Table 6.2-2: Redundancy Equations for Calculating Reliability

Configuration	Reliability, R(t)=
Active Redundancy	"n" fully energized identical parallel units.
1 of 2 Must Be Working	$2e^{-\lambda t} - e^{-2\lambda t}$
1 of 3 Must Be Working	$3e^{-\lambda t} - 3e^{-2\lambda t} + e^{-3\lambda t}$
1 of 4 Must Be Working	$4e^{-\lambda t} - 6e^{-2\lambda t} + 4e^{-3\lambda t} - e^{-4\lambda t}$
1 of n Must Be Working	$\sum_{k=1}^{n} (-1)^{k+1} \frac{n!}{k!\ (n-k)!} e^{-k\lambda t}$
2 of 3 Must Be Working	$3e^{-2\lambda t} - 2e^{-3\lambda t}$
3 of 4 Must Be Working	$4e^{-3\lambda t} - 3e^{-4\lambda t}$
n-1 of n Must Be Working	$ne^{-(n-1)\lambda t} - (n-1)e^{-n\lambda t}$
2 of 4 Must Be Working	$3e^{-4\lambda t} - 8e^{-3\lambda t} + 6e^{-2\lambda t}$
3 of 5 Must Be Working	$6e^{-5\lambda t} - 15e^{-4\lambda t} + 10e^{-3\lambda t}$
n-2 of n Must Be Working	$\frac{n!}{2\ (n-2)!} e^{-(n-2)\lambda t} + \left(2n - n^2\right) e^{-(n-1)\lambda t} + \frac{(n-1)!}{2\ (n-3)!} e^{-n\lambda t}$
m of n Must Be Working	$\sum_{k=m}^{n} \frac{n!}{k!\ (n-k)!} \left(e^{-\lambda t}\right)^k \left(1 - e^{-\lambda t}\right)^{(n-k)}$
Standby Redundancy: 1. All units are identical; 2. Standby units are not energized and assumed to have a failure rate of zero; 3. The failure rate of the switching device is assumed to be zero.	
1 of 2 Must Be Working	$e^{-\lambda t} + \lambda te^{-\lambda t}$
1 of 3 Must Be Working	$e^{-\lambda t} + \lambda te^{-\lambda t} + .5(\lambda t)^2 e^{-\lambda t}$
1 of n Must Be Working	$\sum_{r=0}^{n-1} e^{-\lambda t} \frac{(\lambda t)^r}{r!}$
m of n Must Be Working	$e^{-m\lambda t} \sum_{k=0}^{n-m} \frac{(m\lambda t)^k}{k!}$