

# Prevention of Voltage Instability

- Excitation Control of Synchronous Generators
- Static Reactive Power Compensation
- Need for Reactive Power Reserve

# Synchronous Generator Reactive Power Supply Capability

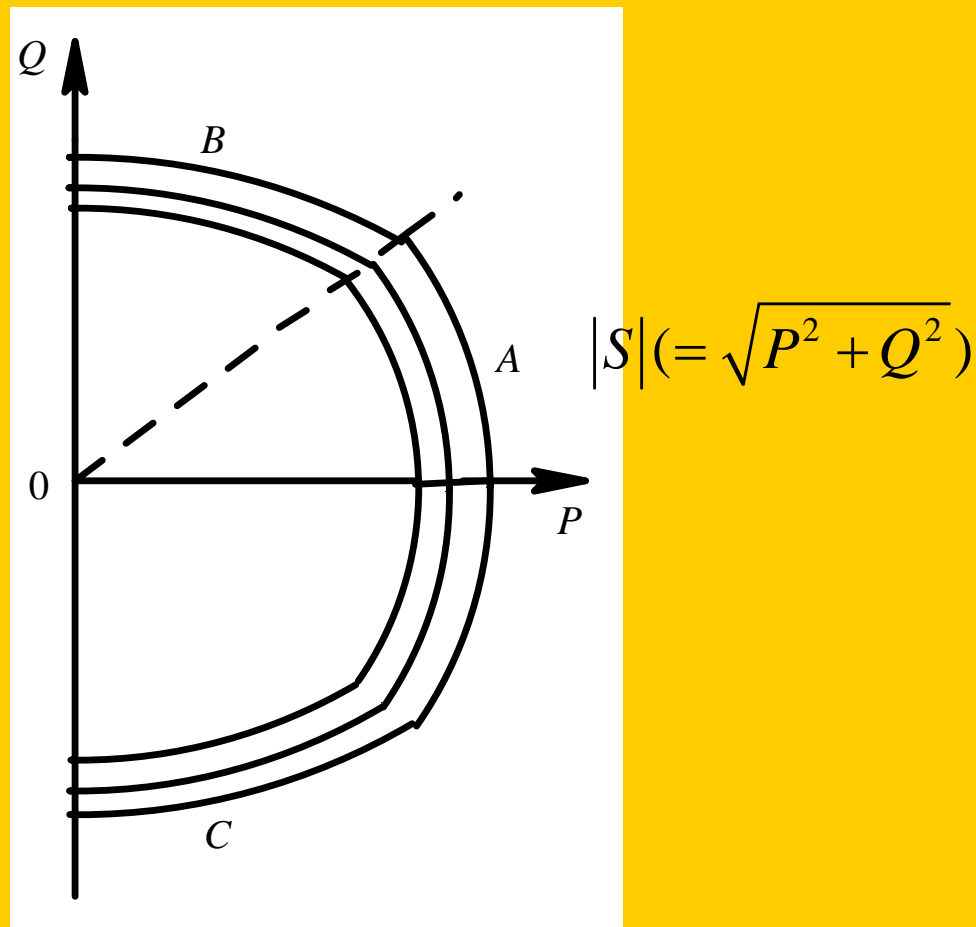


Fig. 10-5 Reactive power supply capability of synchronous generators.

# Effect of Current Power Factor on Bus Voltage

$$\bar{V}_{bus} = \bar{V}_{Th} - jX_{Th}\bar{I}$$

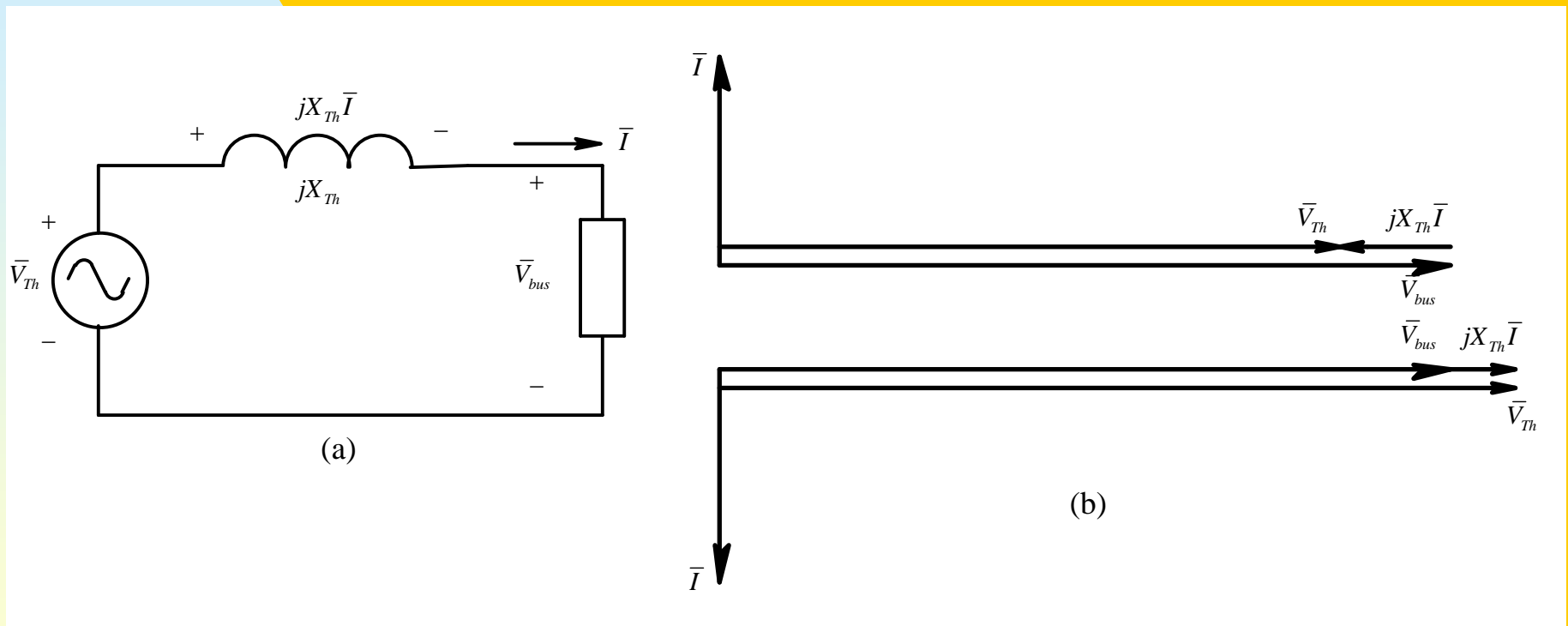


Fig. 10-6 Effect of leading and lagging currents due to the shunt compensating device.

# Static Var Compensators (SVC)

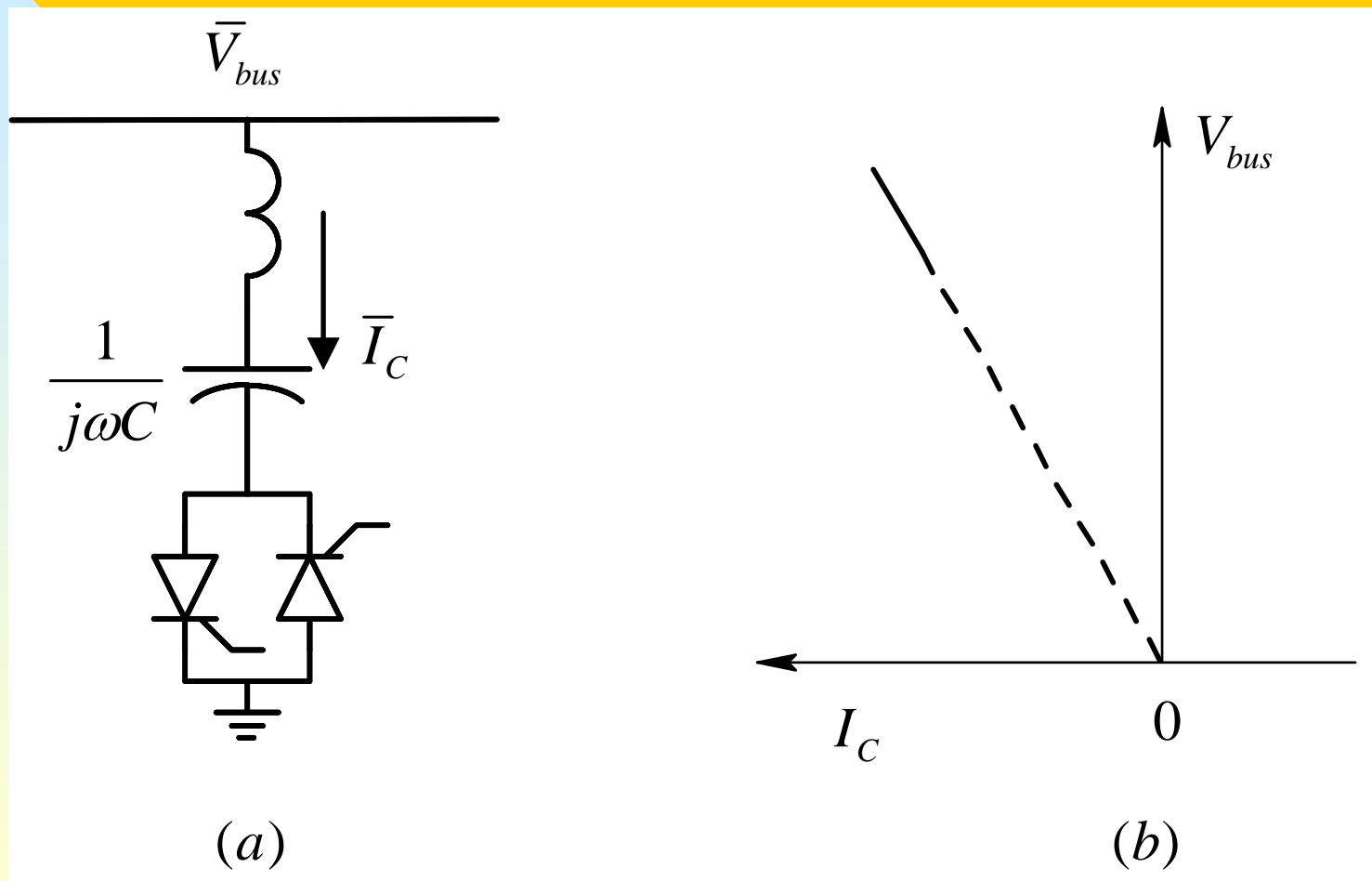


Fig. 10-7 V-I characteristic of SVC.

# Thyristor Controlled Reactors (TCR)

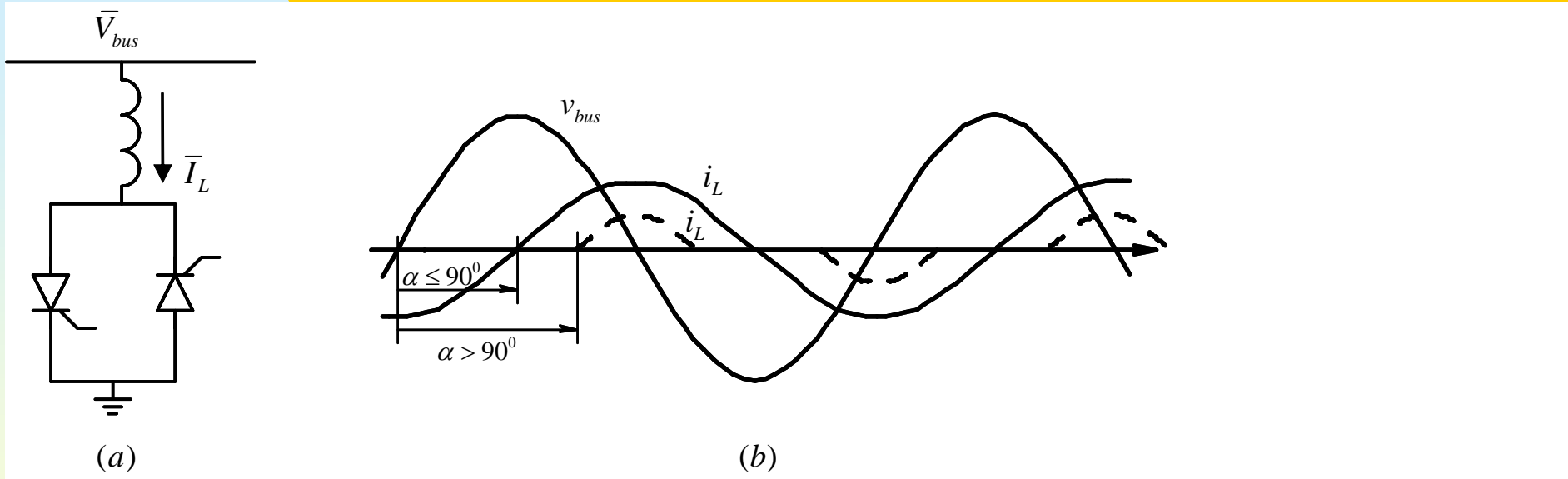


Fig. 10-8 Thyristor-Controlled Reactor (TCR).

# Voltage Control by SVC and TCR Combination

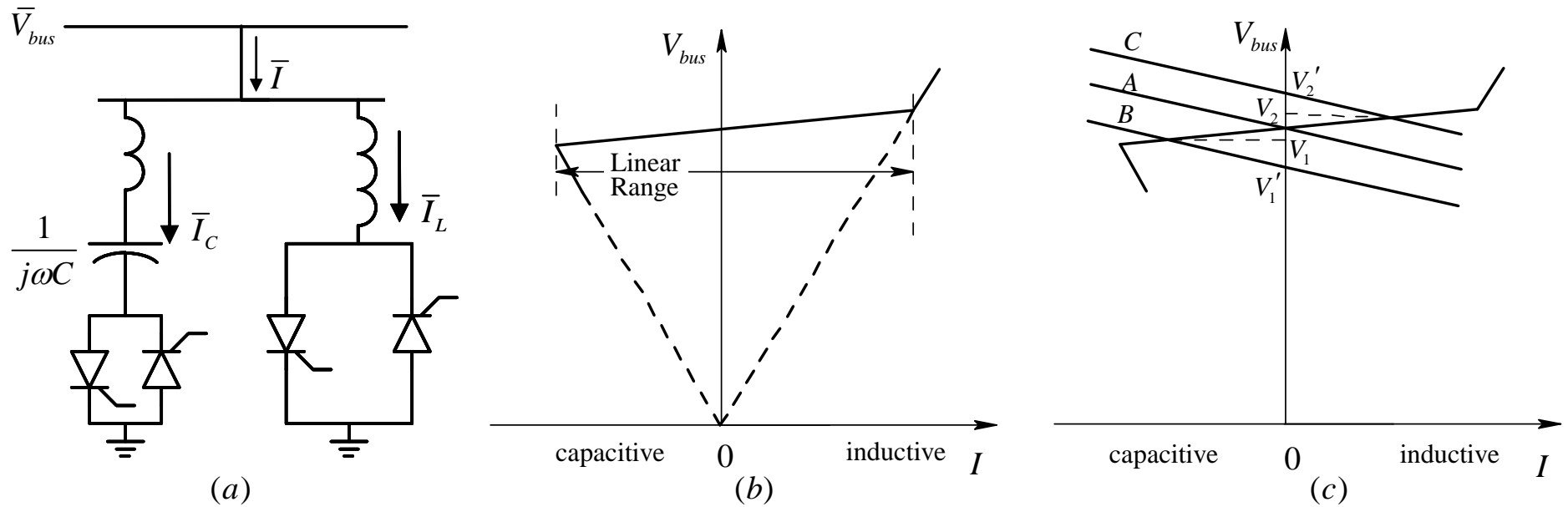


Fig. 10-9 Parallel combination of SVC and TCR.

# STATCOM

$$\bar{V}_{conv} = \bar{V}_{bus} - jX\bar{I}_{conv}$$

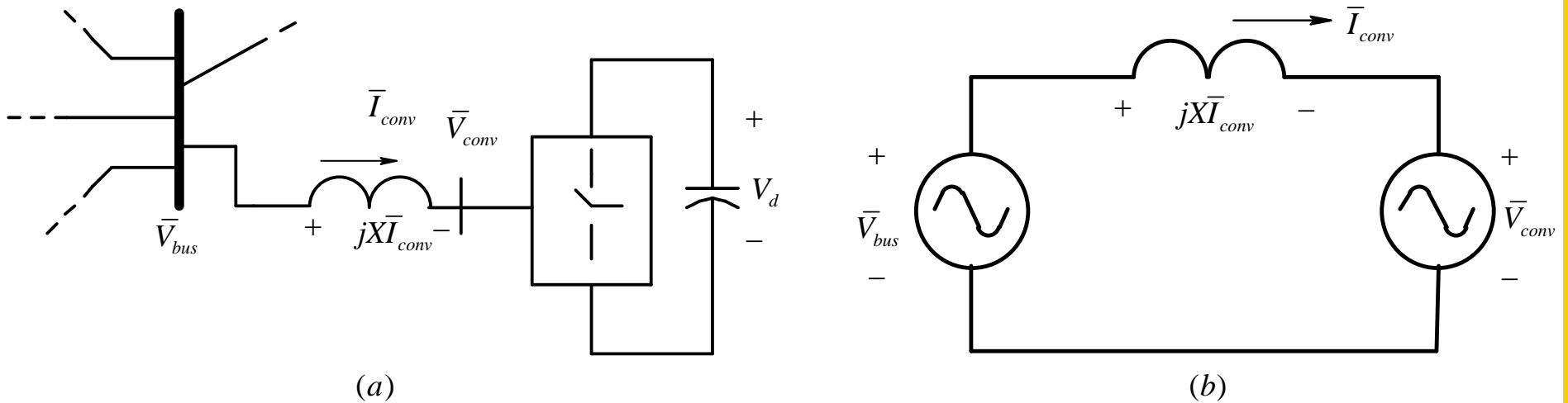


Fig. 10-10 STATCOM.

# STATCOM V-I Characteristic

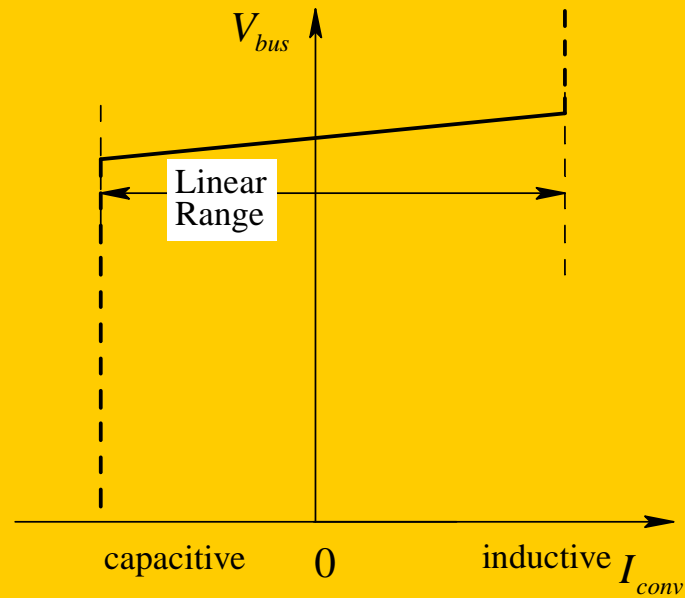
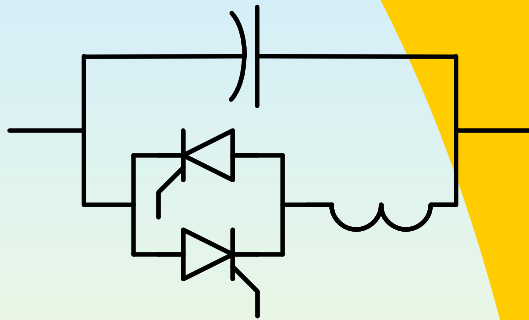


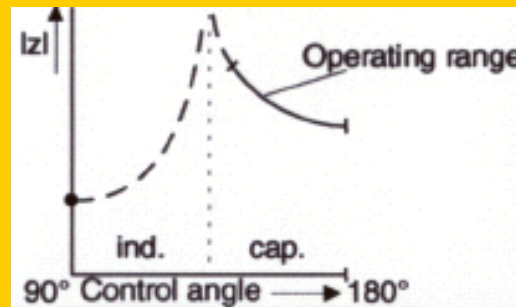
Fig. 10-11 STATCOM VI characteristic.



# Thyristor-Controlled Series Capacitor (TCSC)



(a)



(b)

Thyristor-Controlled Series Capacitor (TCSC)  
Kayenta Substation, USA

(c)

Fig. 10-12 Thyristor-Controlled Series Capacitors (TCSC) [source: Siemens Corp.].

# Summary

- Importance
- Radial System Example
- Voltage Collapse
- Prevention of Voltage Stability
- Synchronous Generators
- Static Reactive Power Compensators