Let’s talk about airplanes!

Lincolnton, NC
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Reliability Myths

- **What is “reliability”?**
  - **Nothing ever fails?**
  - **Parts last forever?**
- **How does acquisition of “high quality” (certified, mil-spec, gold plated, etc) parts improve on reliability?**
  - **“Mil-Specs” go to process and design control.**

Reliability Myths

- **Specifications call out rated service life expectations . . . Failure to meet those expectations is generally considered a maintenance or cost-of-ownership event.**
- **Focus on perceived quality of parts at the expense of considered system design IS NOT the road to electrical system Nirvana.**
- **Going to higher quality ($higher$) parts may translate to longer service life but does not automatically elevate SYSTEM reliability.**

Reliability Myths

- **How about those "certified" parts?**
  - **No such thing as a "certified" part.**
  - **All parts on a type certificated aircraft are "approved" for THAT particular airplane.**
  - **Parts may receive Parts Manufacturing Authority the purpose of approving an alternative supplier of parts or "reverse engineered" parts go to a type-certificated aircraft.**
- **ALL of the above goes to design and process control.**
- **NONE of the above goes to "Reliability" (Failures per flight hour) or "Safety" (Risks to comfortable termination of flight).**

Reliability Myths

- **A part used on a certified airplane suggests some degree of confidence in that part's ability to perform.**
- **HOWEVER, MANY parts approved for installation on certified aircraft are eclipsed for both performance and cost-of-ownership by commercial-off-the-shelf (COTS) components.**
- ***As a general rule, ANYTHING that will survive under the hood of an automobile is entirely suitable for use on your airplane!***

Reliability Realities

- **SYSTEM reliability is achieved when failure of any single component does not put you or your airplane at risk.**

- **The reliable system is FAILURE TOLLERANT**

- **Our primary design goal is to craft a system that does not depend on servicability of any single part for *comfortable termination of flight.***

Reliability Realities

• There are hundreds if not thousands of places in your electrical system where a simple failure can make any system unusable.

- **Screw loose**
- **Wire breaks**
- **Switch contacts corrode**
- **Solder joint in radio opens up**
- **Semiconductor in radio fails**
- **Fault in wiring or appliance opens breaker/fuse.**
- **Etc, etc.**

Reliability Realities

- **NONE of these components fails to perform because the device was not “certified” or fabricated to some specification.**

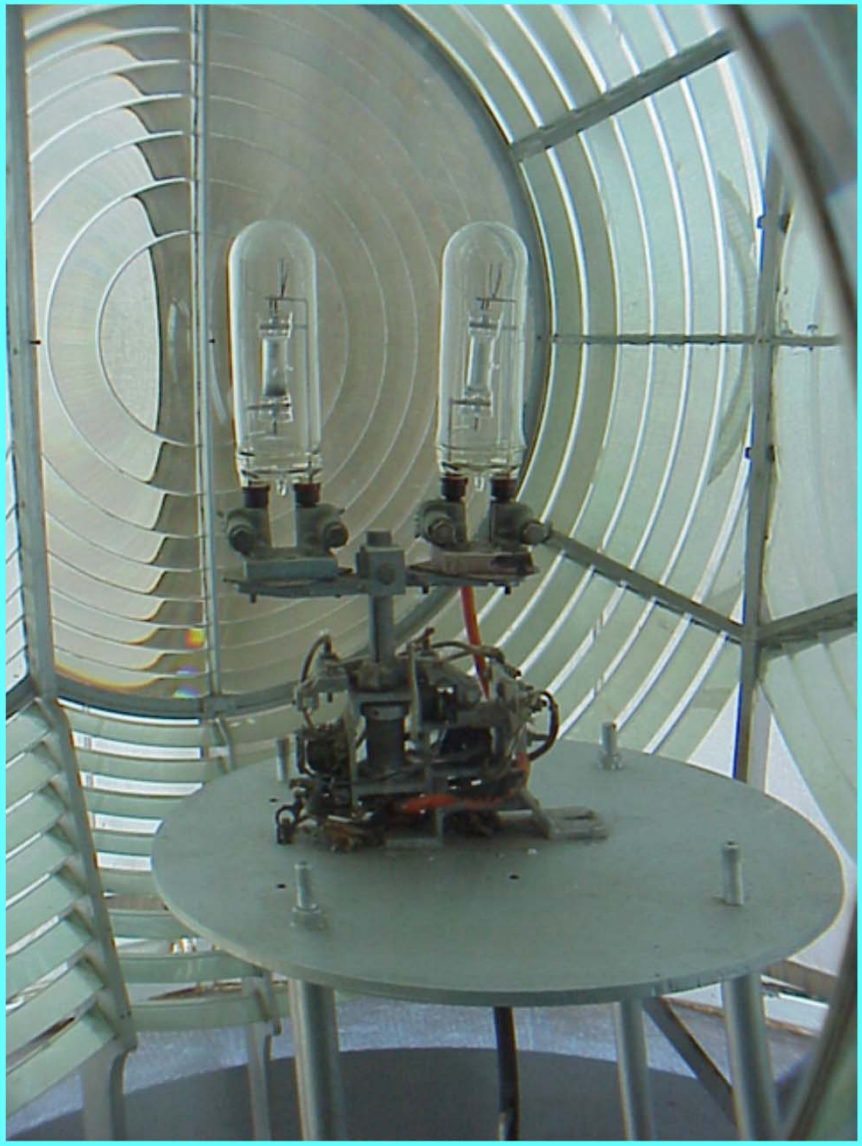
- **Failures occur for some combination of three reasons . . .**

  - **Wear out**
  - **Inappropriate application**
  - **Error of assembly, installation or maintenance.**

Reliability Realities

- **The strongest prophylactics against these ills are knowledge and experience . . . something the Owner Built and Maintained (OBAM) aircraft owner may not have.**

- **If you don't have a lot of knowledge and experience, then perhaps architecture and operational philosophies can come to the rescue . . .**



- **Here's an excellent example of Plan-A, Plan-B architecture . . .**
- **Current drawn by the main lamp in this lighthouse lens assembly keeps a clock spring motor locked.**
- **If the lamp burns out, the motor brake releases and a new lamp is rotated into position.**
- **Nothing here is "super spec'd" The designer KNOWS that light bulbs have a limited service life and WILL fail at some point in time.**
- **The design goal is to craft a minimum parts count solution for automatically implementing Plan-B.**

"Knowledge is not understanding. You can know a great deal, and understand nothing."

-Charles Kettering-

How would you categorize these items????

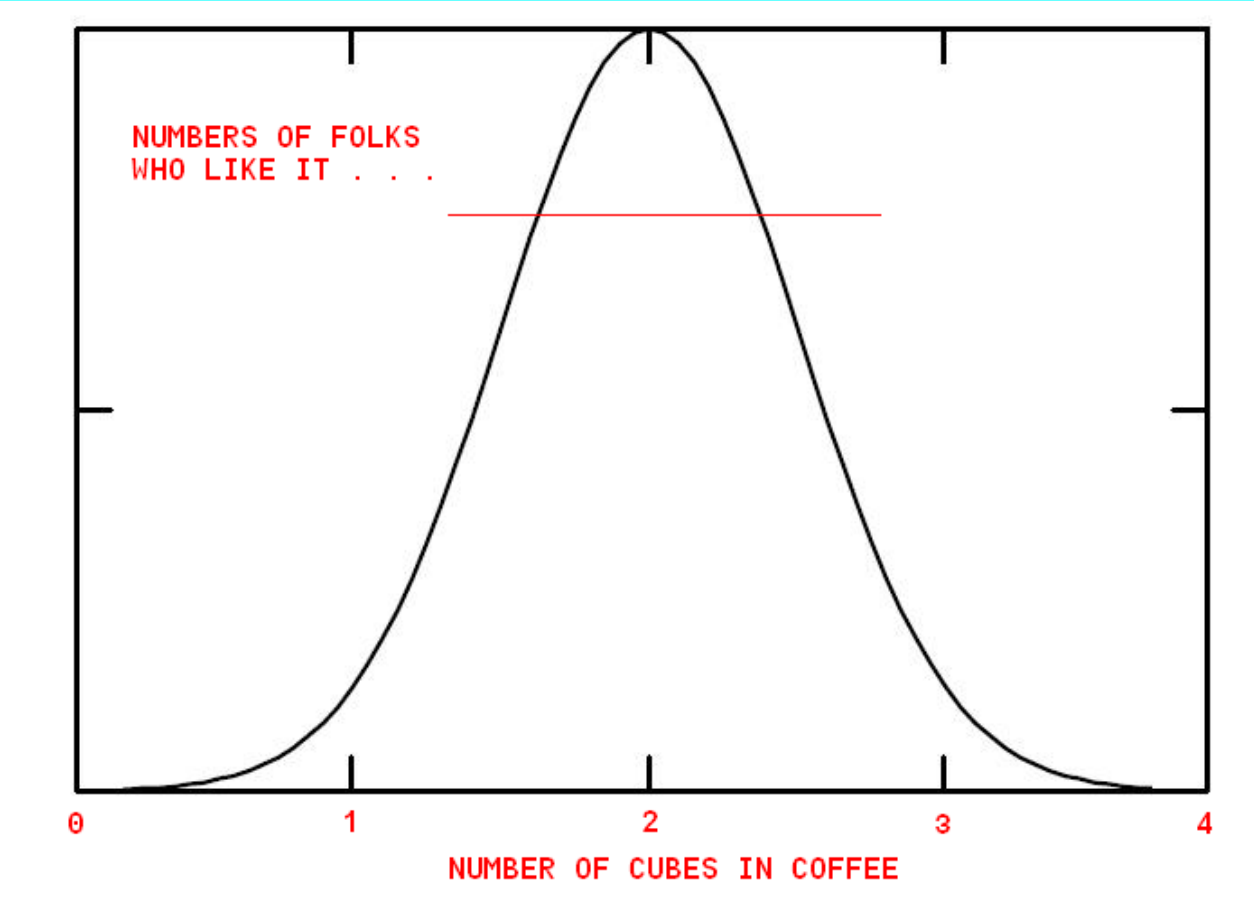
Eggs	
Milk	
Water	
Flour	
Salt	
Sugar	
Vanilla	
Etc, etc . . .	

Recipes for success . . .

- **Recipes for success in every discipline relies on rudimentary ingredients. Taken alone, each ingredient offers limited usefulness.**
- **A knowledgeable and skillful practitioner understands how these ingredients perform in combinations that offer an infinite range of useful designs.**

Parts Bins (Chef)	Parts Bins (E. Designer)
Milk	Transistor
Water	Wire
Flour	Switch
Salt	Relay
Sugar	LED
Vanilla	Battery
Eggs, etc, etc . . .	Capacitor, etc, etc . . .

- **The complete recipe for success requires decisions that go beyond deciding *WHICH INGREDIENTS* will be used . . .**
- **Achieving the desired outcome depends on . . .**
  - ***QUALITY* of ingredients, and**
  - ***QUANTITY* of ingredients balanced in *OPTIMUM PROPORTION*.**
- **What’s all this “OPTIMAL PROPORTIONALITY” stuff anyhow?**
  - **Like sugar in your coffee?**



- **EVERY successful recipe calls for specific quantities of various ingredients that go to a DESIGN GOAL of maximizing user satisfaction.**

- **"Gold plated" parts do not automatically translate to higher reliability . . .**
- **MTBF numbers are more theoretical than practical.**
- **Any effort to reduce parts count while retaining meeting performance goals INCREASES system reliability . . .**
- **Probability of two failures stacking on top of each other on any given tank full of fuel is exceedingly low . . .**
- **System reliability is maximized when you can suffer any of the most common failures and still put the wheels on the ground, at intended destination, without breaking a sweat.**

How much “Stuff” does it take to go flying????

but here's my personal list of reliability priorities:

I. Airframe

1. Surfaces
2. Structure
3. Flight Controls

II Pilot

1. Skills
2. Training
3. Physical Condition

III Power Plant:

1. Engine
2. Propeller
3. Fuel System
4. Controls

IV. Systems

1. Electrical

(a) Panel Lighting
(b) Primary Nav Radio
(c) Transponder
(d) Turn Coordinator
(e) Fuel Pump/Transfer
(f) Engine Support

2. Landing Gear

etc.

- **A goal for this course is to craft thinking tools for looking beyond the perceived *quality* or *service life* of individual parts**
- **Elimination of "tense" words from the vernacular of airplanespeak in electrical systems:**
  - **Emergency**
  - **Essential**
  - **Critical**
  - **Etc**

New lines of communication:

- **Please consider joining the AeroElectric List . . . assuming that you have not already done so.**
- **Sometimes it's difficult to raise "your hand" in a classroom where there's a potential for embarrassment or even personal attack.**
- **Know that your participation on the AeroElectric List is welcome and that honorable citizens who hang out there will go out of their way to defend you from the actions of the very rare visitors with dishonorable intentions.**

Goals for this Presentation . . .

- **If any device on your aircraft is needed for comfortable termination of flight, it needs to have some form of backup.**
- **If you have a plan-B in place for any single failure, you're not going to experience an electrical system "emergency".**
- **A part failure that does NOT cause you to break a sweat is NOT "critical".**

What the OBAM Aviation community is all about . . .

•EVERY great achievement is an amalgam of thousands of ideas, some of which may date back centuries.

• Wisdom arises not from age but from experience. Seeking out and devising tools for the sharing of experience goes to the benefit of all.

• “I am more of a sponge than an inventor. I absorb ideas from every source. My principal business is giving commercial value to the brilliant but misdirected ideas of others.” –Thomas A. Edison-