Fission Rate, U-235 Consumption and Fuel Burn-Up

Fission rate, uranium-235 fissioned and consumed (with capture), energy and average discharge burn-up of a reactor from its thermal power and running time.

Method: Recoverable fission energy and fuel burn-up arithmetic

Input parameters

Unit system: SI

Parameter	Value	Unit
Reactor thermal power	3,000.0	MW
Recoverable energy per fission	200.00	MeV
Capture-to-fission ratio of the fissile nuclide (U-235 thermal 0.169)	0.16900	
Molar mass of the fissile nuclide	235.04	kg/kmol
Full-power running time	330.00	d
Heavy-metal mass in the core (for burn-up)	80.000	t

Calculated results

Parameter	Value	Unit
Fission rate	9.3623e+19	1/s
Fissile nuclide fissioned	3.1571	kg/d
Fissile nuclide consumed (fission + capture)	3.6906	kg/d
Consumed per megawatt-day (g)	1.2302	
Thermal energy produced	23,760	GWh
Fissile consumed over the period	1,217.9	kg
Burn-up over the period	12.375	GWd/t

Notes for this case

• About 1.05 g of U-235 fissions per megawatt-day at 200 MeV per fission, and 1.23 g is consumed with capture. Plutonium bred and fissioned in the fuel carries much of the late-cycle power, so the U-235 figures are an upper bound on what a real core burns.

Formula and method

$$\dot{F} = \frac{P}{E_R}, \quad \dot{m}_c = \dot{F}\frac{M}{N_A}(1+\alpha), \quad BU = \frac{Pt}{m_{HM}}$$

Variables

P	Reactor thermal power	W
E_R	Recoverable energy per fission	J
α	Capture-to-fission ratio of the fissile nuclide (U-235 thermal 0.169)	-
M	Molar mass of the fissile nuclide	kg/kmol
t	Full-power running time	s
m_{HM}	Heavy-metal mass in the core (for burn-up)	kg
$\dot{F}$	Fission rate	1/s
$\dot{m}_f$	Fissile nuclide fissioned	kg/s
$\dot{m}_c$	Fissile nuclide consumed (fission + capture)	kg/s
g/MWd	Consumed per megawatt-day (g)	-

E	Thermal energy produced	J
m_c	Fissile consumed over the period	kg
BU	Burn-up over the period	J/kg

Method and standards

Fission energy balance.

Assumptions and limits

- Average values; plutonium contribution and spatial burn-up variation not modelled.

References

Recoverable fission energy and fuel burn-up arithmetic

Report details

Report reference	FCC-TCQ7-Q20H (the same inputs always give the same reference)
Generated	23 November 2026, 17:35 UTC
Calculator	Fission Rate, U-235 Consumption and Fuel Burn-Up
Method last reviewed	17 November 2026
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/boilers-power-plant/nuclear-power/fission-energy-fuel-consumption

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.