

- ➔ Reference:C:\Web\11_Basic_Functions.mcd(R)
- ➔ Reference:C:\Web\20_Component_Failure_Rates.mcd(R)
- ➔ Reference:C:\Web\Hide Complex.mcd(R)

$$T = \begin{pmatrix} 10 \times 10^8 & 27123 & 12 & 0 & 28 & 47 & 1933 & 60 & 691 & 6094 & 0 & 0 & 0 \\ 0 & 1 \times 10^9 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 \times 10^9 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 27120 & 28 & 10 \times 10^8 & 0 & 0 & 0 & 0 & 691 & 6100 & 0 & 0 & 0 \\ 0 & 12310 & 47 & 0 & 10 \times 10^8 & 0 & 0 & 0 & 691 & 6100 & 0 & 0 & 0 \\ 0 & 21873 & 285 & 0 & 0 & 10 \times 10^8 & 0 & 0 & 691 & 6100 & 600 & 0 & 0 \\ 0 & 24018 & 0 & 0 & 0 & 0 & 10 \times 10^8 & 0 & 691 & 6100 & 0 & 0 & 0 \\ 0 & 26993 & 0 & 0 & 0 & 0 & 0 & 10 \times 10^8 & 691 & 6100 & 0 & 0 & 0 \\ 0 & 22814 & 6100 & 0 & 0 & 0 & 0 & 0 & 10 \times 10^8 & 0 & 0 & 45 & 600 \\ 0 & 24223 & 691 & 0 & 0 & 0 & 0 & 0 & 0 & 10 \times 10^8 & 0 & 45 & 600 \\ 0 & 21273 & 45 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 10 \times 10^8 & 0 & 0 \\ 0 & 22919 & 600 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 10 \times 10^8 & 0 \\ 0 & 23474 & 45 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 10 \times 10^8 \end{pmatrix} \text{ FIT}$$

Transition_Matrix := T

Remove units T := T·hr T₂₄ := T²⁴

Results

State probabilities after proof test interval (8766 hours = 1 year):

$$T_p = 8766$$

$$pfd_{yr} := pfd(T, T_p) \quad pfs_{yr} := pfs(T, T_p)$$

Safe and dangerous failure probability:

$$pfd_{yr} = 363.602 \times 10^{-6}$$

$$pfs_{yr} = 210.766 \times 10^{-3}$$

$$RRF := \frac{1}{pfd_{yr}} \quad RRF = 2750$$

Simplified average dangerous failure probability over one year (assumes linear pfd(t)):

$$pfd_{avg} := \frac{pfd_{yr}}{2}$$

$$pfd_{avg} = 181.8012 \times 10^{-6}$$

$$SIL_D(pfd_{avg}) = 3$$

$$RRF := \frac{1}{pfd_{avg}} \quad RRF = 5501$$

Equivalent failure rates after one year:

$$\lambda_s(T, T_p) = 27001 \text{ FIT}$$

$$\lambda_d(T, T_p) = 41 \text{ FIT}$$

Safe failure percentage

$$\Psi(T, T_p) = 99.8466 \%$$

Integrated average failure rate over one year (intergrated over one hour intervals):

$$t := 1, 2 \dots T_p \quad pfd_{dS} := \frac{\sum_t pfd(T, t)}{T_p}$$

$$pfd_{dS} = 143.1079 \times 10^{-6}$$

$$SIL_D(pfd_{dS}) = 3$$

$$RRF := \frac{1}{pfd_{dS}} \quad RRF = 6988$$

Mean time between safe failures (for the OS protection system w/o power supplies):

$$MTTF := MTTF(T)$$

$$MTTF = 37646 \text{ hr} \quad t := 1, 2 \dots 10000$$

