Wind Farm Collector String Cable Losses

Copper losses in a radial collector string connecting equally spaced wind turbines, from turbine output, voltage, power factor, cable resistance and spacing.

Method: Copper losses in a radial collector feeder

Input parameters

Unit system: SI

Parameter	Value	Unit
Turbines on the string	6.0000	
Output per turbine	4.0000	MW
Collector voltage (line-to-line)	33.000	kV
Power factor	95.000	%
Cable resistance per km (one phase)	0.10000	Ω/km
Spacing between turbines (and to the substation)	600.00	m

Calculated results

Parameter	Value	Unit
Current from one turbine	73.665	A
String losses	88.887	kW
Losses as a share of output	0.37036	%
Current in the last segment	441.99	A

Notes for this case

- Segment k (counted from the far end) carries k turbines' current: losses = 3I²rs·Σk² = 3I²rs·n(n + 1)(2n + 1)/6. Cable sections are often tapered (smaller near the far end), which this uniform-cable sheet does not model; annual losses use the loss factor, not full output.

Formula and method

$$P_L = 3I_t^2 rs \sum_{k=1}^{n} k^2 = 3I_t^2 rs \frac{n(n+1)(2n+1)}{6}, \quad I_t = \frac{P_t}{\sqrt{3}\,V pf}$$

Variables

n	Turbines on the string	-
P_t	Output per turbine	W
V	Collector voltage (line-to-line)	V
pf	Power factor	-
r	Cable resistance per km (one phase)	Ω/m
s	Spacing between turbines (and to the substation)	m
I_t	Current from one turbine	A
P_L	String losses	W
$P_L/(nP_t)$	Losses as a share of output	-
I_{max}	Current in the last segment	A

Method and standards

Collector losses.

Assumptions and limits

- Uniform cable and spacing; identical turbines at full output.

References

Copper losses in a radial collector feeder

Report details

Report reference	FCC-8V7P-GBPH (the same inputs always give the same reference)
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Calculator	Wind Farm Collector String Cable Losses
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Software release	FireCAD Calc, release of 22 November 2026
Release checks	3 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/environmental/wind-power/wind-farm-collector-string-losses

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.