Ferranti Effect: Receiving-End Voltage Rise on an Open Line

Receiving-end voltage rise on a lightly loaded or open line or cable from length, inductance and capacitance per km, with charging current and Mvar.

Method: Stevenson and Grainger; Power System Analysis (McGraw-Hill, 1994); Kothari and Nagrath; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Sending-end line voltage	220.00	kV
Line length	300.00	km
Inductance per length	1.0000	mH/km
Capacitance per length	11.500	nF/km
Frequency	50.000	Hz

Calculated results

Parameter	Value	Unit
Receiving-end voltage at no load	231.74	kV
Voltage rise	5.3343	%
Charging current at the sending end	142.55	A
Charging reactive power	54.321	Mvar

Notes for this case

• Lossless distributed line: V_R = V_S/cos(βℓ). Cables have much higher capacitance than overhead lines, so long cables show the effect at shorter lengths.

Formula and method

$$V_R = \frac{V_S}{\cos \beta\ell}, \quad \beta = \omega\sqrt{L'C'}, \quad I_c = \frac{V_S}{\sqrt{3}\, Z_c}\tan \beta\ell, \quad Z_c = \sqrt{\frac{L'}{C'}}$$

Variables

V_S	Sending-end line voltage	V
ℓ	Line length	m
L'	Inductance per km (mH/km)	-
C'	Capacitance per km (nF/km)	-
f	Frequency	1/s
V_R	Receiving-end voltage at no load	V
$\Delta V/V_S$	Voltage rise	-
I_c	Charging current at the sending end	A
Q_c	Charging reactive power	var

Method and standards

Lossless distributed line.

Assumptions and limits

- Lossless; open receiving end.
- L′ in mH/km and C′ in nF/km in every unit system.

References

• Stevenson and Grainger

- Power System Analysis (McGraw-Hill, 1994); Kothari and Nagrath
- Modern Power System Analysis
- 4th ed. (2011) (lossless line, V_R = V_S/cos βℓ)

Report details

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Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/electrical/power/ferranti-effect

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.