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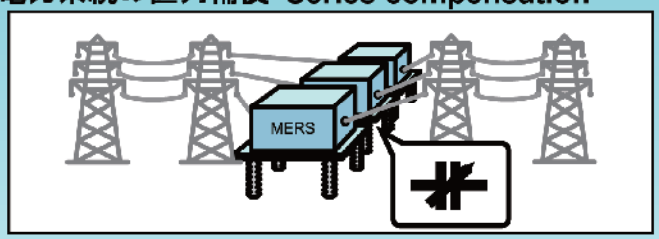
磁気エネルギー回生スイッチ(MERS)の電力系統への応用

Applying Magnetic Energy Recovery Switch (MERS) in Power Systems

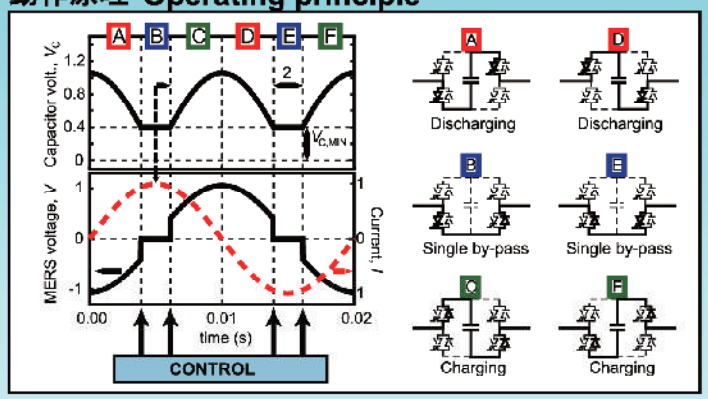
送電容量の増大 (Increasing Transmission Capacity)

電力系統の直列補償 Series compensation

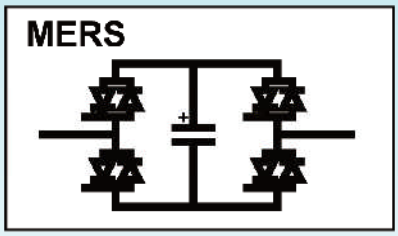


- 送電容量を増大させる
  Increasing transmission capacity
- 電力潮流を制御する
  Flexible control of power flow

動作原理 Operating principle



新しい電力潮流制御装置 A new power flow controller



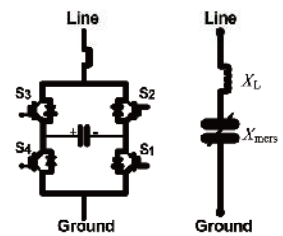
- 電力系統に直列に接続する
  In series with transmission line
- 広い動作範囲
  Large operating range
- トランス・レス
  Transformerless
- 簡単な制御
  Simple Control
- 過電流保護が容易
  Simple over-current protection
- SSR（低周波振動）の可能性が低い
  Low chance for SSR

SSR: Sub-synchronous resonance

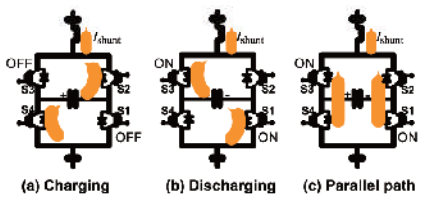
SVC MERSによる電圧制御 (Voltage Control by SVC MERS)

- SVC MERSはMERS+インダクタを回路に並列に接続する構成
  SVC MERS is MERS + inductor connected in parallel.

Configuration



State condition



無効電力制御の原理 (Controlling reactive power)

$$Q\ (\text{Reactive power}) = \frac{V_{in}^{\ 2}}{X_{svc\ mers}}, \quad X_{svc\ mers} = X_L - X_{MERS}(\ )$$

δ : control angle of MERS

- 電圧特性の改善（電圧制御性・安定度の改善）
  Improving voltage profile.
- 力率改善により系統損失の削減
  Power factor correction with reduced grid losses.

SVC MERSの特徴
Features of SVC MERS

- 簡単で高速な制御性 Simple and fast control
- 低周波スイッチング Low switching frequency
- 低スイッチング損失 Low switching losses
- 高調波が少ない Low harmonic distortion

他の方式のSVCとの比較
Comparison to others SVC

SVC MERS	TCR + TSC	STATCOM
Simple with PI control	Dual control with PI control	PWM and complex
Line frequency	Line frequency	High frequency
12 IGBTs	12 Thyristors	6 IGBTs
Small inductor	Large inductor	Large inductor
3 dc capacitors	3 ac capacitors	1 big capacitor
Low harmonics	High harmonics	Low harmonics