UO2 Fuel: Uranium, U-235 and Heavy-Metal Mass

Uranium (heavy metal) and uranium-235 mass in uranium dioxide fuel from its mass, enrichment by weight and O/U ratio, with the atom enrichment and molar masses.

Method: Isotopic mass balance of uranium dioxide fuel

Input parameters

Unit system: SI

Parameter	Value	Unit
Mass of UO_2	100.00	t
Enrichment (U-235 weight fraction of uranium)	4.5000	%
Oxygen-to-uranium ratio	2.0000	

Calculated results

Parameter	Value	Unit
Molar mass of the uranium	237.91	kg/kmol
Molar mass of the oxide	269.91	kg/kmol
Uranium (heavy metal) mass	88.145	t
Uranium-235 mass	3,966.5	kg
Atom enrichment	4.5549	%
Uranium fraction of the oxide	88.145	%

Notes for this case

• Two-isotope uranium (U-234 neglected): 1/M_U = w/M_{235} + (1 − w)/M_{238}; heavy-metal mass m_U = m_{UO_2} M_U/(M_U + (O/U)M_O). Burn-up and fuel prices are quoted per tonne of heavy metal (tHM), not per tonne of oxide.

Formula and method

$$\frac{1}{M_U} = \frac{w}{M_{235}} + \frac{1-w}{M_{238}}, \quad m_U = m_{UO_2}\frac{M_U}{M_U + (O/U)M_O}$$

Variables

m_{UO_2}	Mass of UO_2	kg
w	Enrichment (U-235 weight fraction of uranium)	-
O/U	Oxygen-to-uranium ratio	-
M_U	Molar mass of the uranium	kg/kmol
M_{UO_2}	Molar mass of the oxide	kg/kmol
m_U	Uranium (heavy metal) mass	kg
m_{235}	Uranium-235 mass	kg
e_a	Atom enrichment	-
m_U/m_{UO_2}	Uranium fraction of the oxide	-

Method and standards

Fuel mass conversions.

Assumptions and limits

- U-234 and impurities neglected.

References

Isotopic mass balance of uranium dioxide fuel

Report details

Report reference	FCC-T6Q6-1YXJ (the same inputs always give the same reference)
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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/uo2-fuel-uranium-mass

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.