Long lengths EHV electrical links by AC insulated power cable in Japan

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Long length underground link in JAPAN

- Long length underground link have been introduced into Mega city of Japan
- Formerly Oil-filled cable was adopted and since late 1980's XLPE cables have been generally applied.

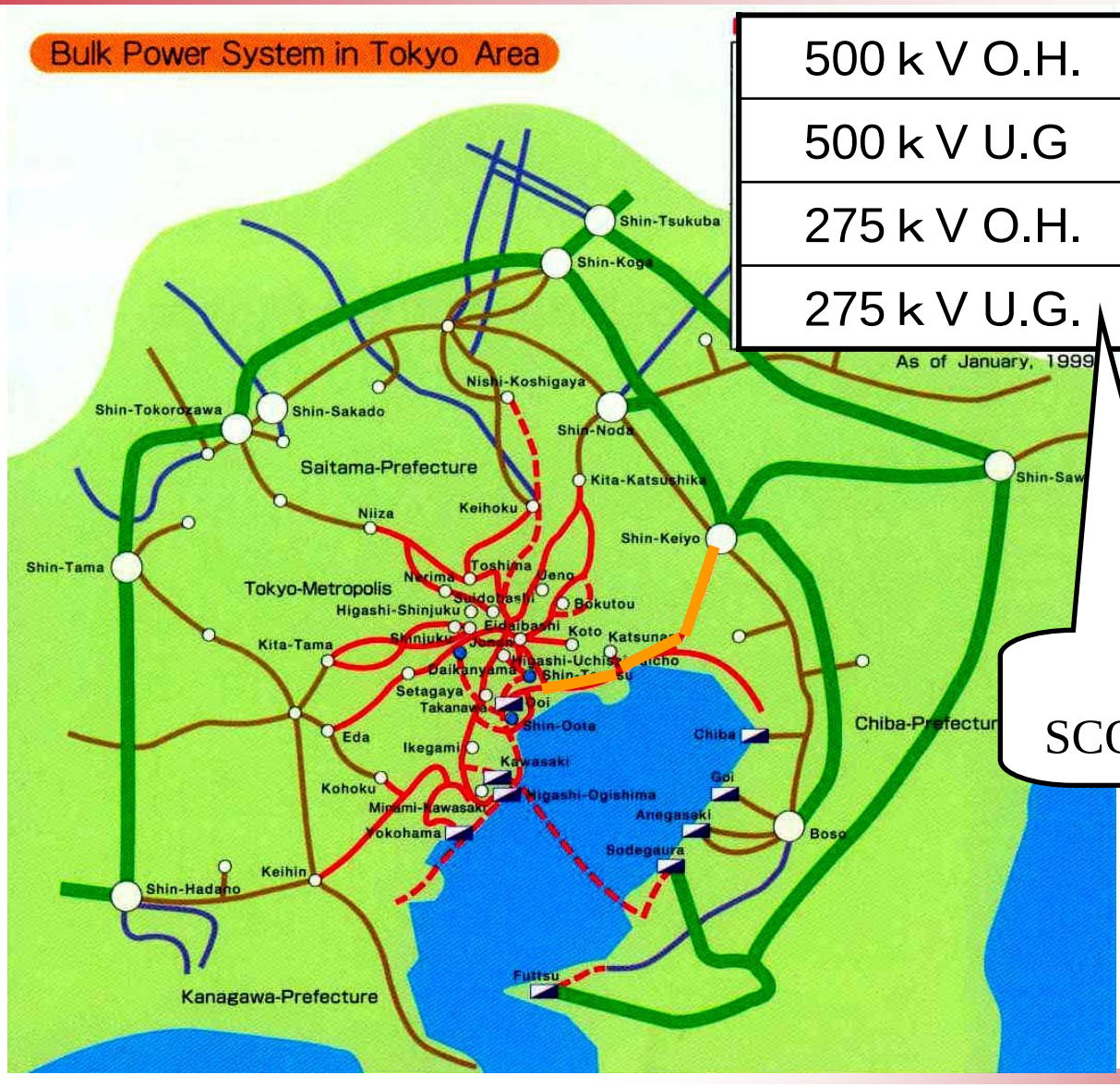
- Typical projects
  - Shin-Toyosu : 500kV XLPE 40km
  - Honshu-Shikoku interconnection : 500kV OF 22km
  - Chita-Minami/Daini-Buheicho : 275kV XLPE 27km
  - and many 275kV links…

many 275kV links… for example…

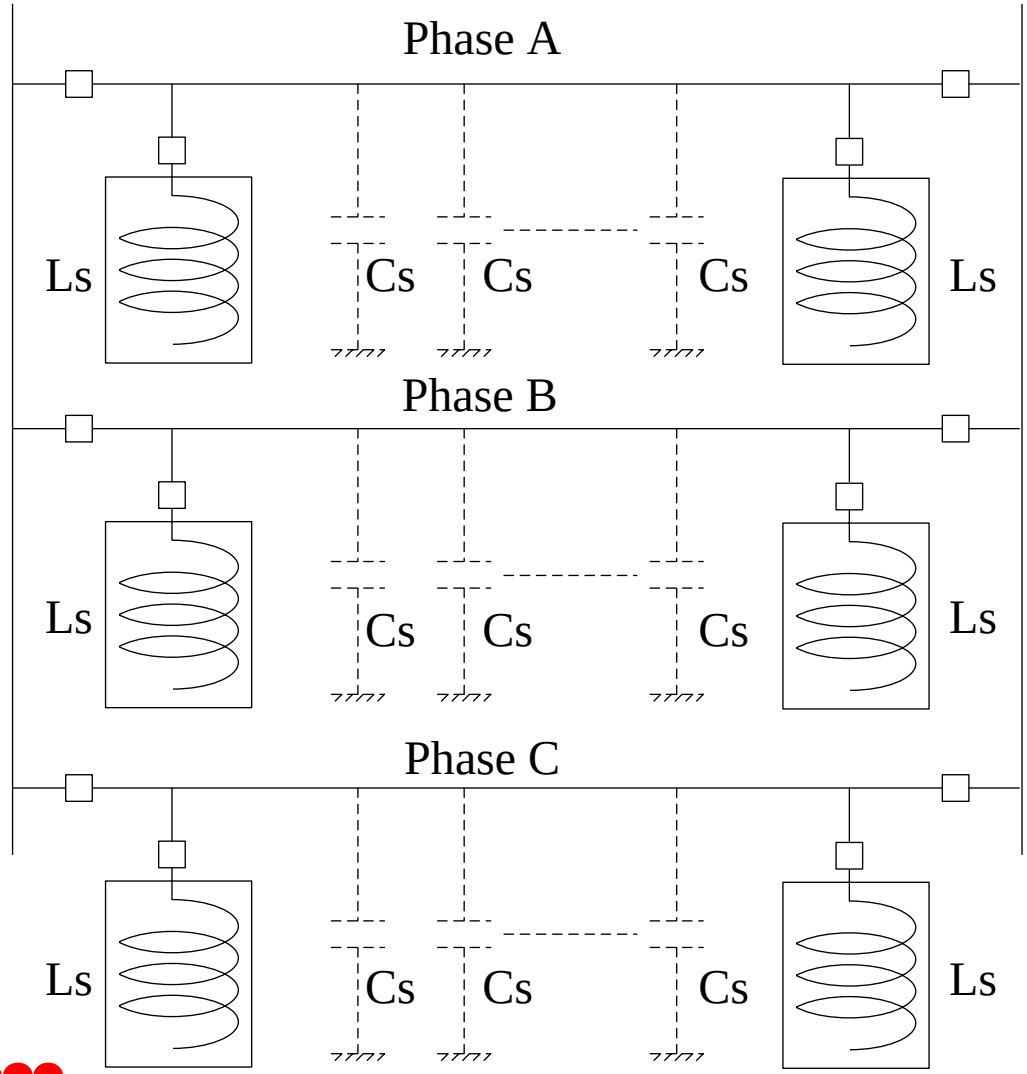
- **In only TEPCO (red font is over 10km)**
  - XLPE (8)
    - MINAMI IKEGAMI LINE
    - UENO SUIDOUBASHI LINE
    - **KATSUNAN SETAGAYA LINE**
    - **HIGASHI SHINJYUKU LINE**
    - **YOKOHAMA KOUHOKU LINE**
    - KITA YONO LINE
    - TOYOSU EITAIBASHI LINE
    - TOYOSU UCHISAIWAICHO LINE
  - Oil-filled or Pipe type Oil-filled (14)
    - **JYOUNAN LINE**
    - **SHINJYUKU LIN**
    - SHINJYUKU-JYOUNAN LINE
    - **TOSHIMA LINE**
    - **SETAGAYA LINE**
    - IKEGAMI LINE
    - **JYOUHOKU LINE**
    - **KITAMUSASHINO LINE**
    - **SUIDOUBASHI LINE**
    - HIGASHIOHGISHIMA KARYOKU LINE
    - **MINAMIKAWASAKI LINE**
    - **BOKUTOU LINE**
    - MINAMI IKEGAMI LINE
    - **UENO LINE**

So many・・・・

Main route of links in TEPCO



Cable as BIG Capacitance

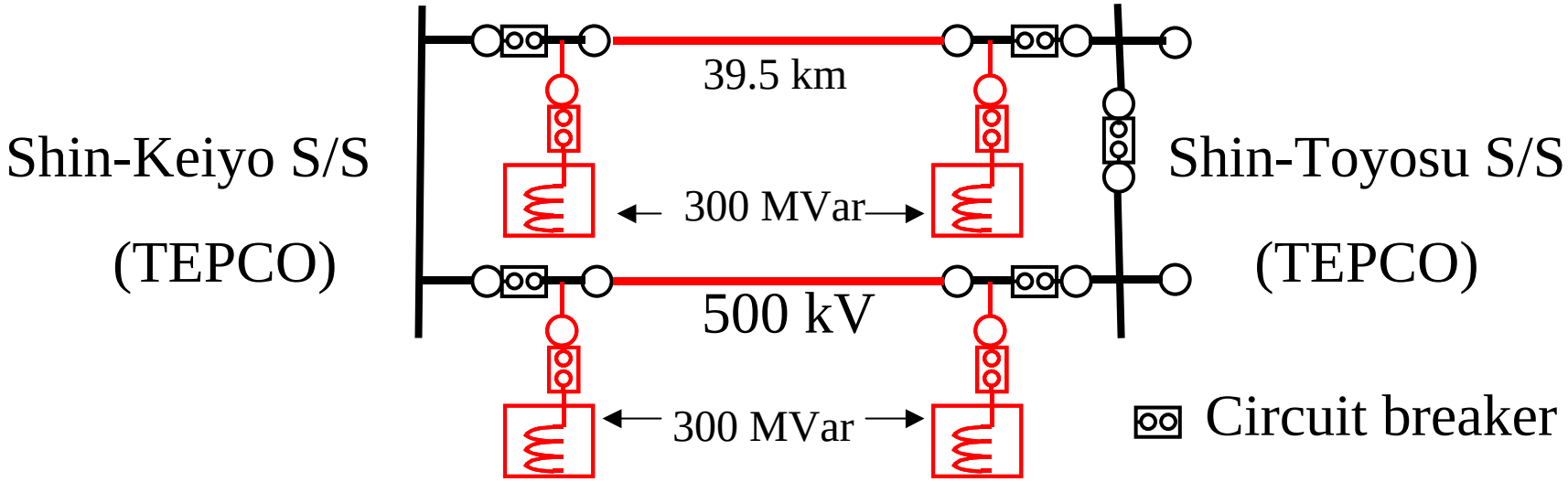


Very long link

Very BIG Capacitance

Should be compensated with a reactance of the reactors

500kV SHIN-TOYOSU LINE (COMPENSATION)



	Shin-keiyo S/S	Shin-Toyosu S/S
Position	at both ends of the line	
	On the ground	Under the building
Nominal power	300MVar (x2)	300MVar (x2)
Space occupied	about 200 m2 (x2)	about 100m2 (x2)

Operational Considerations in the Cable Network

- Shunt Reactive Compensation
  - The capacitance of the cables is completely compensated with a reactance
- That causes other problems in the Network …
  - Delayed Current Zeros
    - When Close *CB* under a no load condition with a shunt reactor, current on *CB* has dc-component for several seconds.
    - If a fault occurs during this periods, circuit breaker cannot interrupt fault current.
  - Restrikes after Shunt Reactor Openings
    - Sudden change in current causes overvoltage of a reactor, and it imposed between terminals of the CB.
  - Overvoltages due to Resonance

Conclusion

- So many long lengths links in Japan
- Tepco considered about…
  - Shunt Reactive Compensation
  - Delayed Current Zeros
  - Restrikes after Shunt Reactor Openings
  - Overvoltages due to Resonance

- It is important to consider the cables as big “C” (and the reactors as big “L”) in power system Network.