimination HV / LV gTr 400kVA



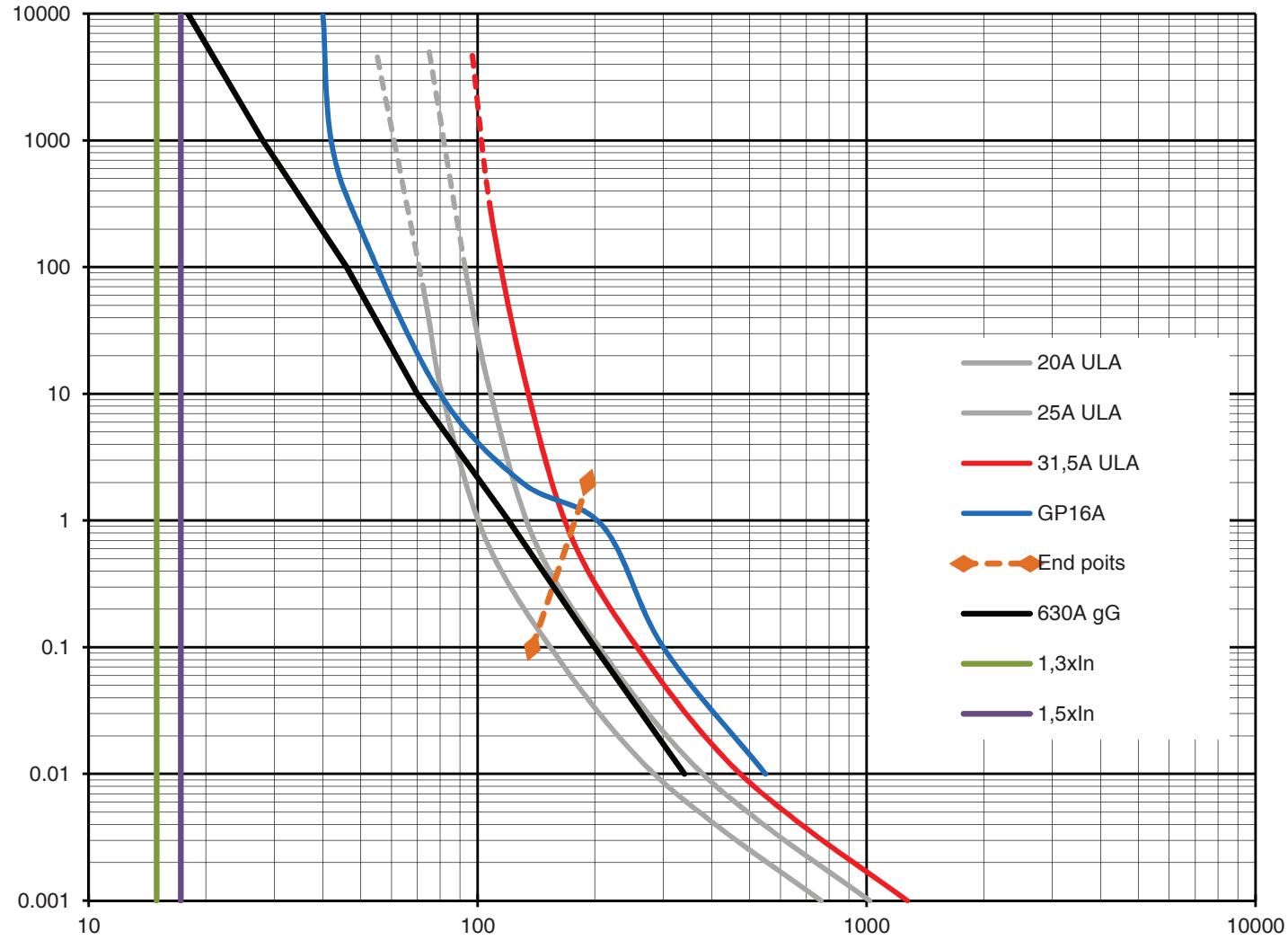
Transformer protection with fuses

Discrimination HV / LV gG 500A



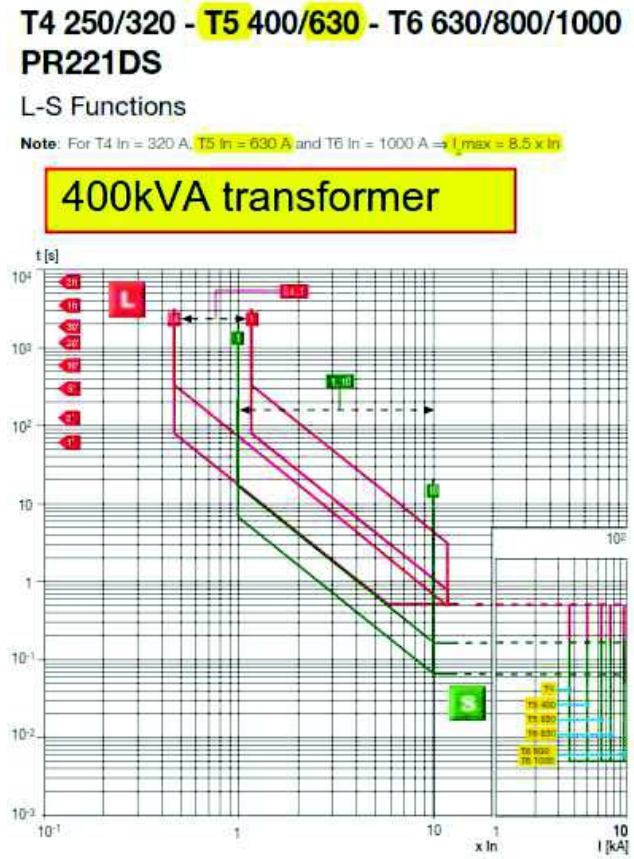
Transformer protection with fuses

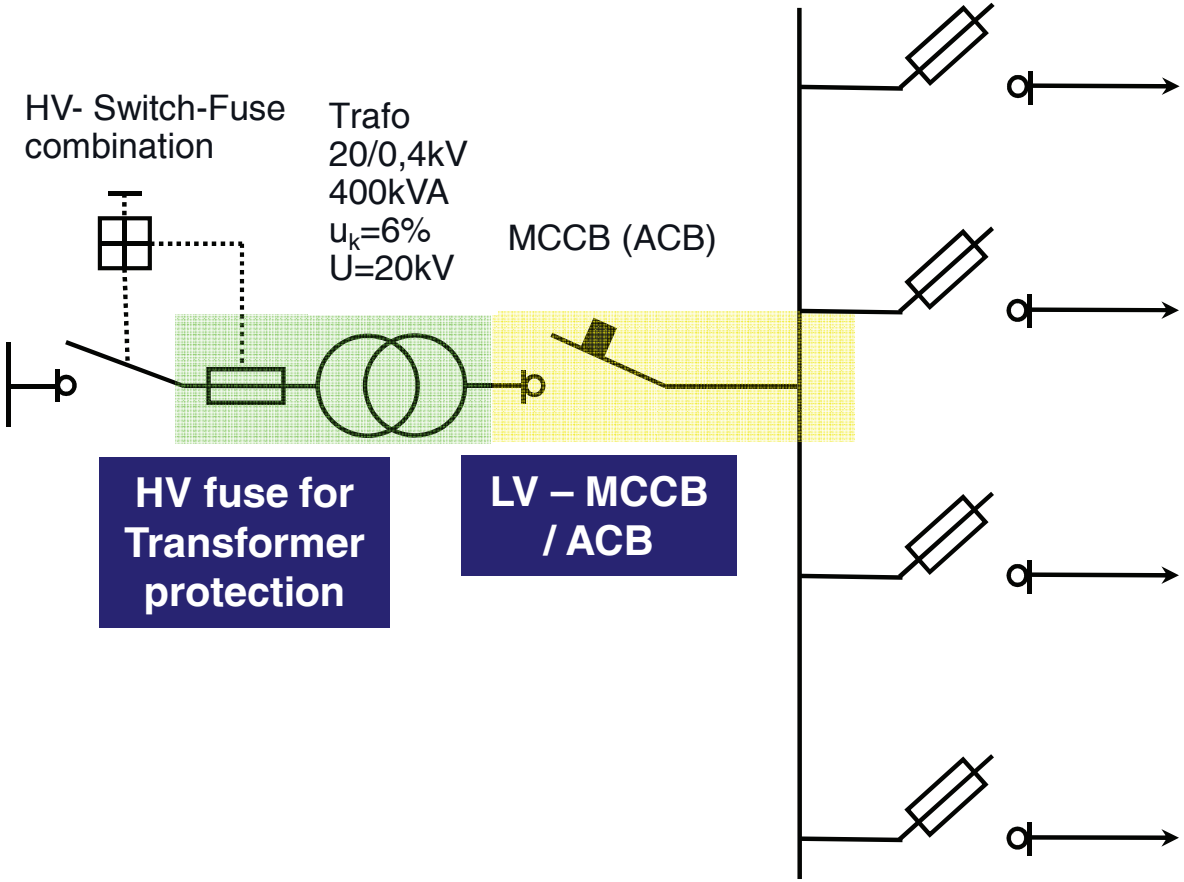
Discrimination HV / LV gG 630A



Transformer protection with fuses

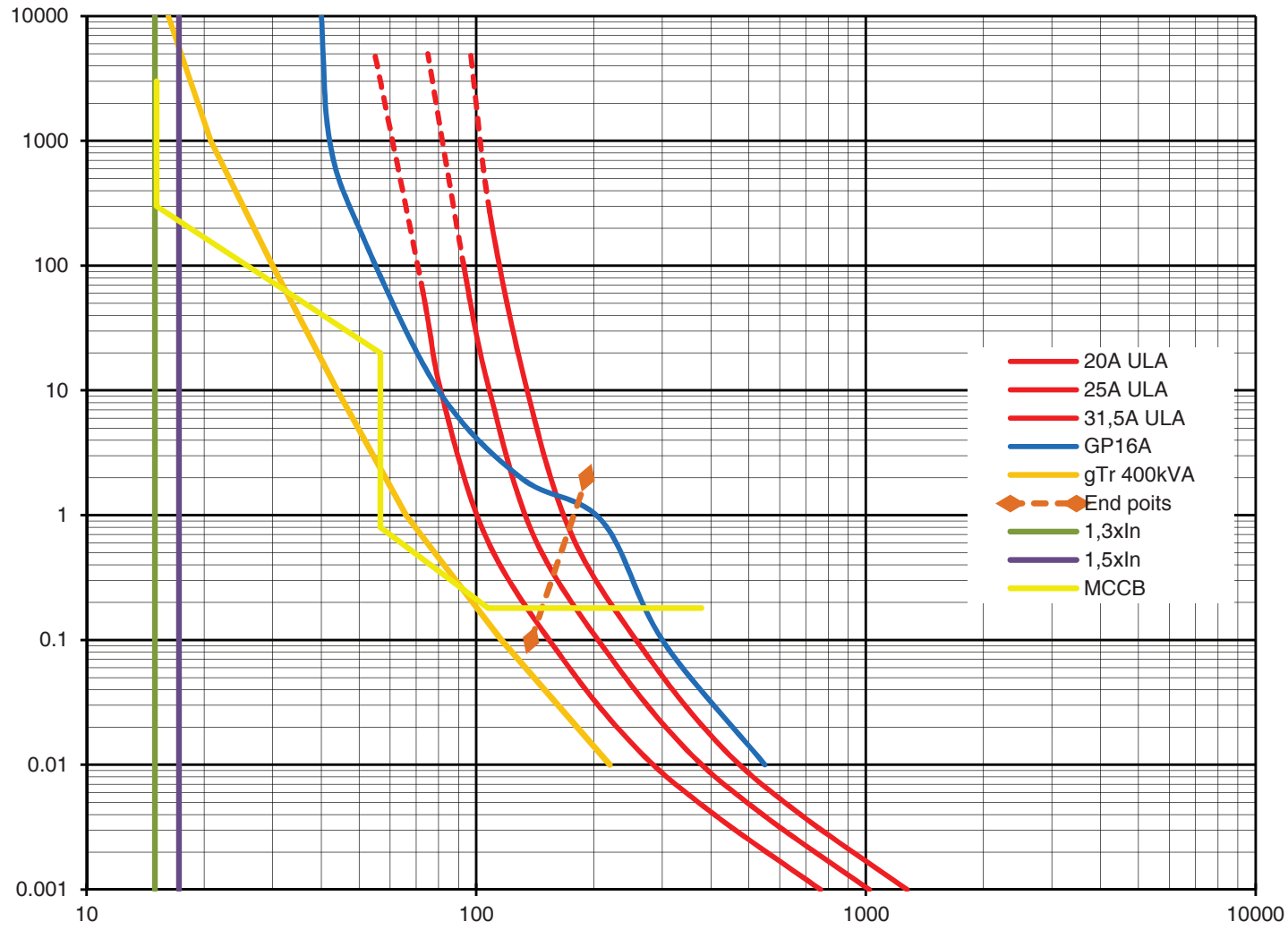
Transformer protection with MCCB/ACB





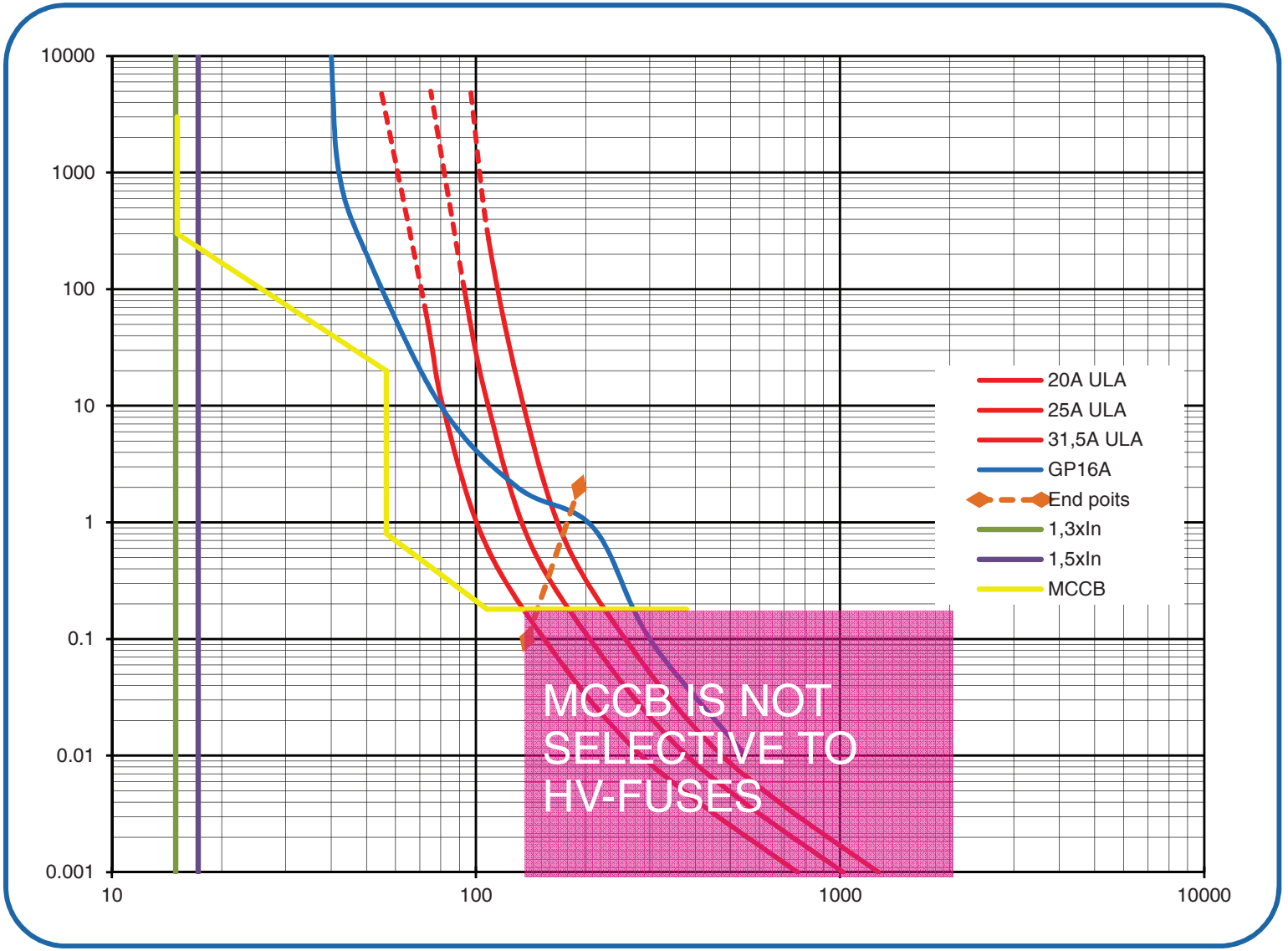
Transformer protection with fuses

Discrimination HV/LV MCCB



Transformer protection with fuses

Discrimination HV/LV MCCB



Transformer protection with fuses

Fuse disconnectors + gTr
Fuses Advantages

- 1-POLE OPERATING
- 1-POLE PROTECTION

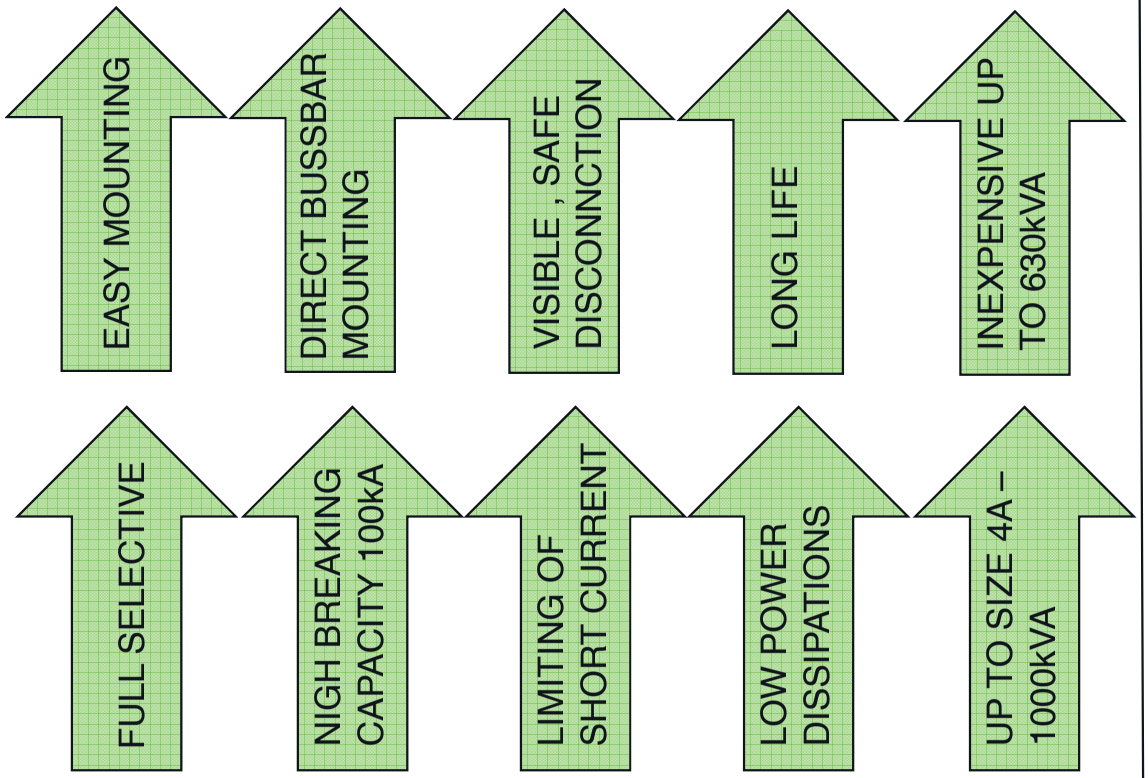
Circuit breakers
MCCB/ACB Advantages

- SAFE OPERATING
- REMOTE OPERATING
- SMALL DIMENSIONS
- EASY TO TURN ON/OFF

- 3-POLE OPERATING
- 3-POLE PROTECTION

Transformer protection with fuses

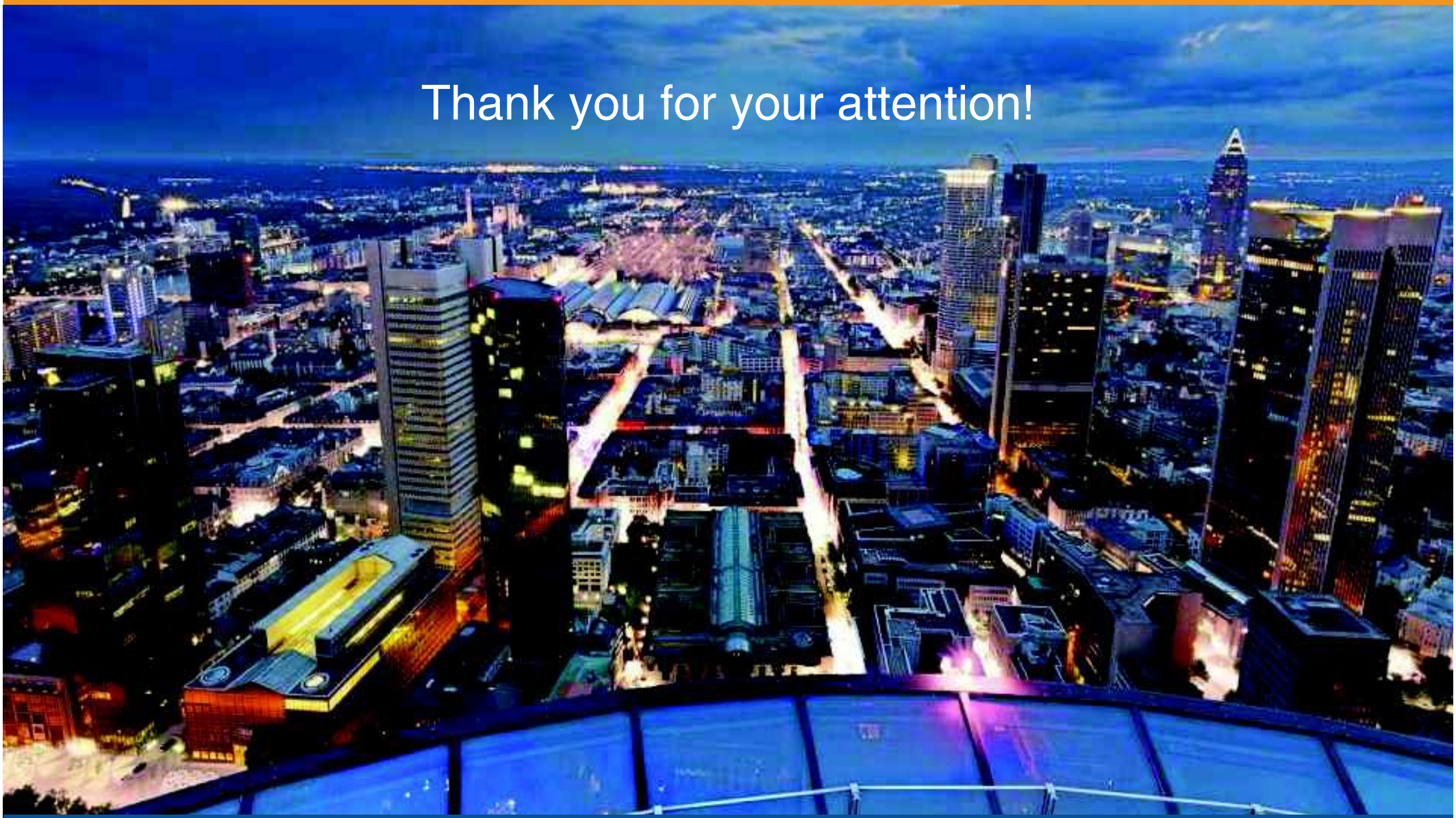
Fuse disconnectors + gTr
Fuses Advantages



Circuit breakers
MCCB/ACB Advantages

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