UTILITY APPLICATIONS OF POWER ELECTRONICS

SESSION no. 26

ECE 529
Module: Multi-Level Converters (MMC)

Startcom and DC/DC converter

DC/DC transmission
Distributed Applications (Dynamic Compensation)

- Drop oscillations
- Increase transient performance
- Ensure proper flow

For transmission

Current transmission compensation
- Change circuit differential
- Unbalanced sausages
- Interruptions
- Temporary overreach
- Volunteering
- Volunteering

Problems to solve:

- In many instances, this is voluntary.

- Primary concern is poverty
- At distribution level

\[ \text{Quantity} \]
TSC

TCR + TSC
TC + Mech Switched Cap
TCR + Fixed Cap

SVC

C1 - Grounds
Load 3 Single Phase

D-STATCOM
STATCOM

Shunt
Compensation Options

or

 struggled

with

volts

most

unbalance

load

temp

outage
Correcting unbalanced currents, keep up with past variations.

Example application: AC arc furnace.
- Input currents for STATCOM
- Analyze admittance for SVC

Option 1 - SVC - Connect
Load Balancing Examples (part 1)

- First convert delta connected load admittances to balanced, unity pf equivalent conductances

\[ a := 1 \cdot e^{j \cdot 120 \text{deg}} \]

\[
\begin{bmatrix}
  \frac{1}{G} \\
  \frac{1}{a^2 \cdot G} \\
  \frac{1}{a \cdot G}
\end{bmatrix}
= 
\begin{bmatrix}
  \frac{1 - a^2}{G} & 0 & -(a - 1) \\
  -(1 - a^2) & \frac{a^2 - a}{G} & 0 \\
  0 & -(a^2 - a) & \frac{(a - 1)}{G}
\end{bmatrix}
\]

\[
P_{3\text{ph}} = G_{AB} \cdot V_{LL}^2 + 0 + 0 \quad \text{-- extreme case} \quad Y_{AB} = G_{AB}
\]

\[
P_{3\text{ph}} = 3G \cdot \left(\frac{V_{LL}}{\sqrt{3}}\right)^2 = G \cdot V_{LL}^2 \quad G = G_{AB}
\]

\[
Y_{BC} = 0 \quad Y_{CA} = 0 \quad \text{open circuit}
\]

- A few useful relationships:

\[
(1 - a^2) = 1.5 + 0.866i \quad (a - 1) = -1.5 + 0.866i \quad a^2 - a = -1.732i
\]

\[
\frac{a^2 - a}{a^2} = 1.5 + 0.866i \quad \frac{1 - a^2}{a^2} = -1.5 + 0.866i
\]

\[
\frac{a - 1}{a} = 1.5 + 0.866i \quad \frac{a^2 - a}{a} = -1.5 + 0.866i
\]

- Compensator only provides reactive part...

\[
\text{IA:} \quad G = G_{AB} = (G_{AB} + j \cdot B_{\text{compAB}})(1 - a^2) - (j \cdot B_{\text{compCA}})(a - 1)
\]

\[
\text{IB:} \quad G = G_{AB} = (j \cdot B_{\text{compBC}}) \cdot \frac{(a^2 - a)}{a^2} - (G_{AB} + j \cdot B_{\text{compAB}}) \cdot \frac{(1 - a^2)}{a^2}
\]

\[
\text{IC:} \quad G = G_{AB} = (j \cdot B_{\text{compCA}}) \cdot \frac{a - 1}{a} - (j \cdot B_{\text{compBC}}) \cdot \frac{a^2 - a}{a}
\]