FTA – SOLUTIONS TO EXAMPLES

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Example for finding minimal cutsets

So in this case:

I1,I2 **Replace I1**

I3,I2
A,I2
B,I2
C,I2 **Replace I2**

I3,F
I3,H
I3,C
A,F
A,H
A,C
B,F
B,H
B,C
C,F
C,H
C,C **Replace I3**

So in this case:

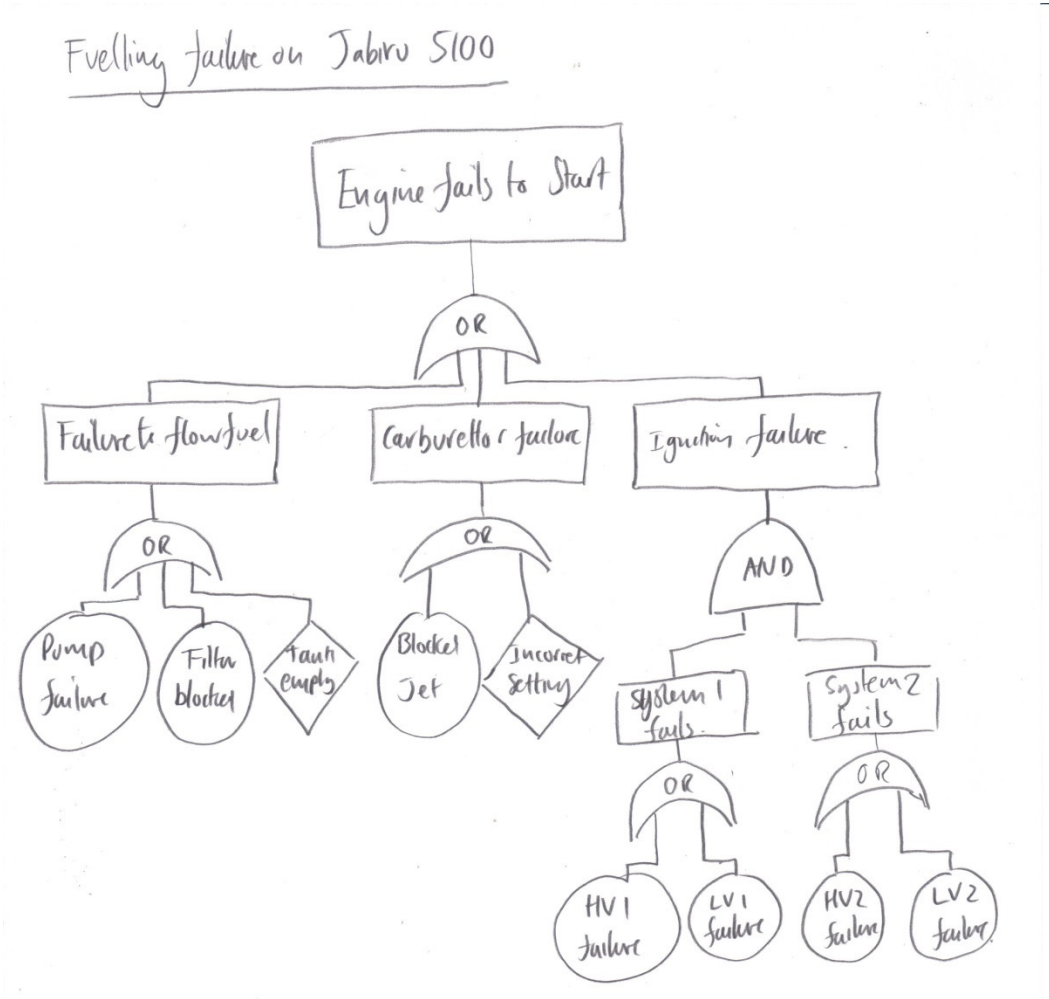
D,E,F
D,E,H
D,E,C
A,F
A,H
A,C
B,F
B,H
B,C
C,F
C,H
C,C

We could go down the list determining if we have a minimal cutset but in this simple case we can see that, if C occurs we need no other failure to give the top event so any cutset combined with C is not a minimal cutset.

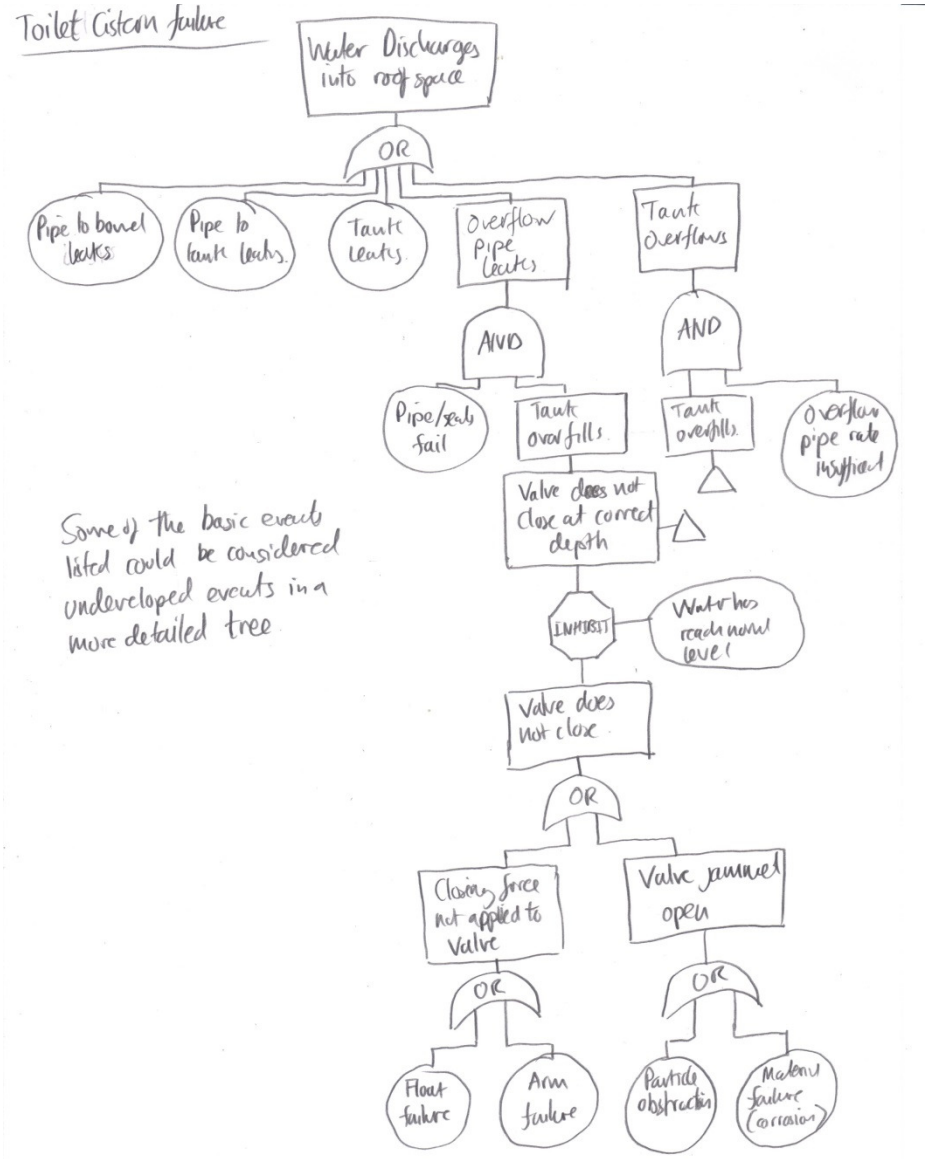
Hence minimal cutsets:

D,E,F
D,E,H
A,F
A,H
B,F
B,H
C

Jabiru 5100 air cooled flat 8

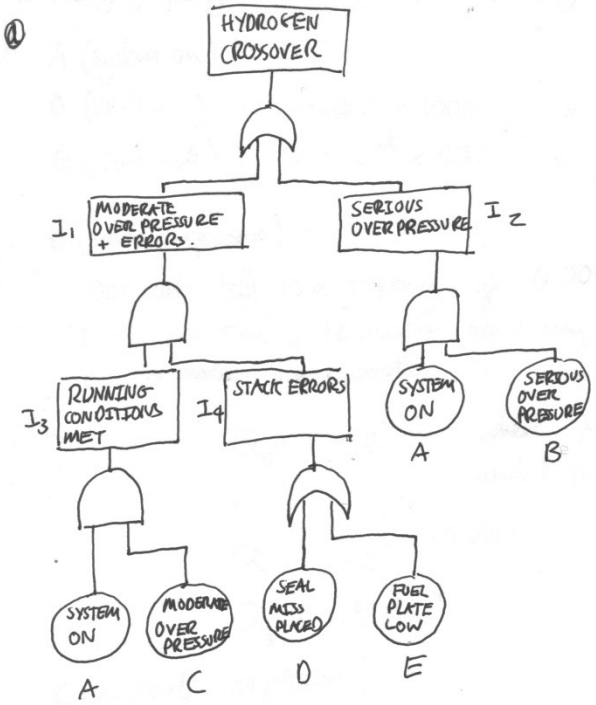


Toilet problem



Mission time example

(a)



(b)

CUT SETS

$\frac{I_1}{I_2} \rightarrow \begin{matrix} I_1 \\ A,B \end{matrix} \rightarrow \begin{matrix} I_3, I_4 \\ A,B \end{matrix} \rightarrow \begin{matrix} A,C,I_4 \\ A,B \end{matrix} \rightarrow \begin{matrix} A,C,D \\ A\ C,E \\ A,B \end{matrix}$

In this case all cutsets are minimal.

(c) Probability of failure (rare event approximation) is sum of minimal cutsets.

Extracting frequencys on an annual basis. [Assuming non-repairable failures]

A (system on) : 0·5

D (O'ring) : $1.8\times10^{-4} \times 1000 = 1.8\times10^{-1}$

E (Fuel plate) : $3.5\times10^{-5} \times 500 = 1.75\times10^{-2}$

B (serious overpressure) :

Our data tells us a frequency of 0.00001/month
Our 'mission time' is 12 months hence using our exponential reliability model (non-repairable)

$$Q_B = 1 - e^{-\lambda t}$$ where λ is our failure rate and t is our mission time.

$$Q_B = 1 - e^{-12\times0.00001}$$

$$Q_B = 1.199\times10^{-4}$$

C (Moderate overpressure):

Same applies as for B:

$$Q_C = 1 - e^{-12\times0.001}$$

$$Q_C = 1.193\times10^{-3}$$

Hence probability of top event is approximately. (in the year)

$A\times C\times D + A\times C\times E + A\times B$

$0.5 \times 1.193\times10^{-3} \times 1.8\times10^{-1} +$

$0.5 \times 1.193\times10^{-3} \times 1.75\times10^{-2} +$

$0.5 \times 1.199\times10^{-4}$

$= 1.78\times10^{-4} \approx 2\times10^{-4}$ /year.