Optimized Energy Exchange in Primary Distribution Networks with DC-Links

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Definition of „Optimized Energy Exchange“

Optimized Energy Exchange = controlled load flow
System design

Optimized Energy Exchange = controlled load flow

IGBT-Converters
pulse frequency 3kHz

Network 1

Q₁
P
Q₂

Network 2
Working principle

- Without load
- Capacitive load
- Inductive load
- Inductive load + active power flow
SIPLINK Control

Network 1

\[ U_1, I_1 \]

Closed loop control
Converter 1

\[ U_{DC}, Q_1 \]

\[ U_{DC}, U_1 \]

Open loop control

Network 2

\[ U_2, I_2 \]

Closed loop control
Converter 2

\[ P, Q_2 \]

\[ P, U_2 \]

\[ U_2 \]

or

or

Network 2:
with power generation
without power generation (isolated network)
Network Application

- Extended inductively earthed systems exceeding the permissible capacitive earth fault current
- Different starpoint treatments in distribution systems
- Limited short circuit capability
- Different frequencies of networks (60, 50, 16 2/3 Hz)
- Separation of networks with disturbed power supply from other distribution systems
Benefits

- Controlled power transfer / exchange between different distribution networks

- Cost savings by “Load Optimization”

- Improvement of power quality:
  - More reliable power supply
  - Stabilization of voltage by generation reactive power

- Investment cost cutting by alternative solutions in network extensions specifically in high loaded areas
SIPLINK Basic Designs

Network 1
U₁, f₁

Master
Slave
Slave

Q₁₁
P₁

Network 2
U₁, f₁

Master
Slave
Slave

Q₁₂

Q₂₁
P₂

Q₂₂

Qₙ₁
Pₙ

Qₙ₂

1,2 MVA. 5 MVA up to 30 MVA
Load flow control between on-board network and shipyard network

Network 1

\[ U_1, f_1 \]

\[ Q_1 \]

\[ P \]

\[ Q_2 \]

Network 2

\[ U_1, f_1 \]
Load flow control between on-board network and shipyard network

- Power supply from the 400V, 50Hz shipyard-network into the 440V, 50/60Hz on board-network
- Reverse power supply from the 440V, 50/60Hz on board network into the 400V, 50Hz shipyard-network (Generator test)
Load interchange in distribution networks

Network 1
$U_1, f_1$

Network 2
$U_1, f_1$

$Q_1$

$Q_2$
Load interchange in distribution networks

"We were in a position to invest in new technology despite the tough Economic climate. The Siemens system allows us to utilize existing energy and capacity reserves at times of peak demand without having to buy in costly regulating energy"

Jürgen Schöffner, Chief technical officer of SWU Energie GmbH