ABB DATA CENTER FORUM 2017, 11TH JULY 2017

ABB Data Center Forum 2017

Perfecting Data Center availability with Ultra-Fast Protection Devices

Barbara Schlegel

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I_S-limiter™

The world's fastest Fault Current Limiter

Barbara Schlegel

I_S-limiter™– Why?

Why are I_S-limiters™ used?

Short-circuit problems



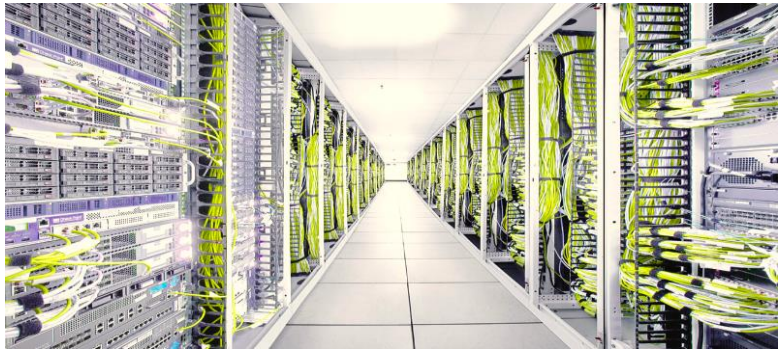
Reducing losses



Reduce downtime



Improve Reliability



Interconnect systems



Downsize



Classification of Data Centers

Electrical challenges

Tier classification

Tier 1
- Only one power supply
- 220 – 320 W/m²

Tier 2
- Two power supply sources
- 430 – 540 W/m²

Tier 3
- Several power supplies
- Redundancy of components
- 1.070 – 1.620 W/m²

Tier 4
- Several power supplies
- Complete redundancy
- More than 1.620 W/m²



Reliable power supply



High power/m² ratio



Effective cooling systems

AVAILABILITY



EFFICIENCY



Stability of voltage

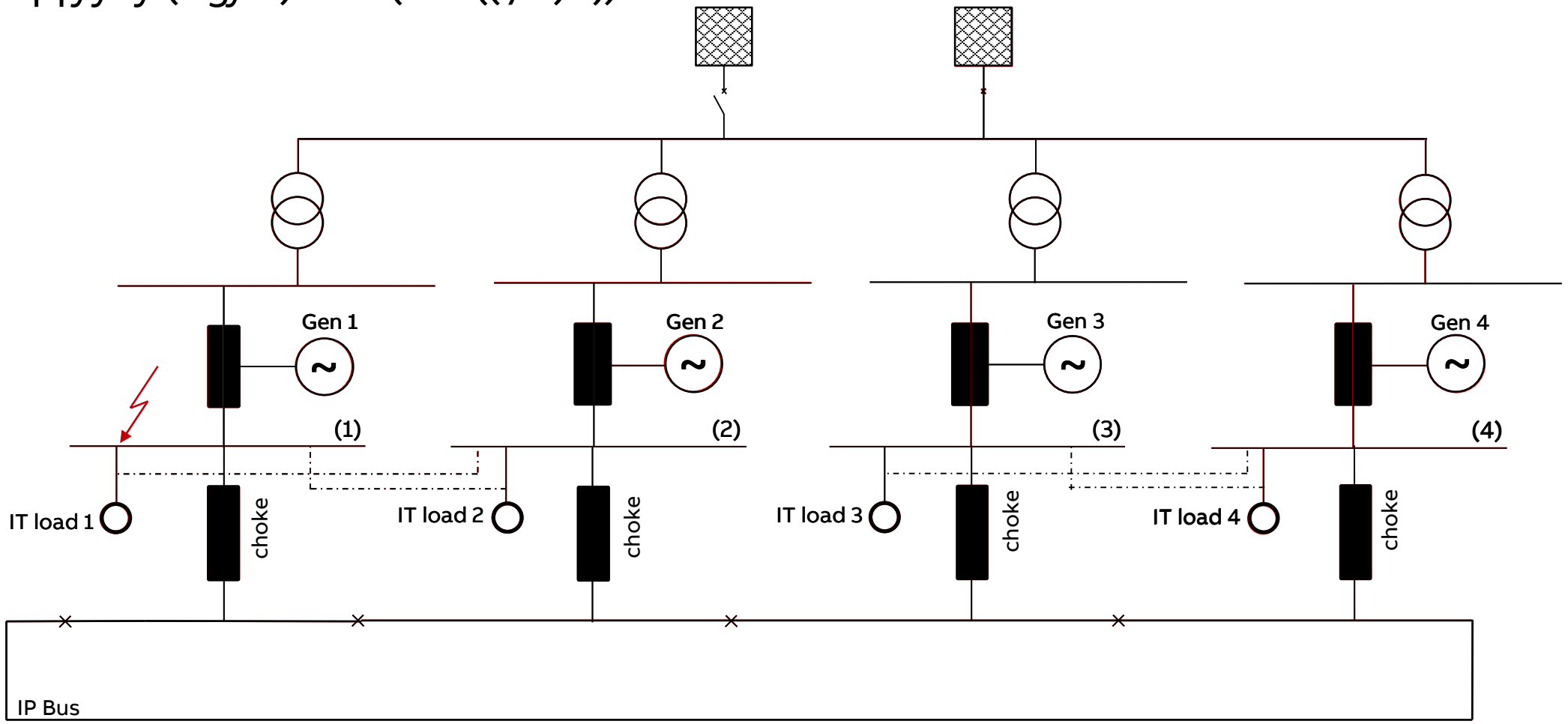


Cost-effective power supply



Flexibility for future expansions

Data Center Structure



Data Center Structure

Problems

Consequences of interconnection

Normal operation

– Redundancy of power supply

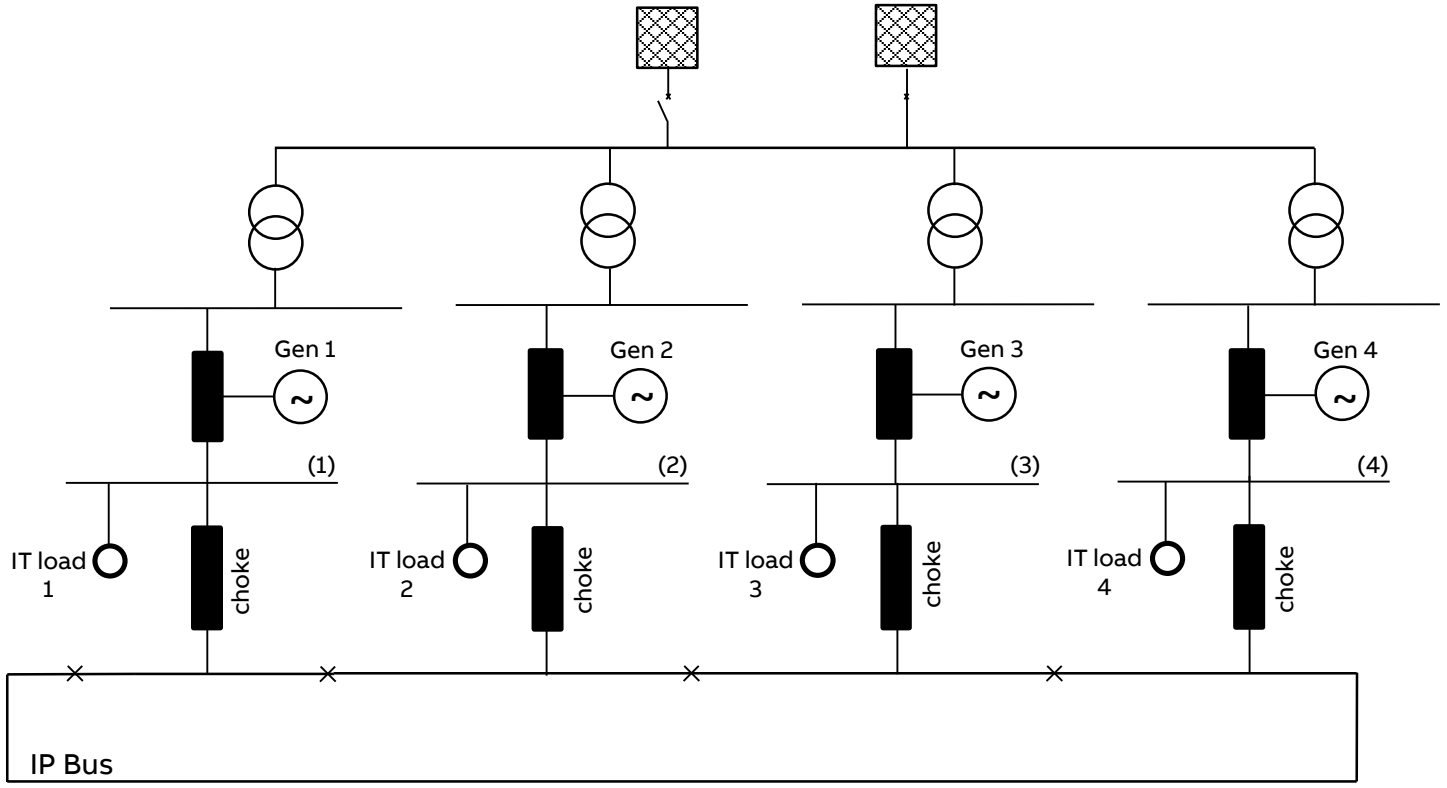
In case of a fault:

– Fault will affect all connected areas
  - Voltage drop in complete system
  - Necessity of chokes to keep short-circuit current low enough

    → Generation of heat

    → Generation of power losses

– Equipment in IP Bus must be able to withstand high short-circuit currents



I_S-limiter™ – Why?

Why are circuit-breakers not helping?

Comparison of I_S-limiter™ and CB

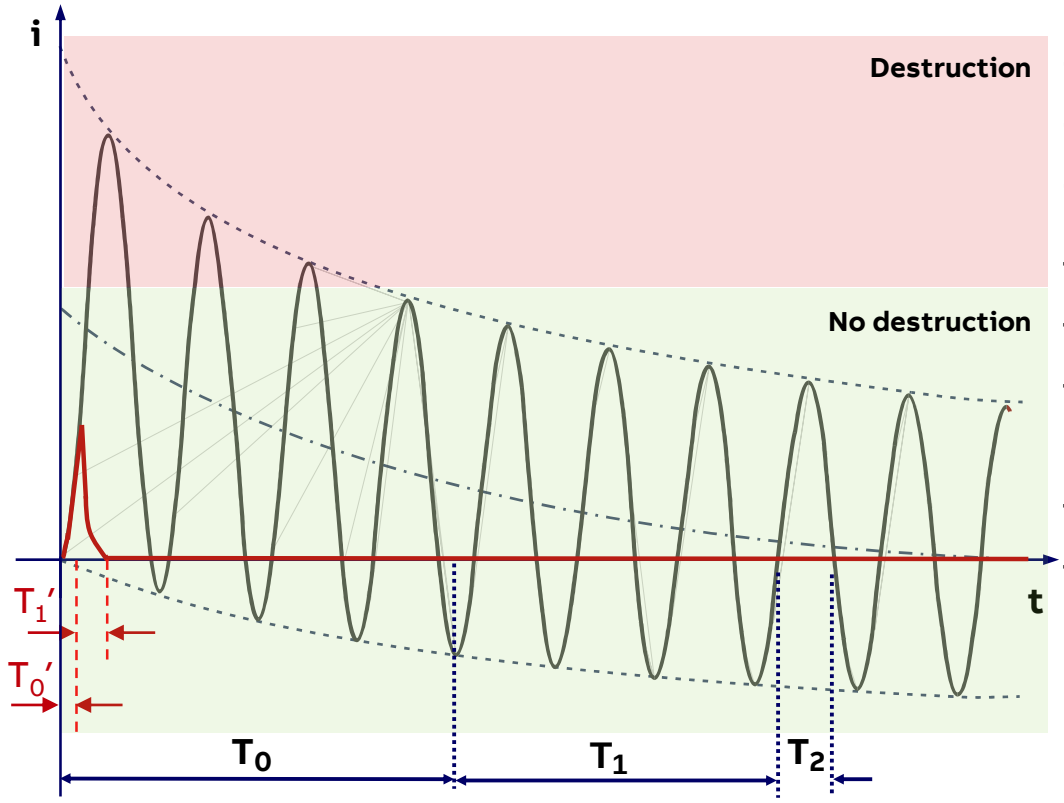
The first peak is the most critical:

- Maximum current
- Maximum forces
- Maximum stress

I_S-limiter™ benefits:

- Ultra fast **detection**
- Ultra fast **limitation**
- **First peak** is never reached
- **No destruction**
- **Voltage drop is reduced**

Ultra fast response for more safety



T_0: Relay operating and response time

T_1: Circuit-breaker operating time

T_2: Circuit-breaker clearing time

$T_0 \approx 10 - 40$ ms

$T_1 \approx 20 - 60$ ms

$T_2 \approx 5 - 20$ ms

T_0': I_S-limiter™ operating time

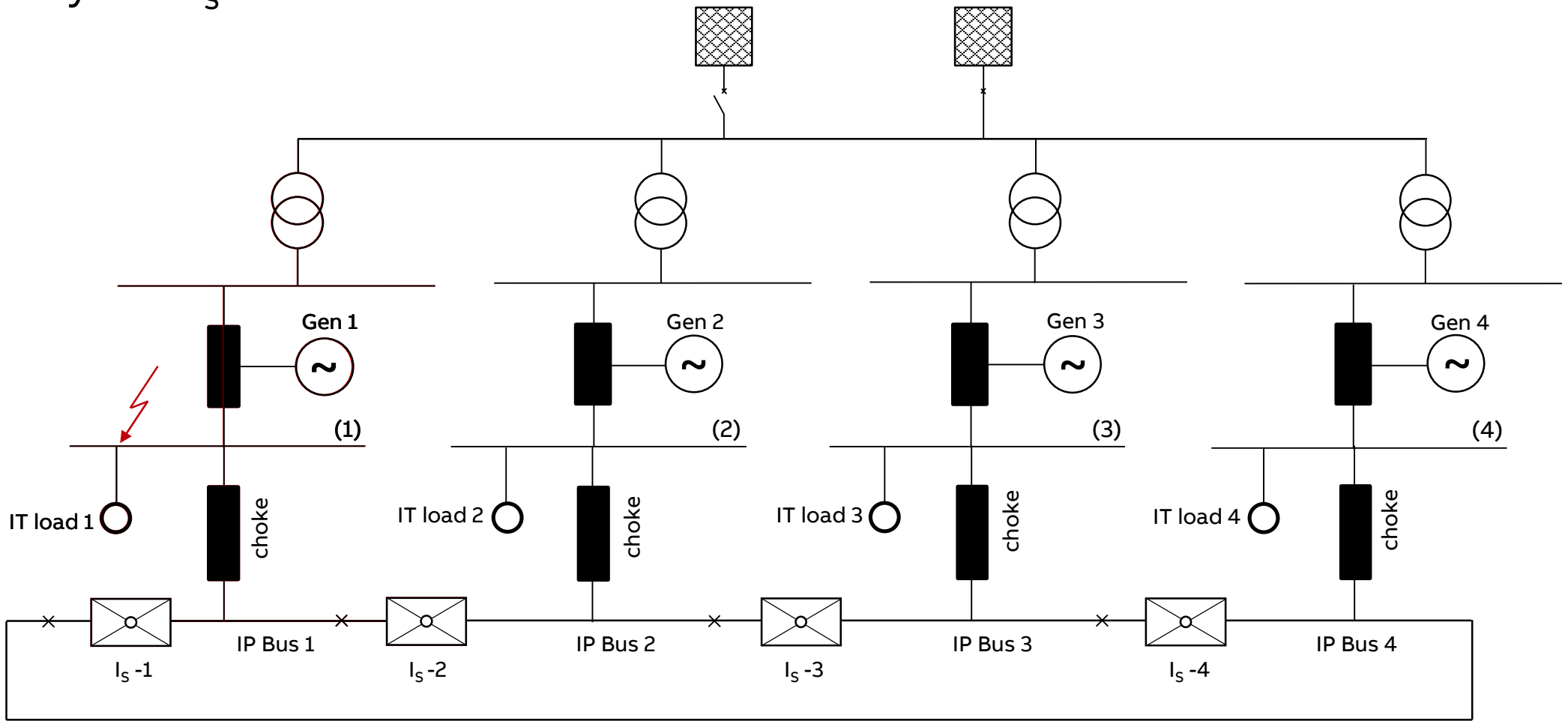
T_1': I_S-limiter™ clearing time

$T_0' < 1$ ms after detection

$T_1' \approx 5$ ms

Data Center Structure

Redundancy with I_S-limiters™



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Data Center Structure

Installation of I_S-limiters™

Installation in IP-Bus

Normal operation

– Redundancy of power supply

In case of a fault:

– Fault will be contained in faulty area

- Reduced voltage drop in system
- Not necessary to install chokes at IP Bus

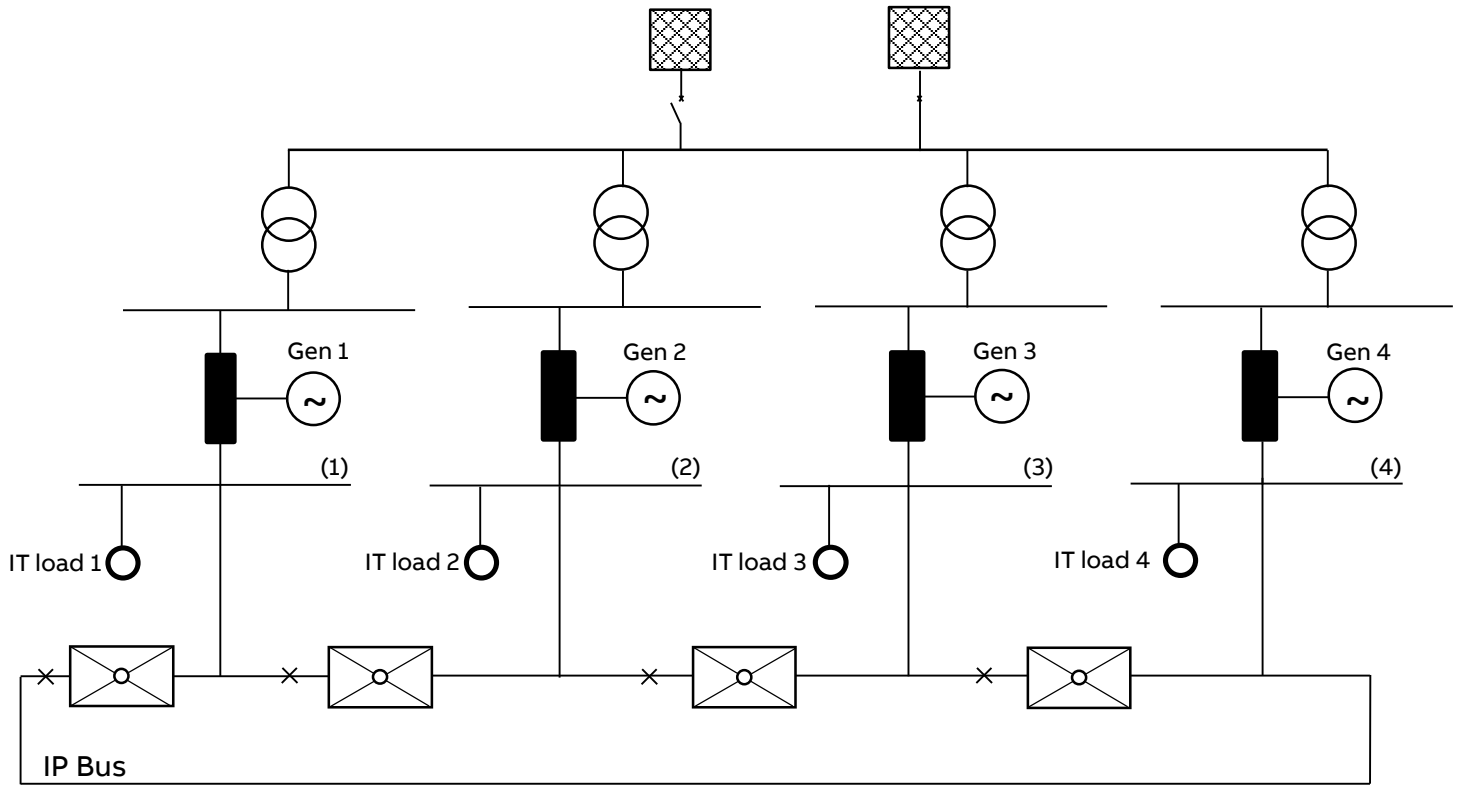
→ Efficient power supply

→ Less generated heat

→ Reduced power losses

– Possibility to downsize equipment

→ Savings of space



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I_S-limiter™

Breaking of short-circuit current with an I_S-limiter™

Application example

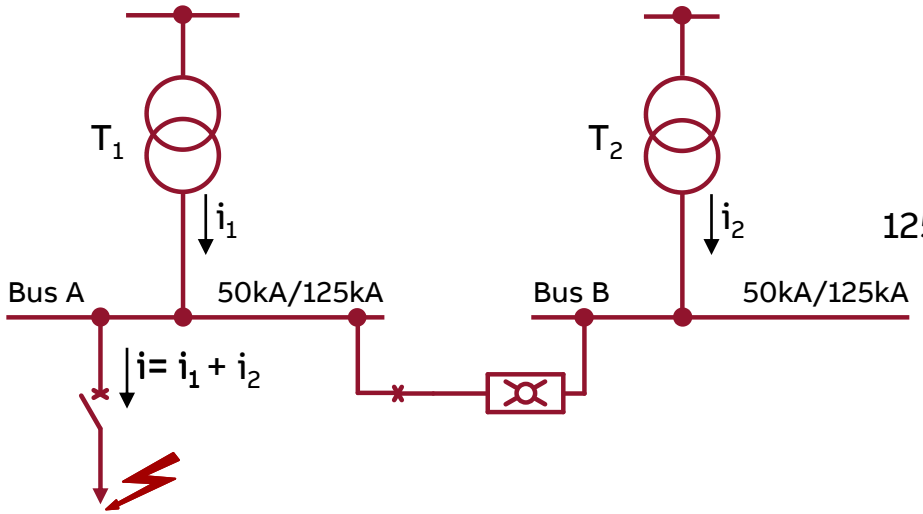
The I_S-limiter™ immediately separates two systems in case of a short-circuit fault

Short-circuit current through I_S-limiter™ is limited in less than 5 ms

Zero peak short-circuit current (i_2) through I_S-limiter™

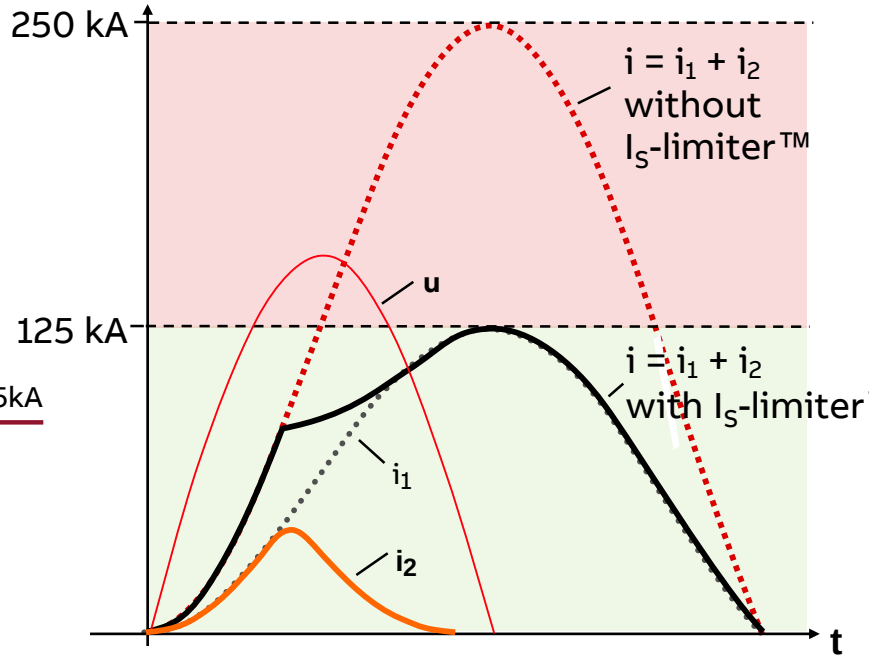
No violation of withstand capability of equipment

Faulty network is immediately separated



Actual fault level at Bus A (with I_S-limiter™):

I''_k = 50 kA / i_p = 125 kA



Current curve at the short-circuit location

u: system voltage
i: total short-circuit current
i_1: current coming from T1
i_2: current coming from bus B, through I_S-limiter™

Standard Applications

I_S-limiter™ in the generator infeed

I_S-limiter™ in generator feeder

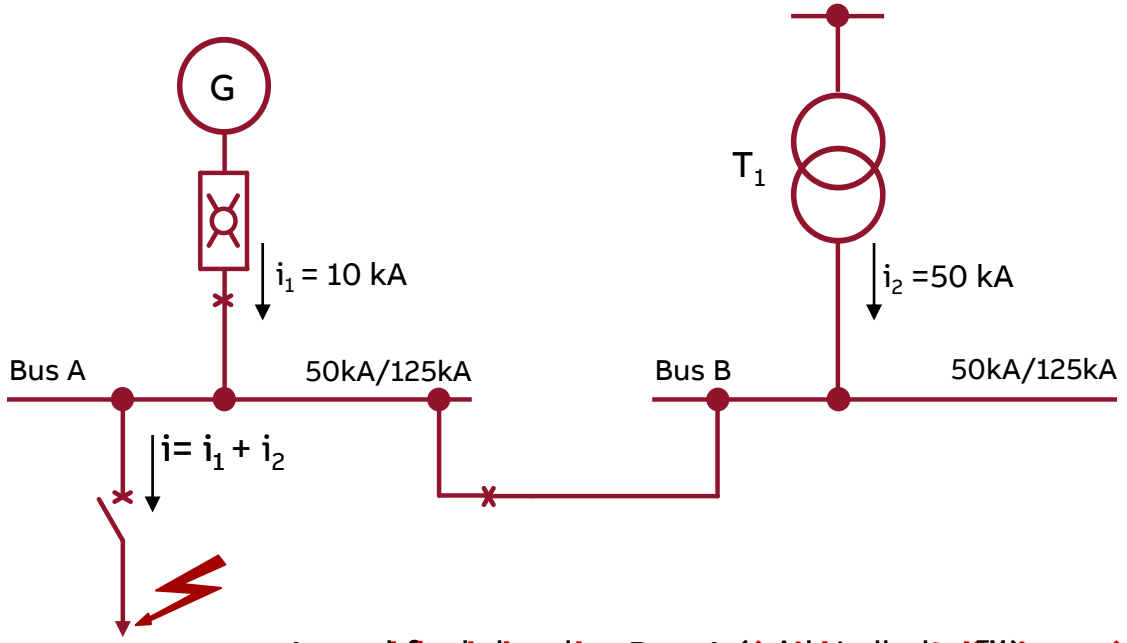
Generator can be connected independent of the short-circuit capability of the system

Higher availability of existing or new system

System extension without replacing existing electrical equipment such as circuit-breaker, busbar or cable system

Reduction of energy released in case of a fault

Easy connection of new power sources



Actual fault level at Bus A (without I_S-limiter™):

$I_k'' = 50$ kA / $i_p = 125$ kA

Actual fault level at Bus A (with I_S-limiter™):

$I_k'' = 50$ kA / $i_p = 125$ kA

Complex Applications

I_S-limiter™ with directional selectivity

I_S-limiter ™ with directional selectivity

Avoid unnecessary tripping

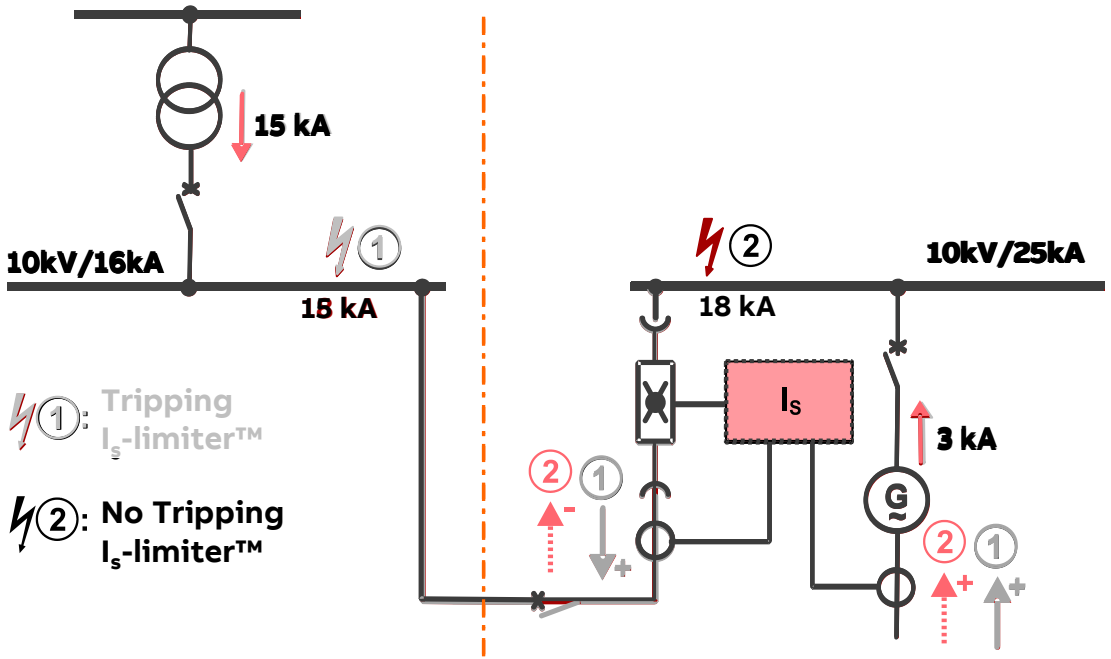
Improve uptime due to selective tripping

Connect private / industrial generator feeder to the fully loaded grid

No conflict to Grid Code

Selective tripping of the I_S-limiter™
(Tripping only at faults within network area ①, not at faults within network area ②)

Minimized number of operations



Complex Applications

I_S-limiter™ with summation selectivity

I_S-limiter™ with summation selectivity

Minimized number of operations

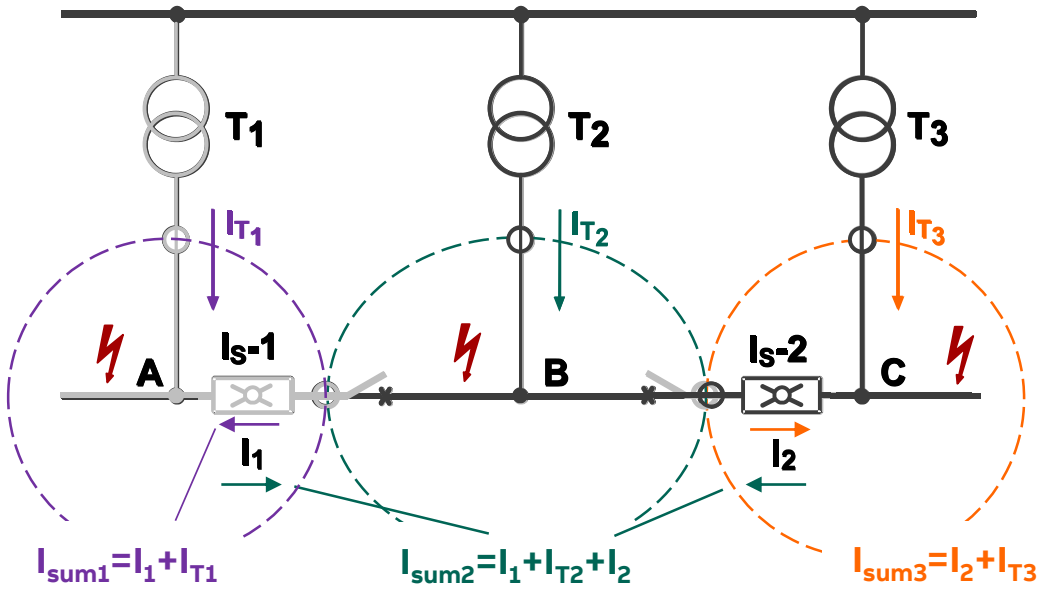
Only I_s-limiter™(s) close to fault location operate

Limitation of short-circuit affected area due to isolation of fault

Reduced **voltage dip** in large healthy area in case of short-circuit fault

Higher availability of system and processes

Isolation of fault area

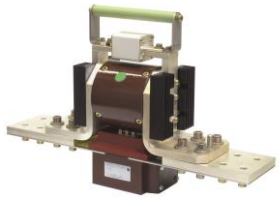


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I_S-limiter ™ Portfolio

I_S-limiter™ family





	I_S-limiter™
Application	Indoor
Medium voltage ratings	… 40,5 kV … 4000A
Low voltage ratings	… 1,4 kV … 5000 A
Panel solution	✓*
Customized solution	✓
Selective tripping	✓

* For medium voltage



I_S-limiter™

Availability – Reliability - Efficiency

Main advantages

Availability - Maximizing your output
- Installation in greenfield and brownfield projects
- Increased uptime and redundancy of the power systems

Reliability – Protecting your assets
- World's fastest fault current limiter to protect systems and processes
- Type tested equipment
- More than 3000 installations in more than 85 countries

Efficiency – Optimizing your investments
- Eco-and cost efficient fault current limiters
- Optimized load flow behavior
- Reduction of energy losses in the system



Our SOLUTION for your short-circuit problems

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UFES

Ultra-Fast Earthing Switch

Barbara Schlegel

Internal Arc Faults

Impacts on switchgear without internal arc classification

Video:
Internal arc test
50kA / 1s

Switchgear
without internal
arc classification
(exemplary)
Circuit-breaker
compartment

©ABB

Internal arc faults

Reasons of formation



Typical human and operational errors:

- Work in a wrong cubicle
- Operation of a wrong disconnector
- Forgetting to ground the working area
- Forgetting to test the presence of voltage in the working area
- Forgetting to remove tools



Technical reasons to arc faults:

- Wrong devices or wrong operation of devices
- Ageing of insulation and mechanical wear
- Overvoltage
- Overheating
- Moisture, dirt
- Destruction of components



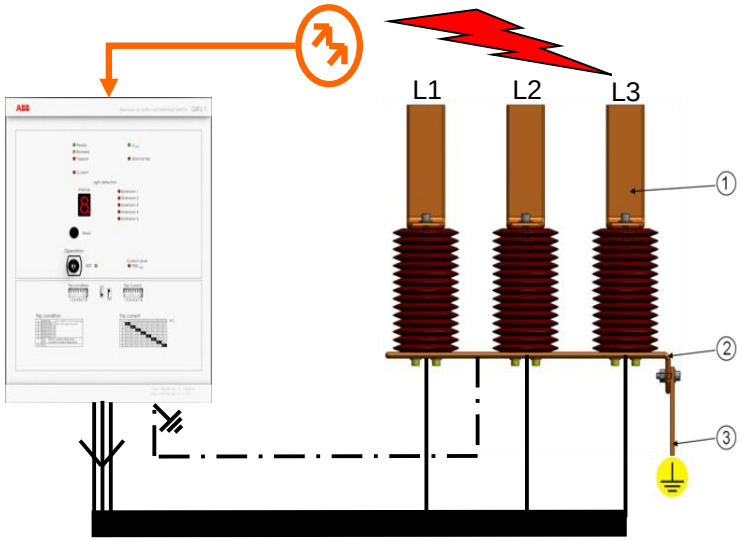
Other technical reasons to arc faults:

- Corrosion
- Foreign objects (e.g. tools) or small animals in the switchgear
- Installation errors
- Bad cable terminations and loose busbar joints

Ultra-Fast Earthing Switch

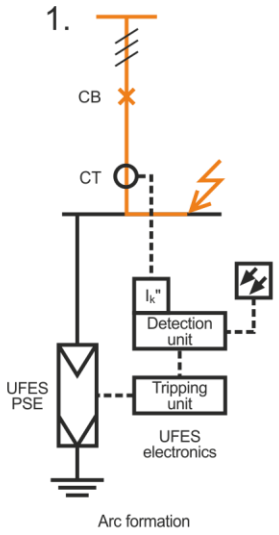
Active internal arc protection by ABB

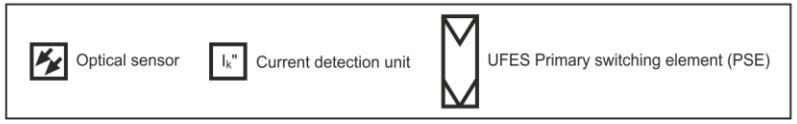
UFES System



Tripping cables

Sequence of tripping operation





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Ultra-Fast Earthing Switch

Comparison



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Ultra-Fast Earthing Switch

Portfolio



	UFES
Application	Indoor
Maximum rated voltage	U_r = 40.5 kV → I_k'' = 40 kA (3s)
Medium voltage	U_r = 17.5 kV → I_k'' = 50 kA (3s) I_k'' = 63 kA (1s)
Low voltage	U_r = 1.4 kV → I_k'' = 100 kA (0.5s)
Integration in ABB panel	✓
Integration in OEM panel	✓

Ultra-Fast Earthing Switch

Available in…

Kit



Removable unit



Service-Box



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Ultra-Fast Earthing Switch type UFES

The insurance for the switchgear



Investing in UFES means…

- More availability of data center
- Minimization of downtime
- Increased switchgear life
- Increasing operator safety

Save lives, Save money!

