Average Neutron Flux from Reactor Power and Fuel Loading

Average thermal neutron flux in a core from its power, the mass of fissile nuclide and its effective fission cross-section, with the fluence over a run.

Method: Reactor power equation P = E_R Σ_f φ V

Input parameters

Unit system: SI

Parameter	Value	Unit
Reactor thermal power	3,000.0	MW
Recoverable energy per fission	200.00	MeV
Mass of fissile nuclide in the core	2,500.0	kg
Molar mass of the fissile nuclide	235.04	kg/kmol
Effective (spectrum-averaged) fission cross-section	400.00	b
Run time (for fluence)	365.25	d

Calculated results

Parameter	Value	Unit
Number of fissile atoms	6.4054e+27	
Fission rate	9.3623e+19	1/s
Average neutron flux	3.6540e+13	1/(cm²·s)
Fluence over the run time	1.1531e+21	1/cm²
Specific power per mass of fissile nuclide	1,200.0	kJ/kg

Notes for this case

• P = E_R σ̄_f N φ̄. The 2,200 m/s fission cross-section of U-235 is 585 b; averaged over a hot thermal spectrum it is lower (about 300–450 b), so enter the averaged value. Specific power is in W per kg (shown as kJ/kg per second).

Formula and method

$$P = E_R \bar{\sigma}_f N_f \bar{\phi}, \quad N_f = \frac{m_f}{M} N_A$$

Variables

P	Reactor thermal power	W
E_R	Recoverable energy per fission	J
m_f	Mass of fissile nuclide in the core	kg
M	Molar mass of the fissile nuclide	kg/kmol
$\bar{\sigma}_f$	Effective (spectrum-averaged) fission cross-section	m²
t	Run time (for fluence)	s
N_f	Number of fissile atoms	-
$\dot{F}$	Fission rate	1/s
$\bar{\phi}$	Average neutron flux	1/(m²·s)
Φ	Fluence over the run time	1/m²
P/m_f	Specific power per mass of fissile nuclide	J/kg

Method and standards

Reactor power equation.

Assumptions and limits

- Core-average flux only; peaking factors are not included.

References

Reactor power equation P = E_R Σ_f φ V

Report details

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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/boilers-power-plant/nuclear-power/reactor-power-neutron-flux

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.