Reactor Period and Power Rise after a Reactivity Step

Stable reactor period, prompt jump and power after a step change in reactivity from the one-delayed-group kinetics equations (inhour equation).

Method: Point reactor kinetics with one effective delayed-neutron group

Input parameters

Unit system: SI

Parameter	Value	Unit
Reactivity step (Δk/k)	0.001000	
Delayed neutron fraction	0.65000	%
One-group decay constant of precursors	0.076700	1/s
Prompt neutron generation time	5.0000e-05	s
Time after the step	60.000	s

Calculated results

Parameter	Value	Unit
Stable period (exact one-group)	71.767	s
Approximate period	71.708	s
Prompt jump β/(β − ρ)	1.1818	
Power ratio at time t	2.7260	
Doubling time T ln 2	49.745	s
Reactivity in dollars	0.15385	

Notes for this case

• One delayed group: ρ = ℓω + βω/(ω + λ). Power n(t)/n₀ = A₁e^(ω₁t) + A₂e^(ω₂t) with n(0) = n₀ and precursors in equilibrium at t = 0.

Formula and method

$$\rho = \ell\omega + \frac{\beta\omega}{\omega+\lambda}, \quad \frac{P(t)}{P_0} = A_1 e^{\omega_1 t} + A_2 e^{\omega_2 t}, \quad T = \frac{1}{\omega_1}$$

Variables

ρ	Reactivity step (Δk/k)	-
β	Delayed neutron fraction	-
λ	One-group decay constant of precursors	1/s
ℓ	Prompt neutron generation time	s
t	Time after the step	s
T	Stable period (exact one-group)	s
$T \approx (\beta-\rho)/(\lambda\rho)$	Approximate period	s
P_+/P_0	Prompt jump β/(β − ρ)	-
$P(t)/P_0$	Power ratio at time t	-
T_2	Doubling time T ln 2	s
ρ/β	Reactivity in dollars	-

Method and standards

One-group point kinetics.

Assumptions and limits

- Point kinetics; no temperature feedback.

References

Point reactor kinetics with one effective delayed-neutron group

Report details

Report reference	FCC-JZ9W-DD95 (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/reactor-period-inhour

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.