

## FAILURE MODES EFFECTS AND CRITICALITY ANALYSIS (FMECA)

### EXPOSE RISK AND RECOMMEND ACTIONS TO REDUCE RISK

FMECA is a Risk Management Tool. It is an inductive method of analyzing a system design or process to evaluate the potential for failures. It consists of defining what can fail and the way it can fail and determining the effect on the system or user. It can include analyzing the criticality - how harmful the effects of a failure mode are. Action plans can then be created to change the design or process to eliminate the failure, reduce its impact, or compensate for the failure should it occur.

| Item    | Function                      | Failure Mode                 | Local Effect                | End Effect                 | S  | P | D  | Score (RPN) | Control Method                        | Mitigated      |                |                  |
|---------|-------------------------------|------------------------------|-----------------------------|----------------------------|----|---|----|-------------|---------------------------------------|----------------|----------------|------------------|
|         |                               |                              |                             |                            |    |   |    |             |                                       | P <sub>m</sub> | D <sub>m</sub> | RPN <sub>m</sub> |
| Door    | Protects user from high power | Latch mal-function           | Door opens                  | User exposed to high power | 10 | 5 | 10 | 500         | Stronger Latch & Label "High Voltage" | 3              | 10             | 300              |
| Battery | Provide Voltage to Relay      | Battery leaking at high temp | Voltage to Relay inadequate | System fails to operate    | 8  | 5 | 10 | 400         | Thermal test in lab                   | 3              | 10             | 240              |
| CPU     | Provides processing to system | No output                    | System hangs                | Mission loss               | 10 | 5 | 8  | 400         | HALT testing                          | 2              | 8              | 160              |

### FMEA

The work is performed by interacting with key personnel involved with the product. Can be focused on Design, User, Software, or Process issues following applicable standards (IEC, SAE, MIL HBDK 1629). Tasks include segmenting product, organizing teams, meetings to identify failure modes and their associated effects. Follow up meetings develop control methods to mitigate effects. Deliverable is a Summary Worksheet.

- Simple Product ~\$2-3,000
- Complex Product ~\$4-5,000

### CRITICALITY ANALYSIS (FMECA)

FMECA provides even more value; all FMEA elements described above are included PLUS Criticality - how harmful the effect of a failure mode is if it occurs. Severity (S), Probability (P), and Detectability (D) are evaluated then scored to assess the associated risk and prioritize corrective actions using Risk Priority Numbers (RPNs). Follow-up meetings develop control methods to mitigate effects and estimate residual risk. Deliverable is a Summary Score Sheet of highest risk items.

- Simple Product ~\$3-5,000
- Complex Product ~\$6-8,000

### RISK MANAGEMENT SUMMARY

This activity is used to manage information produced by a large or in-depth FMEA/FMECA (many score sheets). It organizes, summarizes, and categorizes the results so that scarce resources can be effectively allocated to the most important issues. Deliverable is a summary of highest risk items and associated action plans for each.

- Simple Product ~\$1-2,000
- Complex Product ~\$2-3,000

### FAULT TREE ANALYSIS (FTA)

FTA is an expanded analysis of a specific effect with a high risk. Rather than starting with failure modes and working towards risk - FTA starts with a risk (End Effect) and works backwards using a logic fault tree to uncover all of the conditions which could lead to that risk. The logic tree includes probabilities for each branch (failure mode) to accurately assess total risk of that specific End Effect. Deliverable is the Logic Fault Tree diagram.

- Simple Product ~\$2-3,000
- Complex Product ~\$4-5,000

### REPORT AND PRESENTATION

Detailed Report ~\$ 500

Executive Summary format explains:

- ✓ The analysis process
- ✓ Significance of the results
- ✓ Recommended product improvements

On-Site Presentation ~\$ 500

One to two hour review of results and recommendations, with analysis of the effects of changes to the product.

### OTHER RELATED SERVICES

- ✓ Estimate product Failure Rate (MTBF) with Reliability Predictions at Component Level and System Level
- ✓ Maximize product robustness with Accelerated Stress Testing (HALT)
- ✓ Eliminate infant mortalities with production screening (HASS)
- ✓ Measure the product's reliability with Reliability Demonstration Tests (RDT)

### TERMS

Expedited (rush) analyses available at nominal fee  
 Formal quotes: Fixed Price or Time and Materials basis  
 Invoicing: On progress, Payment: Net 15 days after invoice