Aerostar UAS
Fault Tree Analysis (FTA)
Report

Prepared for
Aeronautics

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1. INTRODUCTION

1.1. Scope

- This report represents the Fault Tree Analysis Report (FTA) for the Aerostar UAS.
- The FTA uses the Top-Down approach and is based on End Effects that were defined in the FMECA report.
- The analysis was conducted by using CARE®-FTA software (Computer Aided Reliability Engineering) developed by BQR Reliability Engineering Ltd. Israel.

1.2. Purpose

The purpose of this document is to analyze and to point out, if exist, any identification of hazards and assess the risk of the total system design. The analysis will present the level of final probability of a "UAV loss of control" failure which must be lower than 10-6.

1.3. Acronyms and Notations

CARE - Computer Aided Reliability Engineering

FMECA - Failure Modes Effects and Criticality Analysis

FTA - Fault Tree Analysis

2. REFERENCED DOCUMENTS

The following documents were employed in the preparation of this FTA report although they may not be specifically referenced in the contents of this report.

2.1. Customer Documents

- Aerostar UAS Schematics.
- Aerostar UAS block Diagram and explanations.
- Aerostar FMECA Report.

2.2. Other Documents

- CARE®-FTA (Computer Aided Reliability Eng.) software and User's Manual by BQR.

3. ANALYSIS APPROACH

3.1. General

- The data used for the FTA is based on system schematics, on the specification, design documents and on the FMECA report.
- All failure modes were checked if they have any effect on safety.
- All possible failures combinations that can cause system's safety hazard as it was defined, i.e. "UAV loss of control", were taken under consideration.
- The Aerostar system Fault Tree analysis was divided in 3 steps:
  - During Ground Roll and Take-off.
  - During Flight.
  - During Landing (Final Approach).
- All the failure distributions of electronic components are exponential.
- All the failure distributions of mechanical components are Weibull.
- Human Errors are considered as relevant failures, that in combination of other failures can cause the system's critical failure, "UAV out of control".
- The detailed FTA is presented in appendix 1.

3.2. Safety Criteria and Methodology

The purpose of this analysis is to analyze and identify all possible combinations of the end-effect, with high severity, defined the system failure mode, which can cause safety hazard and system possible loss:

- UAV loss of control

3.3. Appendix List

1. Hazard FTA Review
2. Hazard FTA – Calculation Report

4. Fault Tree Analysis Results

The Hazard analysis of the UAS was performed in order to calculate all failures combination for possible system loss with high End Effect severity (See Appendix 1).

Table 1 presents the FTA results for 1 operational hour.

FTA	Failure Rate (per million h)	Probability
UAV loss of control	39.3347	0.00000094

Table 1: FTA Results

5. Conclusion and Recommendations

From the results we can see that the hazard was defined and analyzed and it is in acceptable level. All recommendations raised from all RAMS analyses are summarized in the "1477-Aerostar Final RAM report".

6. Appendix 1 – Hazard FTA Calculation Report

Event name	...	FPMH	Probability	Effect probability
UAV loss of control	1	39.3347614552	0.0000009447	
1.During Ground Roll + Take-off	1	11.8758272766	0.0000000360	1.0000000000
2.During flight	1	9.9347475764	0.0000002877	1.0000000000
3.During Landing (Final Approach)	1	17.5241866023	0.0000006210	1.0000000000

Parameter Name	Parameter Value
Event name	UAV loss of control
Description	Phase: Phase 1
Quantity	1
Fixed	☐
F.Rate per million h	39.3347614552
Probability	0.0000009447
Note	
Related Block	System Failure

#	Level	Event Name	Model	Qty	Rate (per million h)	Probability
1	0	UAV loss of control	OR	1	39.3348	9.44696e-007
2	.1	1.During Ground Roll + Take-off	OR	1	11.8758	3.5995e-008
3	..2	Avionics failures	OR	1	2.98478	2.79774e-008
4	...3	Autopilot fails	AND	1	1e-005	1.13909e-023
5	...3	Autopilot fails	AND	1	1e-005	1.13909e-023
6	4	Gyros fail	OR	1	9	0
7	5	Erratic output from Gyros	AND	1	6.75	0
8	6	Erratic output from Gyro1	End cause	1	10.125	1.01249e-006
9	6	Erratic output from Gyro2	End cause	1	10.125	1.01249e-006
10	5	No output from Gyros	AND	1	2.25	0
11	6	No output from Gyro1	End cause	1	3.375	3.375e-007
12	6	No output from Gyro2	End cause	1	3.375	3.375e-007
13	4	Human error - Autopilot on	End cause	1	1e-005	1e-011
14	...3	UMAS failure	OR	1	2.98477	2.79774e-008
15	4	Continuous Reset in UMAS	End cause	1	0.279772	2.79772e-008
16	4	No 28v provided to airborne UMAS	AND	1	2.705	1.64633e-013
17	5	No power from Alternator	OR	1	4.0607	4.0607e-007
18	6	No 28v output from Alternator	End cause	1	4.0607	4.0607e-007
19	5	No power from Battery	OR	1	4.0543	4.0543e-007
20	6	No output from Battery	End cause	1	4.0543	4.0543e-007
21	..2	Communication Lost	OR	1	0.00999682	0

#	Level	Event Name	Model	Qty	Rate (per million h)	Probability
22	...3	UAV can't abort Take-off	AND	1	0.00999682	3.07411e-029
23	4	Down-Link lost	OR	1	5.85001	5.85001e-007
24	5	Ground Prime channel receiver fails	End cause	1	1.35	1.35e-007
25	5	No output from Airborne antenna	End cause	1	4.50001	4.50001e-007
26	4	UAV's velocity is above 40 knots	End cause	1	0.01	1e-008
27	4	Up-Link lost	AND	1	0.556204	5.25487e-015
28	5	Prime channel fails	OR	1	0.902237	0
29	6	Airborne Prime channel receiver fails	End cause	1	0.675	6.75e-008
30	6	No output from Ground Prime channel transmitter	AND	1	0.227237	0
31	7	No output from Dish antenna	End cause	1	0.3443	3.443e-008
32	7	No output from Omni antenna	End cause	1	0.3375	3.375e-008
33	5	Secondary channel fails	OR	1	0.7785	0
34	6	Airborne UHF channel receiver fails	End cause	1	0.7751	7.751e-008
35	6	No output from Ground Secondary channel transmitter	End cause	1	0.0034	3.4e-010
36	..2	Electrical problems	OR	1	2.7848	7.98016e-009
37	...3	No Power	AND	1	2.705	1.64633e-013
38	4	No 28v output from Alternator	End cause	1	4.0607	4.0607e-007
39	4	No 28v output from Alternator	End cause	1	4.0607	4.0607e-007
40	4	No 28v output from Alternator	End cause	1	4.0607	4.0607e-007
41	4	No output from Battery	End cause	1	4.0543	4.0543e-007
42	4	No output from Battery	End cause	1	4.0543	4.0543e-007
43	...3	No output from DC_DC converter from 28v to 13.6 volt	End cause	1	0.0273	2.73e-009
44	...3	No output from DC_DC converter from 28v to 13.6 volt	End cause	1	0.0273	2.73e-009
45	...3	No output from DC_DC converter from 28v to 13.6 volt	End cause	1	0.0273	2.73e-009
46	...3	Short in Main Engine Harness	End cause	1	0.0525	5.25e-009
47	...3	Short in Main Engine Harness	End cause	1	0.0525	5.25e-009
48	..2	Foreign Body hit	XOR	1	0.0002	2e-011
49	...3	Bird	End cause	1	0.0001	1e-011

#	Level	Event Name	Model	Qty	Rate (per million h)	Probability
50	...3	Bird	End cause	1	0.0001	1e-011
51	...3	FOD on the runway	End cause	1	0.0001	1e-011
52	...3	FOD on the runway	End cause	1	0.0001	1e-011
53	..2	Servos critical failure	OR	1	4.11452	4.74213e-012
54	...3	Ailerons critical failure	AND	1	0.35138	3.51798e-013
55	4	Ailerons critical failure	OR	1	0.3518	3.518e-008
56	5	Left Wing Aileron stuck in critical angle	End cause	1	0.1759	1.759e-008
57	5	Right Wing Aileron stuck in critical angle	End cause	1	0.1759	1.759e-008
58	4	Human Error - Bad Pilot	End cause	1	10	9.99995e-006
59	4	Human Error - Bad Pilot	End cause	1	10	9.99995e-006
60	4	Human Error - Bad Pilot	End cause	1	10	9.99995e-006
61	...3	Elevators critical failure	AND	1	1.00316	1.01249e-012
62	4	Elevators critical failure	OR	1	1.0125	1.0125e-007
63	5	LH_Elevator stuck in critical angle	End cause	1	0.50625	5.0625e-008
64	5	RH_Elevator stuck in critical angle	End cause	1	0.50625	5.0625e-008
65	4	Human Error - Bad Pilot	End cause	1	10	9.99995e-006
66	...3	Nose Landing Gear Servo critical failure	AND	1	3.1124	3.37784e-012
67	4	Human Error - Bad Pilot	End cause	1	10	9.99995e-006
68	4	Nose Landing Gear Servo failure	OR	1	3.37785	3.37785e-007
69	5	Nose Wheel stuck in critical angle	End cause	1	3.37785	3.37785e-007
70	..2	Specific conditions during Ground Roll or Take-off	XOR	1	7.52225	1.29029e-011
71	...3	Engine shutdown after take-off	AND	1	7.52224	1.29029e-011
72	4	Engine shutdown after take-off	OR	1	13.1271	1.2903e-006
73	5	ECU critical failure	OR	1	7.57	7.57e-007
74	6	No output from DC_DC converter from 28v to 13.6 volt	End cause	1	0.0273	2.73e-009
75	6	No output from ECU	End cause	1	6.7536	6.7536e-007
76	6	Wrong readings received from sensors	End cause	1	0.7891	7.891e-008
77	5	Electrical problems	OR	1	4.1405	4.1405e-007

#	Level	Event Name	Model	Qty	Rate (per million h)	Probability
78	6	No 28v output from Alternator	End cause	1	4.0607	4.0607e-007
79	6	No output from DC_DC converter from 28v to 13.6 volt	End cause	1	0.0273	2.73e-009
80	6	Short in Main Engine Harness	End cause	1	0.0525	5.25e-009
81	5	Fuel provision failures	OR	1	1.1925	1.1925e-007
82	6	Fuel line blocked	End cause	1	0.0675	6.75e-009
83	6	No fuel transferred throw fuel pipe	End cause	1	1.125	1.125e-007
84	5	Ignition failures	AND	1	0.224066	3.84434e-022
85	6	No output from pick-up sensor	End cause	1	3.375	3.375e-007
86	6	No spark	AND	1	0.225	0
87	7	No spark from Spark1	End cause	1	0.3375	3.375e-008
88	7	No spark from Spark2	End cause	1	0.3375	3.375e-008
89	4	Human Error	End cause	1	10	9.99995e-006
90	...3	Possible Deviation from center line	AND	1	9.90894e-006	0
91	4	EP Flight Box failed	OR	1	9.99901e-006	0
92	5	Possible Deviation from center line	AND	1	9.99901e-006	0
93	6	Autopilot fails	AND	1	1e-005	1.13909e-023
94	6	Human error - Autopilot on	End cause	1	0.001	1e-009
95	6	UAV's velocity is above 40 knots	End cause	1	0.01	1e-008
96	6	UAV's velocity is above 40 knots	End cause	1	0.01	1e-008
97	4	Human Error	End cause	1	0.0001	1e-010
98	4	No steering during Taxi	OR	1	3.37785	0
99	5	Nose Wheel stuck in critical angle	End cause	1	3.37785	3.37785e-007
100	..2	Wheels Lost during Ground Roll + Take-off	OR	1	1.39449e-008	2.22045e-015
101	...3	Main Wheel lost	ANDp	1	2.10375e-009	1.88738e-015
102	4	Foreign Body hit	XOR	1	0.0002	2e-011
103	4	Rear Wheels mechanics failure	OR	1	19.0135	1.90135e-006
104	5	Rear Wheels lost due to puncture	End cause	1	19.0135	1.90135e-006
105	...3	Nose Wheel Lost	ANDp	1	1.18411e-008	3.33067e-016

#	Level	Event Name	Model	Qty	Rate (per million h)	Probability
106	4	Foreign Body hit	XOR	1	0.0002	2e-011
107	4	Foreign Body hit	XOR	1	0.0002	2e-011
108	5	Bird	End cause	1	0.0001	1e-011
109	5	FOD on the runway	End cause	1	0.0001	1e-011
110	4	Nose Wheel stuck in critical angle	End cause	1	3.37785	3.37785e-007
111	4	Nose Wheel stuck in critical angle	End cause	1	3.37785	3.37785e-007
112	4	Nose Wheel stuck in critical angle	End cause	1	3.37785	3.37785e-007
113	.1	2.During flight	OR	1	9.93475	2.87706e-007
114	..2	Avionics failures	OR	1	2.98477	2.23828e-007
115	...3	UMAS failure	OR	1	2.98477	2.23828e-007
116	4	Continuous Reset in UMAS	End cause	1	0.279772	2.23818e-007
117	4	No 28v provided to airborne UMAS	AND	1	2.705	0
118	5	No 28v output from Alternator	End cause	1	4.0607	3.24855e-006
119	5	No output from Battery	End cause	1	4.0543	3.24343e-006
120	...3	Wrong Ground Control	AND	1	1e-007	3.56796e-043
121	4	IP Station Fails	OR	1	10.0327	2.21198e-010
122	5	No Power	AND	1	2.705	1.05365e-011
123	5	Control Assembly fails	AND	1	7.32767	2.10661e-010
124	6	PC Assembly fails	End cause	1	27	2.69996e-005
125	6	Mechanical Assembly fails	End cause	1	7.8024	7.80237e-006
126	4	PO Station Fails	OR	1	10.0327	2.21198e-010
127	5	No Power	AND	1	2.705	1.05365e-011
128	5	Control Assembly fails	AND	1	7.32767	2.10661e-010
129	6	PC Assembly fails	End cause	1	27	2.69996e-005
130	6	Mechanical Assembly fails	End cause	1	7.8024	7.80237e-006
131	4	Autopilot fails	AND	1	1e-007	7.29221e-024
132	5	Gyros fail	OR	1	9	0
133	6	Erratic output from Gyros	AND	1	6.75	0

#	Level	Event Name	Model	Qty	Rate (per million h)	Probability
134	7	Erratic output from Gyro1	End cause	1	10.125	8.09997e-006
135	7	Erratic output from Gyro2	End cause	1	10.125	8.09997e-006
136	6	No output from Gyros	AND	1	2.25	0
137	7	No output from Gyro1	End cause	1	3.375	2.7e-006
138	7	No output from Gyro2	End cause	1	3.375	2.7e-006
139	5	Human error - Autopilot on	End cause	1	1e-007	1.00031e-013
140	..2	Electrical problems	OR	1	2.7848	6.38505e-008
141	...3	No Power	AND	1	2.705	1.05365e-011
142	...3	No Power	AND	1	2.705	1.05365e-011
143	...3	No Power	AND	1	2.705	1.05365e-011
144	4	No 28v output from Alternator	End cause	1	4.0607	3.24855e-006
145	4	No 28v output from Alternator	End cause	1	4.0607	3.24855e-006
146	4	No output from Battery	End cause	1	4.0543	3.24343e-006
147	4	No output from Battery	End cause	1	4.0543	3.24343e-006
148	...3	No output from DC_DC converter from 28v to 13.6 volt	End cause	1	0.0273	2.184e-008
149	...3	Short in Main Engine Harness	End cause	1	0.0525	4.2e-008
150	..2	Fire in UAV	AND	1	0.0505936	1.23022e-020
151	...3	Battery shortage	End cause	1	4.0543	3.24343e-006
152	...3	Fuel Leakage	End cause	1	0.0878	7.024e-008
153	...3	Fuel Spreading in the Fuselage	End cause	1	0.0675	5.4e-008
154	..2	Human Pilot Error	AND	1	6.66667e-005	1e-020
155	...3	Autopilot Off	End cause	1	0.0001	1e-010
156	...3	Human error	End cause	1	0.0001	1e-010
157	..2	Servos critical failure	OR	1	4.11452	3.79371e-011
158	...3	Aileron critical failures	AND	1	0.35138	2.8144e-012
159	4	Ailerons critical failure	OR	1	0.3518	2.8144e-007
160	5	Left Wing Aileron stuck in critical angle	End cause	1	0.1759	1.4072e-007
161	5	Right Wing Aileron stuck in critical angle	End cause	1	0.1759	1.4072e-007

#	Level	Event Name	Model	Qty	Rate (per million h)	Probability
162	4	Human Error - Bad Pilot	End cause	1	10.0001	1e-005
163	4	Human Error - Bad Pilot	End cause	1	10.0001	1e-005
164	4	Human Error - Bad Pilot	End cause	1	10.0001	1e-005
165	...3	Elevators critical failures	AND	1	1.00316	8.1e-012
166	4	Elevators critical failure	OR	1	1.0125	8.1e-007
167	5	LH_Elevator stuck in critical angle	End cause	1	0.50625	4.05e-007
168	5	RH_Elevator stuck in critical angle	End cause	1	0.50625	4.05e-007
169	4	Human Error - Bad Pilot	End cause	1	10.0001	1e-005
170	...3	Nose Landing Gear Servo critical failure	AND	1	3.1124	2.70228e-011
171	4	Human Error - Bad Pilot	End cause	1	10.0001	1e-005
172	4	Nose Landing Gear Servo failure	OR	1	3.37785	2.70228e-006
173	5	Nose Wheel stuck in critical angle	End cause	1	3.37785	2.70228e-006
174	.1	3.During Landing (Final Approach)	OR	1	17.5242	6.20995e-007
175	..2	Avionics failures	OR	1	2.98487	2.79774e-008
176	...3	Autopilot fails	AND	1	0.0001	1.13909e-022
177	...3	Autopilot fails	AND	1	0.0001	1.13909e-022
178	4	Gyros fail	OR	1	9	0
179	5	Erratic output from Gyros	AND	1	6.75	0
180	6	Erratic output from Gyro1	End cause	1	10.125	1.0125e-006
181	6	Erratic output from Gyro2	End cause	1	10.125	1.0125e-006
182	5	No output from Gyros	AND	1	2.25	0
183	6	No output from Gyro1	End cause	1	3.375	3.375e-007
184	6	No output from Gyro2	End cause	1	3.375	3.375e-007
185	4	Human error - Autopilot on	End cause	1	0.0001	1e-010
186	...3	UMAS failure	OR	1	2.98477	2.79774e-008
187	4	Avionics failures	AND	1	2.705	1.64633e-013
188	5	No power from Alternator	OR	1	4.0607	4.0607e-007
189	6	No 28v output from Alternator	End cause	1	4.0607	4.0607e-007

#	Level	Event Name	Model	Qty	Rate (per million h)	Probability
190	5	No power from Battery	OR	1	4.0543	4.0543e-007
191	6	No output from Battery	End cause	1	4.0543	4.0543e-007
192	4	Continuous Reset in UMAS	End cause	1	0.279772	2.79772e-008
193	..2	Communication Lost	OR	1	6.4062	5.85e-007
194	...3	Down-Link lost	OR	1	5.85	0
195	4	Ground Prime channel receiver fails	End cause	1	1.35	1.35e-007
196	4	No output from Airborne antenna	End cause	1	4.5	4.5e-007
197	...3	Up-Link lost	AND	1	0.556204	0
198	4	Prime channel fails	OR	1	0.902237	0
199	5	Airborne Prime channel receiver fails	End cause	1	0.675	6.75e-008
200	5	No output from Ground Prime channel transmitter	AND	1	0.227237	0
201	6	No output from Dish antenna	End cause	1	0.3443	3.443e-008
202	6	No output from Omni antenna	End cause	1	0.3375	3.375e-008
203	4	Secondary channel fails	OR	1	0.7785	0
204	5	Airborne UHF channel receiver fails	End cause	1	0.7751	7.751e-008
205	5	No output from Ground Secondary channel transmitter	End cause	1	0.0034	3.4e-010
206	..2	Electrical problems	OR	1	2.7848	7.98016e-009
207	...3	No Power	AND	1	2.705	1.64633e-013
208	4	No 28v output from Alternator	End cause	1	4.0607	4.0607e-007
209	4	No 28v output from Alternator	End cause	1	4.0607	4.0607e-007
210	4	No 28v output from Alternator	End cause	1	4.0607	4.0607e-007
211	4	No output from Battery	End cause	1	4.0543	4.0543e-007
212	4	No output from Battery	End cause	1	4.0543	4.0543e-007
213	...3	No output from DC_DC converter from 28v to 13.6 volt	End cause	1	0.0273	2.73e-009
214	...3	No output from DC_DC converter from 28v to 13.6 volt	End cause	1	0.0273	2.73e-009
215	...3	No output from DC_DC converter from 28v to 13.6 volt	End cause	1	0.0273	2.73e-009
216	...3	Short in Main Engine Harness	End cause	1	0.0525	5.25e-009
217	...3	Short in Main Engine Harness	End cause	1	0.0525	5.25e-009

#	Level	Event Name	Model	Qty	Rate (per million h)	Probability
218	..2	End of Fuel before landing	AND	1	0.0098843	5.87837e-024
219	...3	Faulty Data from the Fuel Tank	OR	1	0.6699	0
220	4	TPS fails	OR	1	0.6149	0
221	5	Magnets malfunction	End cause	1	0.6149	6.149e-008
222	4	Wrong data from Gauge	OR	1	0.055	0
223	5	Erratic Output	OR	1	0.055	0
224	6	Cause of Erratic Output	End cause	1	0.055	5.5e-009
225	...3	Fuel Leakage	OR	1	0.08775	0
226	4	Crack	OR	1	0.0675	0
227	5	Fatigue	End cause	1	0.0675	6.75e-009
228	4	Crack	OR	1	0.0135	0
229	5	Fatigue	End cause	1	0.0135	1.35e-009
230	4	Fracture	OR	1	0.0135	0
231	5	Foreign Body hit	End cause	1	0.0135	1.35e-009
232	...3	Human Error	End cause	1	0.01	1e-008
233	..2	Engine Shutdown out of safety range	AND	1	7.52224	1.29029e-011
234	...3	Engine shutdown out of safety range	OR	1	13.1271	1.2903e-006
235	4	ECU critical failure	OR	1	7.57	7.57e-007
236	5	No output from DC_DC converter from 28v to 13.6 volt	End cause	1	0.0273	2.73e-009
237	5	No output from ECU	End cause	1	6.7536	6.7536e-007
238	5	Wrong readings received from sensors	End cause	1	0.7891	7.891e-008
239	4	Electrical problems	OR	1	4.1405	4.1405e-007
240	5	No 28v output from Alternator	End cause	1	4.0607	4.0607e-007
241	5	No output from DC_DC converter from 28v to 13.6 volt	End cause	1	0.0273	2.73e-009
242	5	Short in Main Engine Harness	End cause	1	0.0525	5.25e-009
243	4	Fuel provision failures	OR	1	1.1925	1.1925e-007
244	5	Fuel line blocked	End cause	1	0.0675	6.75e-009
245	5	No fuel transferred throw fuel pipe	End cause	1	1.125	1.125e-007

#	Level	Event Name	Model	Qty	Rate (per million h)	Probability
246	4	Ignition failures	AND	1	0.224066	3.84434e-022
247	5	No output from pick-up sensor	End cause	1	3.375	3.375e-007
248	5	No spark	AND	1	0.225	0
249	6	No spark from Spark1	End cause	1	0.3375	3.375e-008
250	6	No spark from Spark2	End cause	1	0.3375	3.375e-008
251	...3	Human Error	End cause	1	10	9.99995e-006
252	..2	Extream Weather conditions	End cause	1	1e-009	9.99201e-016
253	..2	Foreign Body hit	XOR	1	0.0002	2e-011
254	...3	Bird	End cause	1	0.0001	1e-011
255	...3	Bird	End cause	1	0.0001	1e-011
256	...3	FOD on the runway	End cause	1	0.0001	1e-011
257	...3	FOD on the runway	End cause	1	0.0001	1e-011
258	..2	Possible Deviation from center line	AND	1	5.25963e-005	0
259	...3	EP Flight Box failed	OR	1	6.65994e-005	0
260	4	Possible Deviation from center line	AND	1	9.90991e-005	0
261	5	Autopilot fails	AND	1	0.0001	1.13909e-022
262	5	Human error - Autopilot on	End cause	1	0.001	1e-010
263	5	UAV's velocity is above 40 knots	End cause	1	0.0001	1e-011
264	...3	Human Error	End cause	1	0.0001	1e-010
265	...3	No steering during Taxi	OR	1	3.37785	3.37785e-007
266	4	Nose Wheel stuck in critical angle	End cause	1	3.37785	3.37785e-007
267	4	Nose Wheel stuck in critical angle	End cause	1	3.37785	3.37785e-007
268	4	Nose Wheel stuck in critical angle	End cause	1	3.37785	3.37785e-007
269	..2	Servos critical failure	OR	1	4.11452	4.74215e-012
270	...3	Ailerons critical failures	AND	1	0.35138	3.518e-013
271	4	Ailerons critical failure	OR	1	0.3518	3.518e-008
272	5	Left Wing Aileron stuck in critical angle	End cause	1	0.1759	1.759e-008
273	5	Right Wing Aileron stuck in critical angle	End cause	1	0.1759	1.759e-008

#	Level	Event Name	Model	Qty	Rate (per million h)	Probability
274	4	Human Error - Bad Pilot	End cause	1	10.0001	1e-005
275	4	Human Error - Bad Pilot	End cause	1	10.0001	1e-005
276	4	Human Error - Bad Pilot	End cause	1	10.0001	1e-005
277	...3	Elevators critical failures	AND	1	1.00316	1.0125e-012
278	4	Elevators critical failure	OR	1	1.0125	1.0125e-007
279	5	LH_Elevator stuck in critical angle	End cause	1	0.50625	5.0625e-008
280	5	RH_Elevator stuck in critical angle	End cause	1	0.50625	5.0625e-008
281	4	Human Error - Bad Pilot	End cause	1	10.0001	1e-005
282	...3	Nose Landing Gear Servo critical failure	AND	1	3.1124	3.37785e-012
283	4	Human Error - Bad Pilot	End cause	1	10.0001	1e-005
284	4	Nose Landing Gear Servo failure	OR	1	3.37785	3.37785e-007
285	5	Nose Wheel stuck in critical angle	End cause	1	3.37785	3.37785e-007
286	..2	Wheels lost during Landing	AND	1	0.0999972	1.90135e-013
287	...3	Human Error - Bad Pilot	End cause	1	0.1	1e-007
288	...3	Wheels lost during landing	OR	1	19.0135	1.90135e-006
289	4	Nose wheel lost during landing	ANDp	1	1.18411e-008	9.16228e-017
290	5	Human Error - Bad Pilot	End cause	1	0.1	1e-007
291	5	Nose Wheel Lost	ANDp	1	1.18411e-008	3.33067e-016
292	6	Foreign Body hit	XOR	1	0.0002	2e-011
293	7	Bird	End cause	1	0.0001	1e-011
294	7	FOD on the runway	End cause	1	0.0001	1e-011
295	6	Nose Wheel stuck in critical angle	End cause	1	3.37785	3.37785e-007
296	4	Rear Wheels mechanics failure	OR	1	19.0135	1.90135e-006
297	5	Rear Wheels lost due to puncture	End cause	1	19.0135	1.90135e-006