Spent Fuel Pool Heat-Up, Time to Boil and Boil-Off

Time for a spent fuel pool to reach boiling after loss of cooling, the boil-off rate, level fall and the time until the water falls to the top of the fuel.

Method: Adiabatic heat-up and boil-off energy balance

Input parameters

Unit system: SI

Parameter	Value	Unit
Decay heat in the pool	5.0000	MW
Pool water surface area	108.00	m²
Total water depth	12.000	m
Water depth above the top of the fuel	7.0000	m
Initial pool temperature	40.000	°C
Pressure at the pool surface	101.33	kPa
Fraction of the pool volume taken by racks and fuel	20.000	%

Calculated results

Parameter	Value	Unit
Water mass	1,178.8	t
Time to boil	16.461	h
Boil-off rate	7,976.8	kg/h
Level fall while boiling	0.077067	m/h
Time from boiling until the water reaches the top of the fuel	90.829	h
Total time to uncover the fuel	107.29	h

Notes for this case

• Adiabatic pool: heat-up t_b = m_w(h_f − h₀)/Q, then boil-off ṁ = Q/h_fg. Heat losses from the surface and walls, which lengthen the times, are ignored (conservative); the racked fuel zone holds less water than the open pool above it. Water and steam properties from IAPWS-IF97.

Formula and method

$$t_b = \frac{m_w(h_f - h_0)}{Q}, \quad \dot{m}_b = \frac{Q}{h_{fg}}, \quad t_u = \frac{H_a \rho_f A}{\dot{m}_b}$$

Variables

Q	Decay heat in the pool	W
A	Pool water surface area	m²
H	Total water depth	m
H_a	Water depth above the top of the fuel	m
T_0	Initial pool temperature	K
p	Pressure at the pool surface	Pa
ϕ	Fraction of the pool volume taken by racks and fuel	-
m_w	Water mass	kg
t_b	Time to boil	s
$\dot{m}_b$	Boil-off rate	kg/s

$\dot{z}$	Level fall while boiling	m/s
t_u	Time from boiling until the water reaches the top of the fuel	s
$t_b + t_u$	Total time to uncover the fuel	s

Method and standards

Pool energy balance.

Assumptions and limits

- Adiabatic and well mixed; no make-up or heat loss.

References

Adiabatic heat-up and boil-off energy balance

Report details

Report reference	FCC-GHF1-ERB7 (the same inputs always give the same reference)
Generated	23 November 2026, 17:35 UTC
Calculator	Spent Fuel Pool Heat-Up, Time to Boil and Boil-Off
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/spent-fuel-pool-time-to-boil

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.