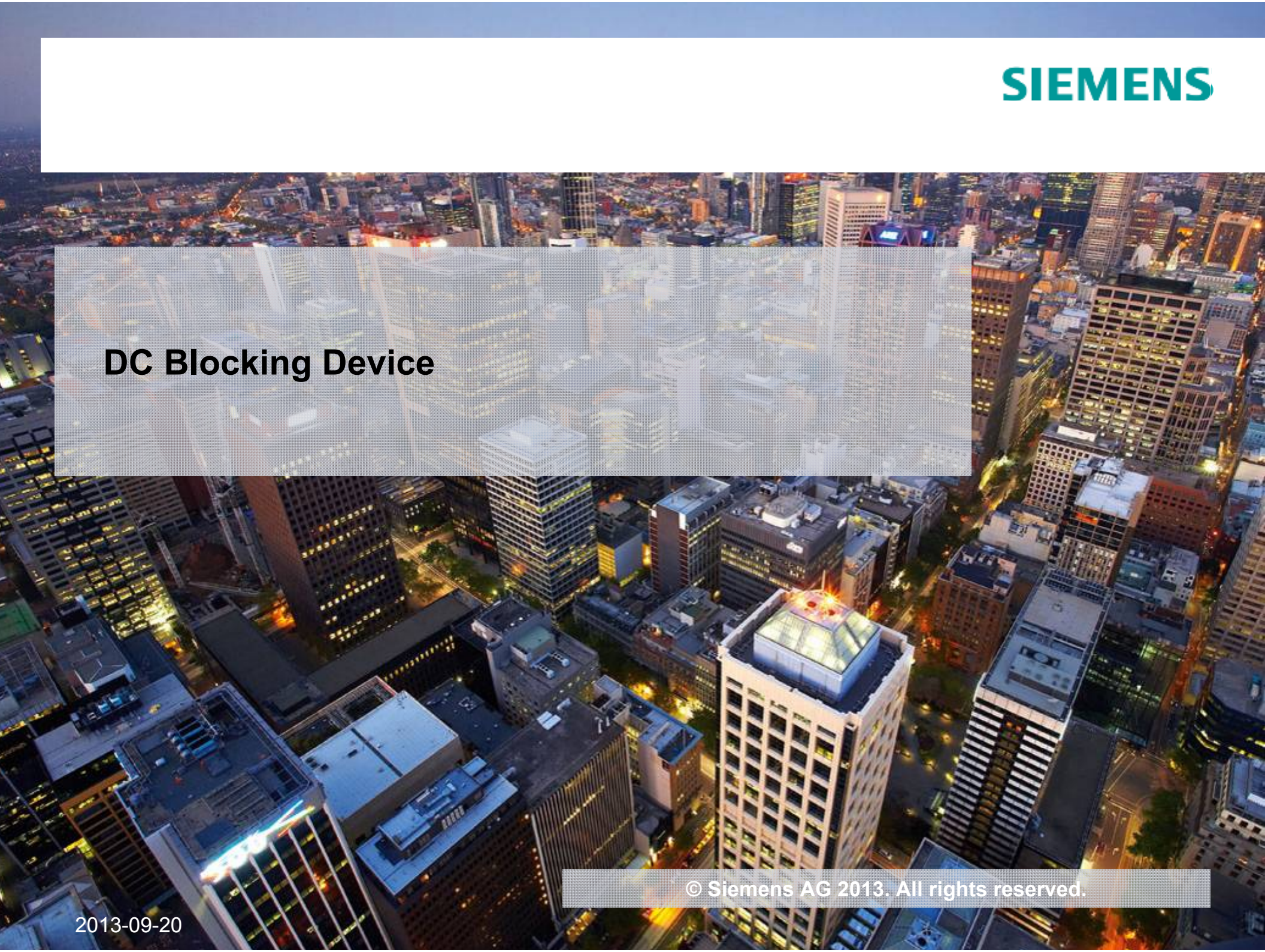


DC Blocking Device

2013-09-20

DC Blocking Device Application (1 / 2)

SIEMENS

Problem:

DC current component in transformer neutral connection may result in increased noise level, heat generation, partial saturation and damage to the windings.

Possible Causes

- During “ground return” operation mode, HVDC systems inject DC current into earth electrode which may lead to a DC current component flowing through AC transformer neutral connections.
- Geomagnetic induced current in AC lines (GIC):
  Currents induced by a slow variation of the magnetic field of the earth. Often caused by strong solar activity (e.g. solar wind).
- DC powered railway systems

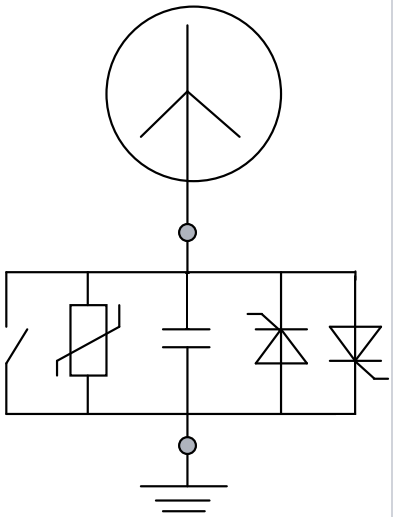
DC Blocking Device
Application (2 / 2)

SIEMENS

Solution:

Installation of DC Current Blocking Device (DCBD) at transformer neutral:

- The blocking capacitor eliminates completely the DC current flow, whilst providing a low impedence grounding for operational AC currents (i.e. unbalance current).
- The power electronic system ensures a low impedance of grounding during transient events like line faults and transformer inrush currents.
- Built-in intelligence enables automatically reset of the device once the AC system fault is cleared.
- Manually operated disconnector (optional) can be provided for maintenance and bypassing actions.



DC Blocking Device
History of Capacitive DC Blocking Device

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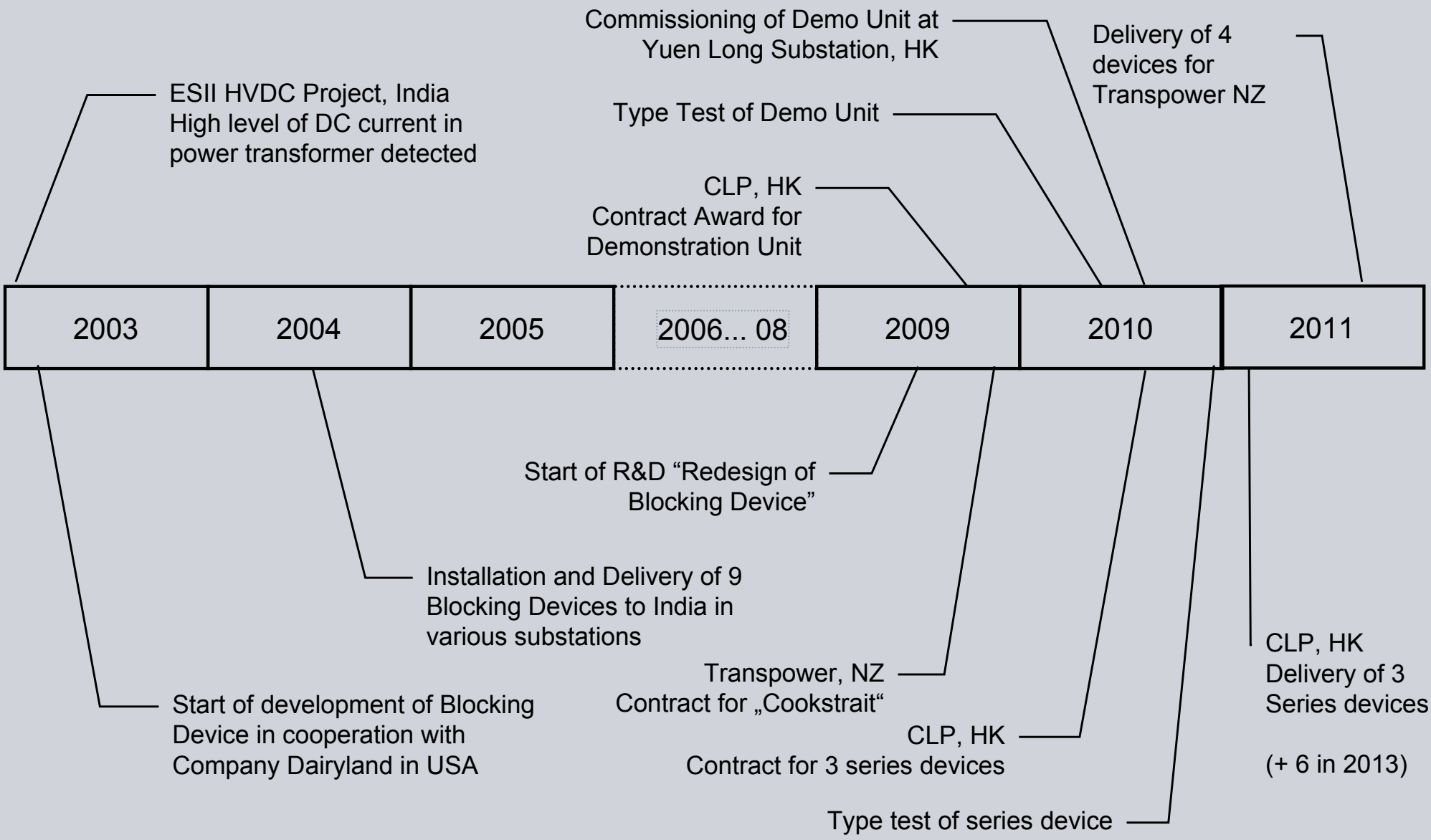

DC Blocking Device
Demonstration Unit in High Current Test Setup

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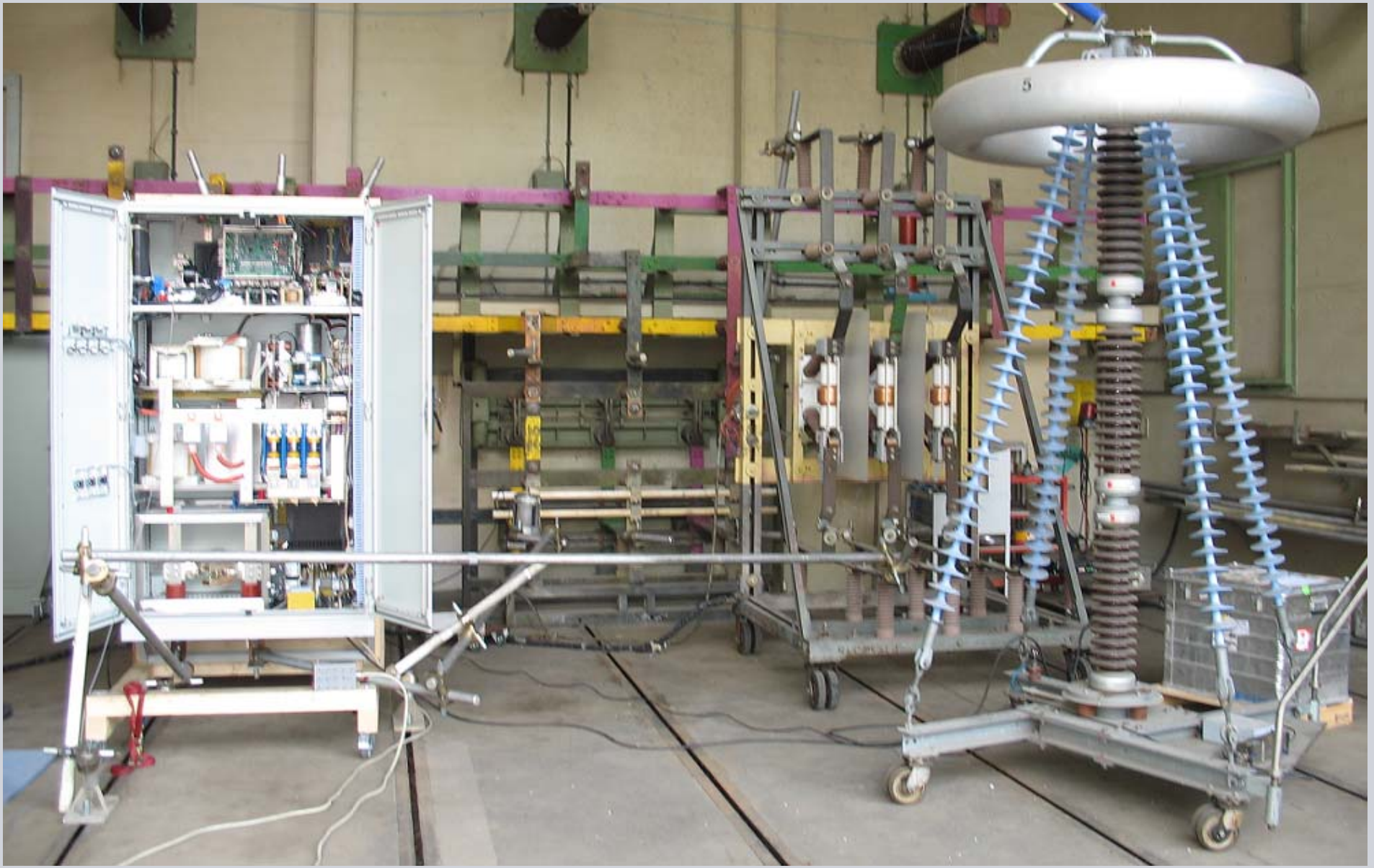

DC Blocking Device
Series Device

SIEMENS

DCBD Enclosure

- Stainless Steel Design (A2 Quality)
- Doors with padlock support
- IP55 Rating
- Rain and Sun proof
- Indoor and outdoor Installation possible
- Floor socket or wall mounting frame

DCBD unit in Nuremberg factory

DCBD unit in CLP transformer bay

DC Blocking Device
Simplified Diagram

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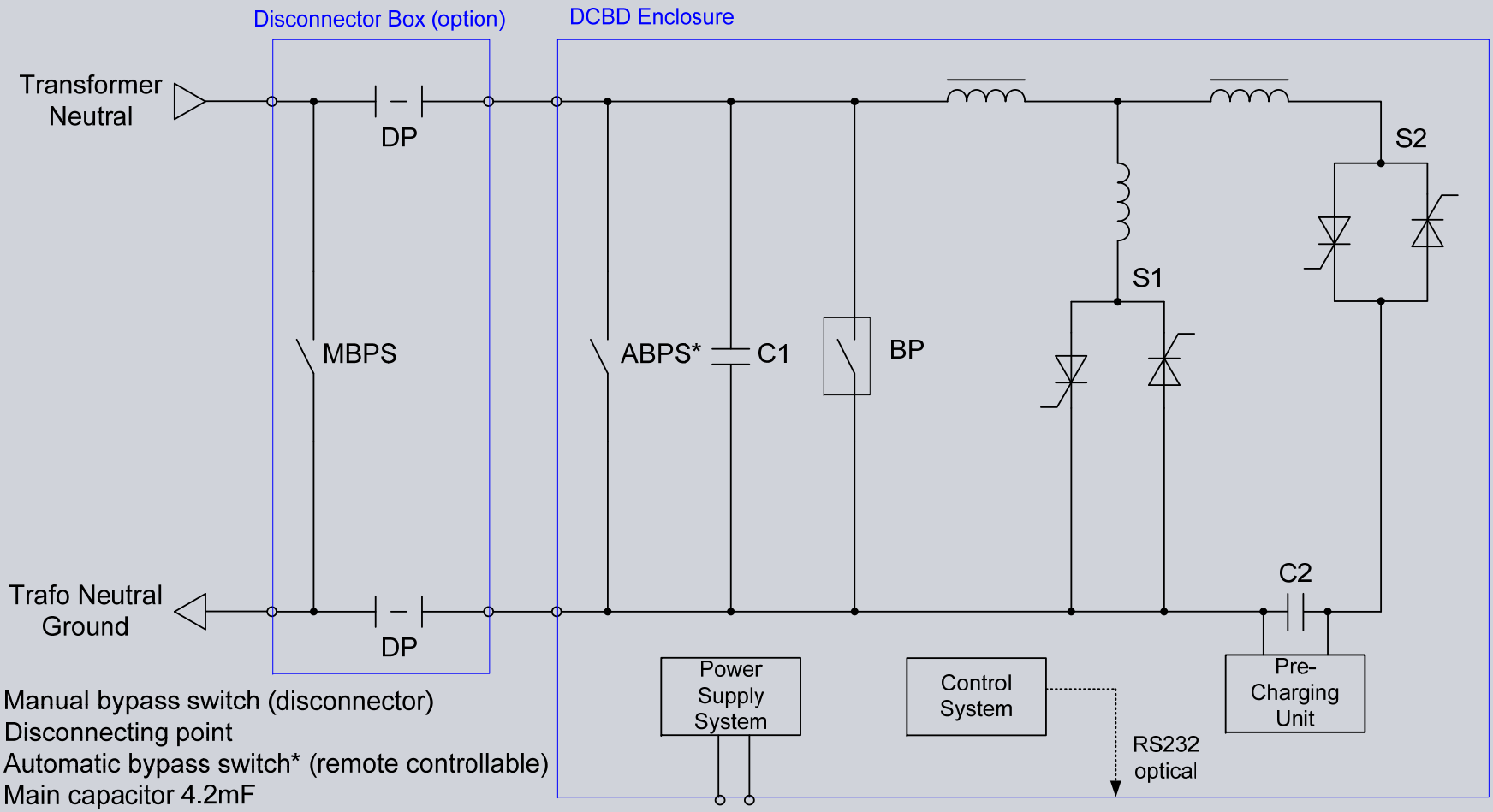


MBPS = Manual bypass switch (disconnector)
DP = Disconnecting point
ABPS = Automatic bypass switch* (remote controllable)
C1 = Main capacitor 4.2mF
BP = Energency bypass
S1 = Fast thyristor bypass
S2 = Commutation thyristors
C2 = Commutation capacitor

*Automatic switching of ABPS in case of increased transformer neutral DC currents is feasible in terms of an optional feature which is subject to project specific definition

DC Blocking Device
Basic Function of Thyristor Bypass

SIEMENS

Activation of Thyristor (SCR) based Bypass

- In case of a line fault, voltage on main capacitor will rise rapidly
- As soon as „Primary trigger Level“ is exceeded, SCR will be triggered
- Afterwards DCBD control system keeps SCR conducting for a preset time („secondary firing period“), in order to account for decay of transformer inrush currents or clearing of line faults respectively

Deactivation of Thyristor (SCR) based Bypass

- At the end of the secondary firing period, a DC current component may flow through SCR
  → lack of natural current zero crossings may occur
  → SCR does not turn off naturally.
- In oder to turn off the SCR bypass reliably, a commutating circuit will be fired at the end of the secondary firing period
  → SCR will turn off even in case of high operational DC currents

DC Blocking Device
Unique Protective Concept

SIEMENS

Backup triggering of Thyristor (SCR) based Bypass

- In case of a breakdown of DCBD control system or due a fault of external power supply respectively, normal triggering of SCR's would not be possible
- Therefore a 100% passive backup trigger circuit is implemented which will trigger the SCR as soon as a backup trigger level voltage is exceeded

Emergency Bypass (BP)

- In order to cope even with a complete malfunction of SCR, a fast-acting emergency bypass is implemented which will short circuit the main terminals in less than 1ms.
- Emergency bypass is also activated by an independent 100% passive trigger circuit, i.e. also works independent of control system

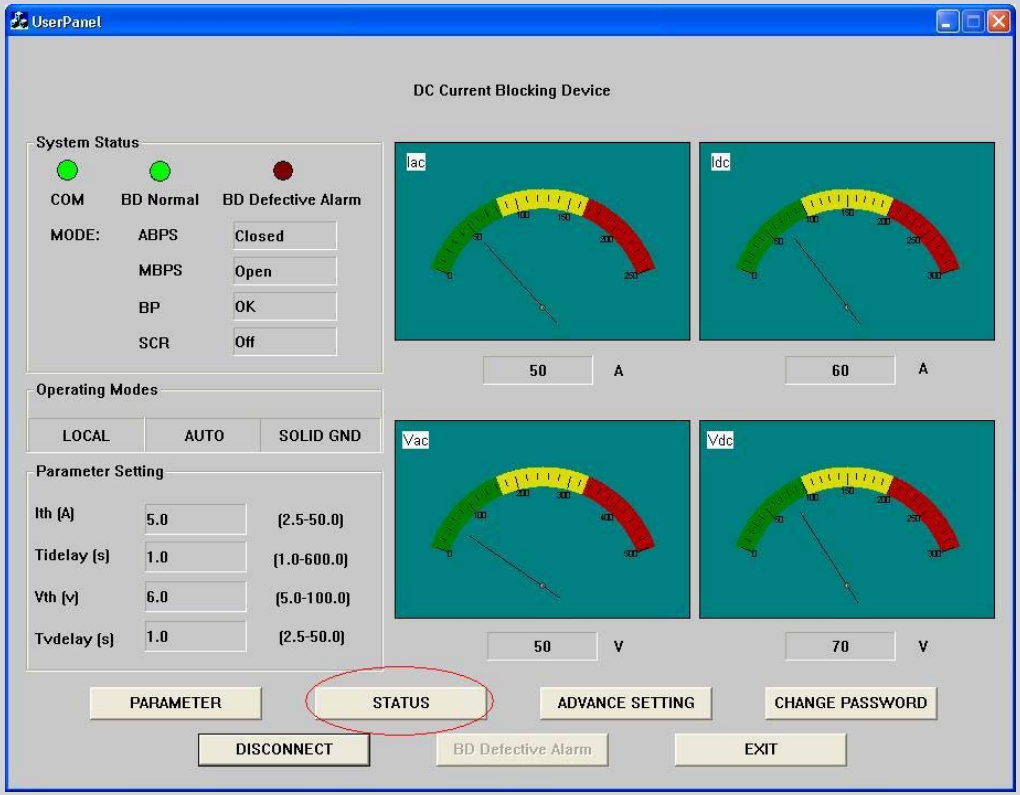
→ ***Unique protective concept prevents any severe fault of DCBD.***

DC Blocking Device
Innovative HMI

SIEMENS

Communication with DC Blocking Device control system

- DCBD control system is provided with an electro-optical RS232 converter
- HMI can be operated on every standard notebook with RS232 interface (a suitable optic-electrical interface module can be provided by Siemens)
- Features and functions of HMI:
  - *Current & Voltage Measurement (VAC, VDC, IAC, IDC*)*
  - *System Status*
  - *Operating Modes*
  - *Parameter Setting*
  - *Alarm Record, Components Failures*
- HMI can be operated safely even on a life DC Blocking Device



**IDC only in with installation of ABPS*

DC Blocking Device
Ratings and Technical Data (1 / 3)

SIEMENS

Key Ratings

- Maximum AC current = 200Arms continuous
- Maximum DC current = 200A when DC is allowed to flow
  (can be increased to 300A upon request)
- Fault Current rating = 31.5kArms 500ms
- Rated DC Block. Voltage = 500V (limit for automatic SCR turn-off)
- DC Blocking Capacitance = 4.2mF

Settings of Thyristor Bypass

Primary Triggel Level	=	800V (instantaneous)	adjustable on site
Overcurrent trigger level	=	300Arms	preset
Secondary Firing period	=	20s (default)	adjustable on site

DC Blocking Device
Ratings and Technical Data (2 / 3)

SIEMENS

External Power Supply

- Main Power Supply = DC110V (other values optional)
  → for DC Blocking Device control circuits
- Auxiliary Power Supply = AC220/230V 50/60Hz (other values optional)
  → for Anti-Condensation heater and blower
- Redundant Power Supplies supported, i.e. 2 x DC as well as 2 x AC with automatic switching between supplies (DCBD internal)

Control Interfaces

- HMI = RS232 via electric-optical converter;
  HMI tool can be operated on any standard notebook with RS232 interface
- Local Indications = Signal Lamps on front panels
- Remote Indications = via potential-free contacts
- Remote Control (optional) = via Interposing Relay, e.g. 50V coil voltage

DC Blocking Device
Ratings and Technical Data (3 / 3)

SIEMENS

DCBD Enclosure

▪ Material	=	Stainless Steel Quality A2, (RAL 7035 coating)
▪ IP-Rating	=	IP55
▪ Ambient Temperature	=	-10°C .. +40°C (+50°C) standard (up to -30°C optional)
▪ Place of installation	=	Indoors and Outdoors (rain and sun proof)
▪ Dimensions	=	1200mm x 800mm x 2000mm (separate Disconnector Box extra)
▪ Kind of Installation	=	Either floor mounted via socket (standard) or wall mounting via separate adapter (option)