Tidal Stream Turbine Power and Annual Energy

Peak and mean power and annual energy of a tidal stream turbine from spring and neap peak currents, rotor size, power coefficient, cut-in speed and rated power.

Method: Tidal current power with semidiurnal and spring-neap variation

Input parameters

Unit system: SI

Parameter	Value	Unit
Rotor diameter	18.000	m
Spring-tide peak current	3.0000	m/s
Neap-tide peak current	1.6000	m/s
Power coefficient	0.40000	
Drive-train efficiency	90.000	%
Cut-in current	0.70000	m/s
Rated power	1.0000	MW
Seawater density	1,025.0	kg/m³

Calculated results

Parameter	Value	Unit
Power at the spring peak (uncapped)	1.2676	MW
Mean power over the spring-neap cycle	268.59	kW
Annual energy	2,352.8	MWh
Capacity factor	26.859	%
Current at which rated power is reached	2.7720	m/s

Notes for this case

• Current v = $V_0|\sin\theta|$ through each tide, with the peak V_0 varying sinusoidally between neap and spring; power $\tfrac{1}{2}\rho A C_P \eta v^3$ between cut-in and rated. Mean found by averaging over both cycles (Simpson). Real sites have asymmetric ebb and flood and diurnal inequality.

Formula and method

$$P(v) = \frac{1}{2}\rho A C_P \eta v^3, \quad v = V_0|\sin\theta|, \quad V_0 = \bar{V} + \Delta V \cos\phi$$

Variables

D	Rotor diameter	m
V_s	Spring-tide peak current	m/s
V_n	Neap-tide peak current	m/s
C_P	Power coefficient	-
η	Drive-train efficiency	-
V_{ci}	Cut-in current	m/s
P_r	Rated power	W
ρ	Seawater density	kg/m³
P_{spring}	Power at the spring peak (uncapped)	W
$\bar{P}$	Mean power over the spring-neap cycle	W
E	Annual energy	J

CF	Capacity factor	-
V_r	Current at which rated power is reached	m/s

Method and standards

Tidal current resource and turbine output.

Assumptions and limits

- Symmetric semidiurnal tide; uniform flow over the rotor.

References

Tidal current power with semidiurnal and spring-neap variation

Report details

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

This calculator online

https://calc.firecad.com/environmental/geothermal-ocean/tidal-stream-turbine-energy

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Reopens the calculator with the inputs of this report.