ASQ CRE Prep course

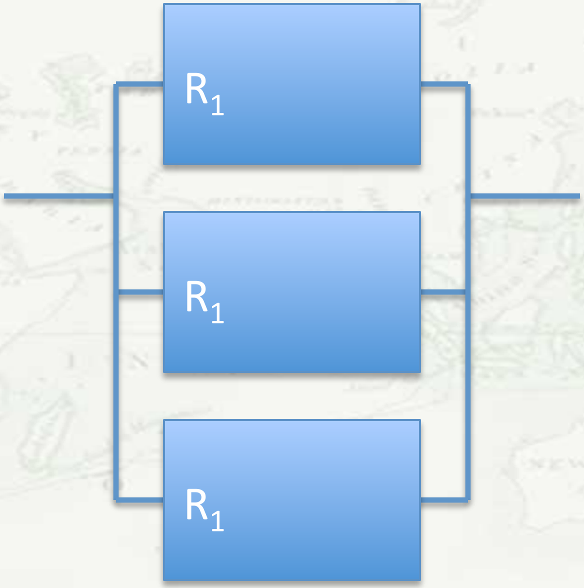
Lesson IV. A. 2. c.
Reliability Block Diagrams and Models – Redundancy

Not fully redundant, fully

RELIABILITY BLOCK DIAGRAM MORE THAN PARALLEL

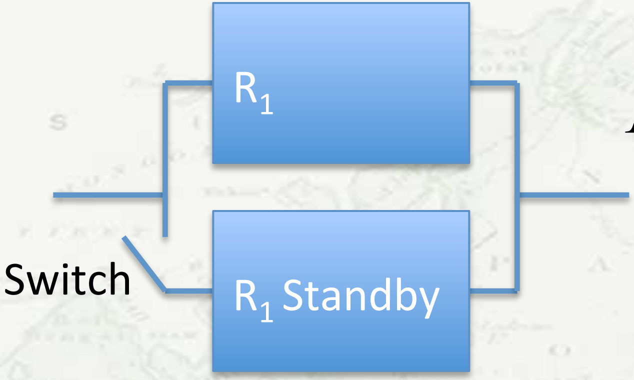
Other Types of Parallel

k-out-of-n



$$R_{system} = \sum_{i=k}^{n} \frac{n!}{i!(n-i!)} \left(e^{-\lambda t}\right)^{i} \left(1-e^{-\lambda t}\right)^{(n-i)}$$

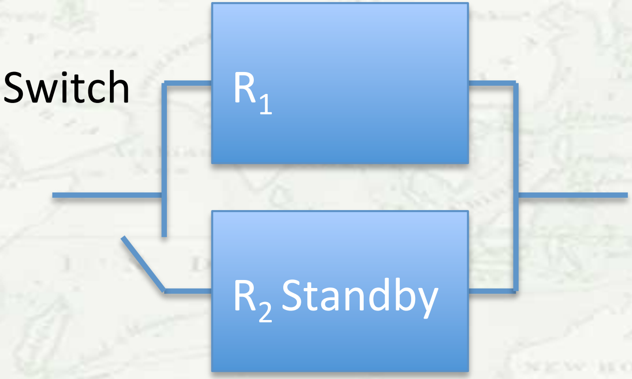
Standby Redundancy
Equal Failure Rates Perfect Switching



$$R(t) = e^{-\lambda t}(1 + \lambda t)$$

$$R(t) = e^{-\lambda t} \sum_{i=0}^{n-1} \frac{(\lambda t)^i}{i!}$$

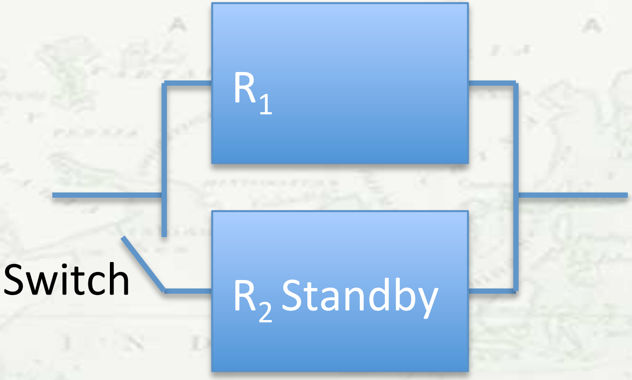
Standby Redundancy Unequal Failure Rates Perfect Switching



$$R(t) = e^{-\lambda_1 t} + \frac{\lambda_1}{\lambda_2 - \lambda_1}\left(e^{-\lambda_1 t} - e^{-\lambda_2 t}\right)$$

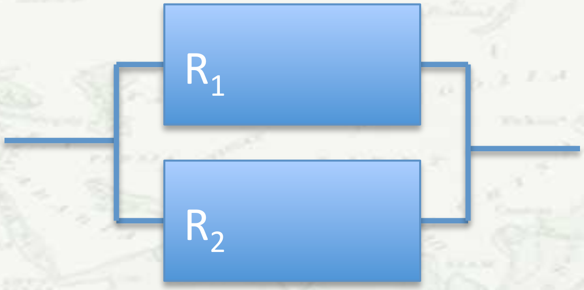
$$R(t) = \sum_{i=1}^{n}\left[e^{-\lambda_1 t}\left(\sum_{\substack{j=1 \\ j \neq i}}^{n} \frac{\lambda_j}{\lambda_j - \lambda_i}\right)\right]$$

Standby Redundancy
Unequal Failure Rates Imperfect Switching



$$R(t) = e^{-\lambda_1 t} + R_{sw} \frac{\lambda_1}{\lambda_2 - \lambda_1}\left(e^{-\lambda_1 t} - e^{-\lambda_2 t}\right)$$

Shared Load Between 2 Elements



$$R(t) = e^{-2\lambda_1 t} + \frac{2\lambda_1}{2\lambda_1 - \lambda_2}\left(e^{-\lambda_2 t} - e^{-2\lambda_1 t}\right)$$

Sometimes the switch is the problem

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Lesson IV. A. 2. d.
Reliability Block Diagrams and Models – Complex