SAFETY "Lessons not Learned"

By Capt M. P. Pappy Papadakis

There are no new types of air crashes — only people with short memories....Stephen Barlay

Lawyers are always interested in what a defendant knew and when he knew it. More importantly, the question becomes once you knew you had a defective product what did you do about it.?

To delve into an aircraft investigations of this historic nature takes far greater tenacity and investigative tools of legal discovery than the investigative agencies routinely exert. It is true that the FAA, NASA, and the NTSB have very useful historical databases, which can be helpful. They generally, do not delve into company design records, test records and field service data. They typically do not research engineering change proposals that were not acted upon (rejected). They do not often scrutinize field technical representative reports. They do not often look at warranty work records. Moreover, they almost never look to lessons learned from substantially similar equipment installed in other manufacturers aircraft. They are unlikely to analyze non aviation equipment failures for the lessons applicable to aviation.

Lessons learned are valuable tools for design engineers to utilize to keep from making similar mistakes on future aircraft. Lessons are often learned in smoking holes littered with human tragedy. Worse sometimes lessons are not learned, and worse yet, sometimes lessons are forgotten or egregiously overlooked.

In my experience, the failure to incorporate changes found from lessons learned discipline may often qualify as a wanton disregard; The following recitation of repeat accidents is extremely long and tragic.

These accidents have each happened previously and lessons and data were available to prevent re occurrences. It is often that lawyers find the historical data from lessons learned while the accident investigators do not. This is because the field investigator generally concerns him with the present accident and does not have a protocol or a method to routinely search out ancient historical data. Lawyers do this through subpoena and discovery. .

NOTE: *Throughout the following chapter certain famous aviation quotations are included. These quotations are apropos to the case being reviewed but no quotation was made concerning any of these specific* cases.

REDUNDANT FLIGHT CONTROLS

> I **a**m *a history major. I believe that the past is prologue. The archives bear that out. Most major aircraft accidents are not acts of God. In our recommendations we try to take what we have learned and correct situations so it shouldn't happen again.*
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> *— James Hall, NTSB, 1996*

In the Vietnam War we had two aircraft, the F105 Thunderchief and the A-7, both used as air to ground attack aircraft. They delivered ordinance with low level bombing runs. Soon enough, it was found that they were susceptible to small arms fire. That was exacerbated because the hydraulic fluid lines of each redundant system to power flight controls ran adjacent along the belly of the aircraft from engine pumps to the tail actuators. A single small arm shell could render both systems inoperative. A fix was to reroute one of the two hydraulic lines.

The Turkish DC-10 had a rear door blow open over Paris and the rear cabin floor collapsed. The hydraulic lines for three hydraulic systems ran under that floor and were lost.

That accident almost repeated itself in the United States when a similar DC-10 incident resulted in loss of two of the three systems. The aircraft was recovered safely.

The famous Sioux City United DC-10 accident also resulted in all hydraulic controls being lost due to a rear engine failure and resulting shrapnel penetrating and causing hydraulic systems losses.

The lessons here should be that flight controls should be designed to be truly separated and redundant. In each design a common cause failure was capable of destroying flight capability of the aircraft.

Then in the haste to design a lightweight agile fighter the General dynamics designers created the single engine fighter the F-16 Viper, (Later Named Talon). For a short period of time, as it was hurriedly introduced, it got a bad reputation and was nicknamed the Lawn Dart. One hearsay story is that the name Viper was changed as F-4 pilots transitioning to F-16 said it was called Viper, because it was a snake in the grass waiting to kill you. The official story is far different.

One true SOTA [state of the Art] advance was the incorporation in F-16 of an electric fly by wire system. This system did away with heavy and

unneeded hydraulic plumbing to power flight controls. A truly redundant system of four separate flight control channels, any of which capable of powering flight controls, were incorporated through different wires/cables. The problem was each and every wire ran from cockpit to controls in a common wire bundle which ran through the right hand Strake to distribution panels. This run of cable was susceptible to common cause failure due to fire, wire bundle chaffing or small arms fire.

A LESSON NOT LEARNED

After several incidents of wire chaffing this vulnerability was recognized and the individual flight control channels were routed separately making control loss far less likely After the first run of F-16a were completed follow on fighters incorporated vastly different electrical system, different routing and new F-16 have two generators and different wiring routing.

WIRE INSULATION-WIRE CHAFFING –FLASH OVER 1982-1987

> *Of the major incentives to improve safety, by far the most compelling is that of economics. The moral incentive, which is most evident following an accident, is more intense but is relatively short lived.*
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> *— Jerome Lederer*

Aviation wiring is critical to the mission and safety of aircraft. Wiring insulation and wire bundles are installed by the manufacturer at the time of manufacture. They are expected to last a long time, perform flawlessly and not create a fire hazard.

Routing new or replacement cables is difficult unless accomplished during major aircraft overhaul periods, Access to wire bundles are often hidden, and they have long and difficult pathways. The wire insulation is supposed to be heat resistant to certain temperatures and each insulation is tested to specific temperature standards, the heat resistant insulation is for hot areas around engine areas.

In addition to heat resistance, wire insulation is expected to not deteriorate within specified and warranted time periods. Wire insulation is expected to insulate and prevent electrical cross talk among adjacent wires. Wire insulation should be tough and resilient so as to not chafe and or become brittle with age. A thin and light weight insulation covering is thought superior to a heavy and cumbersome insulation, if the lighter one can do the job. The wire was also required to be impervious to environmental factors. (Heat, cold, ultra violate rays, sea air environment etc) Of course a factor in the choice

was the products low cost. The government buys from the lowest qualified bidder. Often the more you buy the lower the cost.

In spaceships and in airline aircraft every ounce of weight saved can translate to payload. The choice in aviation shifted to a new, thin, insulation known as Kapton. The USAF chose it for its light weight characteristics. The Navy followed suit somewhat reluctantly. NASA looked at the wire insulation and was concerned about two phenomena. They were concerned about chaffing and wire cross talk, they were concerned that the wire exhibited a phenomenon known as "Flashover" This consists of a rapidly spreading fire path along a chaffed wire. This phenomenon is known in several insulations, but it seemed worse in Kaptan.

Fire in wire bundles is known to cause loss of mission capability and sometimes loss of aircraft and life. NASA is very cognizant of this ever since the loss of astronauts in a space capsule tests in the Apollo Program. NASA has a very deep concern about fire sources as they were using a pure oxygen environment which made fire potential even more critical. NASA did not use the insulation on spacecraft.

Later it was found that salt sea- air environment made the insulation even more susceptible to the flashover fire phenomenon. The new F-16 used this wire extensively and They had an extreme wire bundle chaffing, flashover and fire problem with the new Insulation. It is true, in early version F-16s that many USAF missions were cut short because of chaffing problems and flashover problems.

After a short period of time The United States Navy, because of the carrier salt air environment banned the insulation at great cost. The USAF in F-16 removed that insulation from exposed areas such as wheel wells to decrease environmental influences. These actions were documented well before 1998

However, the insulation was utilized on airline variety of aircraft. The Swissair McDonnell Douglas MD-11 lost on 2 September 1998 . It was thought to be the ignition source for the onboard fire that resulted in tragic loss of the aircraft and death of all aboard.

HUFF n PUFF

A law case concerning an airplane crash was put into settlement position by, among other things, proving that the designer of a new airplane knew or should have known of a certain safety feature built into a World War II airplane but left out of the design of the modern craft. Here is a description of one facet of the 1970 case from attorney Myron P. Papadakis who at the time was assisting Houston attorney Wayne Fisher

From a system safety standpoint it is far better to predict and eliminate hazard than to discover hazard as a result of an accident investigation. The experience in this case will demonstrate that fact.

A manufacturer of General Aviation Aircraft introduced a radical new aircraft in the mid 1960's. It was a twin engine, twin boom aircraft with high-mounted wings and retractable landing gear. Mounted facing forward was a center-line reciprocating engine. Aft of the passenger compartment was a second, rearward-facing engine with a pusher propeller.

The wonderful simplicity of this aircraft as advertised by the manufacturer was the idea that if a general aviation pilot loses a wing-mounted engine on an ordinary twin-engine aircraft, the aircraft yaws terrifically at low takeoff speeds and a novice pilot would have his hands full.

Cessna advertised their plane with words similar to: *THE 337 AIRCRAFT , Every man's P –38, Lose an engine, It is a piece of cake, with the center line mounting there is no yaw, so continue straight ahead like any single-engine airplane.*

This seemed a good idea except that there were several incidents and accidents where the pilots had attempted takeoffs with failed rear engines. In the civilian design the engine instruments were not of optimum design or location and the pilot by design would not feel the loss of an engine with no yaw. Moreover, the location of the engine made it difficult to hear loss of power or see prop rotation stop.

In our lawsuit we suggested that because of the poor instrument design and layout, and because of the inability of the pilot to see or feel the loss of a rear engine, he was unaware of his rear engine failure. We suggested that the airplane should be equipped with a rear-engine-out warning light.

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I found a book with a picture of a Nazi fighter plane on the cover. It was a piston-powered Dornier 335 Pfeil (Anteater) aircraft. The amazing thing about this aircraft was the fact that it had one engine mounted in the nose and another pusher engine and propeller in the tail. It too was a "Huff and Puff"

As I picked the book up, I realized this was the only other centerline-mounted prop plane in existence. The United States shortly after the war had a half jet – half prop plane called the Ryan Fireball. This then was the genesis of the centerline thrust – low drag machine that Cessna was replicating.

To my amazement I read that a very early prototype of the Dornier 335 had crashed due to a test pilot's attempting a takeoff with a failed rear engine. It was a fatality.

I called Adolph Galland -- then president of the Luftwaffe Fighter Pilot's Association and the all-time world's leader fighter pilot ace. He placed me in contact with a former test pilot and I learned an amazing story about the aircraft. After the first fatal takeoff the Nazis designed and subsequently installed an engine-out warning light called a Fuehrer Warning Lamp. It was installed in the cockpit for the pilot. Dornier in 1942 had learned the hard way what the new designer had not.

The case settled, and we suspect that a message came back from that 1942 accident and reminding engineers to be ever-vigilant in not overlooking lessons Learned."

CALIFORNIA FIRE BOMBERS and G LIMITERS

Another interesting case was why was it that California firefighters were losing their life frequently in old reliable Grumman S2F airplanes converted to fire Tankers. There had been nine California Forest Department fatal accidents with S2 Tankers, all have been written off as pilot error. Pilots who complain about safety were fired.

Officially, most of the accidents are attributed to stall or accelerated stalls of one variety or another. There are several accidents where immediately before plunging to the ground the aircraft was seen to be very nose high-almost inverted, and these have been labeled stall accidents.

Such was the case of our deceased. They said he died of terminal stupidity in that he accelerates stalled his S2 into the ground after dropping a load of fire retardant and was pulling off target. Curious that they could call it an accelerated stall since anyone who has ever flown an S2 will tell you that an S2 in an accelerated stall will pitch nose down after or simultaneously with a rapid roll.

> "*POWER ON ACCELERATED STALLS" in either in the clean or landing configuration usually roll off to the right. A light airframe buffet occurs at about .25 g before roll off occurs"* **S2F NATOPS , p105, MAY 1959**

In an accelerated stall the nose does not go up after the stall. The accident aircraft was seen to pitch up, go vertical, then inverted while simultaneously rolling LEFT, all before it plummeted earthward. Other California crashes did the same maneuver before meeting their makers, and each time the result was an official finding of pilot error." accelerated stall"

Some people simply concluded that Tanker aviation around fires is very dangerous business, and the pilots who fly there are part crazy anyway. Mostly nobody cared what really happened except the widow. To know what really went

wrong you had to be around the S2 community in the early development of that airplane for the U.S. Navy. It is a twin engine, propeller airplane that was designed to operate from very old and small aircraft carriers. Its job was to carry torpedoes and depth bombs and search equipments to find and destroy enemy submarines.

It was slow and overpowered since it would be asked to carry big loads of fuel and armaments on 7 hour patrol type missions. It was to be stored aboard aircraft carriers, and the size of the airplane had to be small. Like most carrier planes it's wings fold so that it can be easily stored beneath decks.

When Grumman originally submitted its plans for a prototype the Navy rejected them. The problem was that the new proposed airplane was too long to fit down the flight deck elevators of the small carriers. The obvious answer was to shorten the airplane and this is exactly what Grumman did. They cut 4 feet off from their original plans and resubmitted a new plan for what would become the S2F aircraft.

The newly shortened design was not without some serious aerodynamic ramifications, and because the airplane had become stubby several additional changes were required. Any time you shorten an airplane the tail becomes less effective, and less stable. Just imagine a very short arrow as compared to a regular arrow, and guess which will flies straighter.

The new airplane was very responsive in nose movement up or down, and stick force per g gradient was not at all predictable as the nose was brought up quickly in pitch changes. When the nose rose suddenly the downwash of air spilling off the wing would disturb the wind around the tail and the nose would tend to pitch up.

Even significant forward application of nose down elevator might not stop the pitch up tendency. The worst-case scenario was to have high engine power on during pitch up, because this worsened the condition.

> *" For Example at takeoff or Military power the roll off is very abrupt and the elevator forces reverse prior to the stall, which requires greater push on the wheel to effect recovery"* NATOPS , May 1959

Dropping ordinance and pulling up and adding full power was a sure way to disaster in the stubby S2.

The Navy and Grumman were enough concerned about pitch up and the tail structure that they added a device to make pulling up on the nose harder to do. It was called a G limiter, and it was effective in preventing pitch up and structural overload.

Additional problems with the shortened S2 were both single engine control and single engine control speed exceeding normal landing speeds. The last thing that the stubbly airplane required was a rudder boost package on the tail to facilitate single engine flight, because if the engine failed there simply wasn't enough movable tail to counteract the asymmetric thrust from the wing mounted engine.

All of these problems were as a direct result of Grumman being forced to shorten the fuselage by 4 feet from the desired and planned prototype. Two of the problems could kill you and the worst and most insidious was the pitch up tendency.

The flight characteristics of the stubby airplane were well known to the Anti Submarine fleet of the late fifties and early sixties. These S2 airplanes were the oldest models and soon enough two variants were introduced to the fleet and they were different. They were longer and consequently they did not have the pitch up or single engine problems. They also had a stronger tail and as a result the G limiter was removed in both the S2D and S2E models that went to the fleet to replace the old stubby S2.

The stubby S2 was returned to overhaul and transformed into the Navies Advanced multi engine training airplane. This transformation included removing all the antisubmarine equipment and now the airplane was to be flown at much lighter weights and in a much more docile environment (no rocket runs, no bombing, and no 60 degree turns to return to datum.) Thus at the new low weights there was little chance that the airplane would be overstressed. Thus, there was thought to be little continued need for the g limiter.

On October 1964 ,there was a disaster at Vt-27 (training squadron 27 (in Corpus Christi Texas) One clear fall afternoon a S2a training plane pitched up, went vertical, then inverted and plummeted to the ground at mid field. I was an eye witness to this disaster and the crew were acquaintances .Two NAVCADS and their instructor were killed. This resulted in an investigation and a call for Patuxent River test pilots to again test the S2a model (the stubby trainer) and see why it pitched up. In two separate printed test flight results Patuxent River said that the elevator effectiveness in the tail was insufficient to overcome pitch up and the recommended additional authority be added to down elevator. This was never done. Also Patuxent River recommended that the G limiter be retained in the stubby version S2 presumably since it made it difficult to pull the airplane too nose high quickly. The year was 1966.

The S2a was getting old and the Navy retired them to the Desert at Davis Monthan Air Force base in Tucson, Arizona to presumably rot slowly to death in the government’s airplane graveyard. The trouble with good plans…invariably somebody comes along and [F…s] it up. Such was the case with the State of California.

Without malice and forethought, in fact without thought, some genius decided that these old stubby S2 airplanes would make a good tanker for fire fighting. The price was right since they were issue free. They took the birds and added fire retardant drop tanks. This made the airplane even heavier than maximum when it was used as a submarine chaser.

Since it was now civilian, they had to impress the F.A.A that the new tanker would be airworthy. They went to the United States Army to conduct test flights with it. The Army told the State of California that the airplane was barely-marginally satisfactory for its intended purpose. The Army told California that they should put in more nose down elevator authority because of pitch up tendency. California chose to ignore the advice. California was told by the army that the airplane had an unstable pitch up propensity. California was told that if a pilot were to drop his entire load at one drop the airplane would pitch up.

California told it's pilots that dropping a full load was a prohibited maneuver and the maximum drop was 1/2 load at a time. So much for pitch up. What California and it's Contract flying companies did not teach was.

1. The aerodynamics of pitch up phenomena.
2. That adding power would worsen pitch up
3. That lowering landing gear would help recover from pitch up.
4. That raising gear would pitch the aircraft up.
5. That reducing power would help recover from pitch up
6. That since the g limiter was removed it was easy to pull back stick too rapidly.
7. That pitch up actually disrupted airflow at the tail because of down wash.
8. That stick force per g lessened at the onset of pitch up regime.
9. That the Army test pilots found the airplane marginally acceptable as a tanker.
10. That the Army suggested the need for more down elevator to combat pitch up
11. That the Navy in 1966 said the airplane would pitch up.
12. That the Navy in 1966 said it needed more nose down capability
13 That the Navy said in 1966 that the G limiter should not be removed.

There is no pilot flying for the State of California that had ever experienced a actual pitch up maneuver in an S2 that has progressed into tail washout and then recovered as part of any training program provided by the state. There is no known survivor of a real pitch up to tail washout during a firefighting mission for the State of California.

The State of California knew so little about its own airplanes that they label an airplane exhibiting all the traits of pitch up as pilot error accelerated

stall. Even their own flight manual describes S2 stalls as the nose falling through and down. There is no stall in an S2 where the nose pushes up.

Several California Tanker Pilots died in similar accidents. Still today the California Forestry Service in Sacramento remains tight lipped in its decisions. These politicians did not know or care about S2a aerodynamics or performance. This may have been a case of supervisory error. Even as the aircraft is thankfully retired from service they aren't admitting the mistake. They'll tell you that there are better airplanes available, and you know what for once they're right.

DOUBLE ENGINE FAILURE

The United States Navy and Grumman of Bethpage Long Island, well before World War II decided that they were going to be in the coastal patrol business by launching a seaplane line of aircraft named for waterfowl. The Grumman Goose was a 1937 vintage craft powered by air cooled radial engines rated at 450 shp. Three hundred fifty were built –Sixty five fly today.

The United States Navy used them for Anti submarine coastal patrol during WWII. The United States Navy had been warned by Grumman Aircraft to never ever never leave the aircraft in a fuel cross feed condition when fuel state was low. They warned that at such low fuel state the left engine should use left fuel tank fuel and the right engine should use left fuel tank fuel. Both engines should not be feeding from a single tank and the aircraft should not be cross feeding fuel. Grumman warned that at such low fuel state both engines could fail due to cavitations similar to vapor lock. Grumman knew that the expectation of double engine failure would be increased even further if the fuel pumps on each side were putting out differing fuel pressures.

Research showed that after the war these birds were surplus and many were bought cheaply and converted to civilian Passenger use. Naturally when the CAB, the forerunner to FAA, approved the aircraft for civilian use a new civilian flight manual was issued. Apparently in writing the new Manual the old was not consulted. Instead the new Manual recommended running the system in fuel cross feed at low fuel state. The thought was this would allow both engines to continue operating until all fuel was used up. In fact running fuel in cross feed at low fuel state is a common and safe airline practice for many aircraft.

One such airplane was purchased by Antilles airboats that ran a scheduled operation in the Caribbean islands. On this particular hot day, a pilot chose to follow procedure and utilize cross feed as his fuel stat became low. He was at about the ¼ fuel remaining level when he found himself flying an aircraft with two failed engines. He attempted several restarts unsuccessfully.

In the glide into a hostile sea state with sufficient waves to break the aircraft on impact the pilot yelled for the passengers to prepare for ditching

September 2, 1978, an Antilles airboat airlines aircraft crash-landed into the Caribbean while on a flight from an Island to St Thomas. The plane crashed into the ocean, broke apart and sank due to double engine failure. Some passengers were killed, and other passengers were severely injured, some ravaged by sharks

On reconstruction my law partner (a former NASA pilot) and I rented a Grumman Goose for ground tests and with help from a NASA scientist we replicated a double engine failure by running low fuel state in Cross feed. We had rigged temperature sensing in the cross feed lines and sure enough, we got the equivalent of vapor lock, killing both engines. Later we asked the owner to try it airborne and he reported he ended up dead sticking the machine into Lake Ponchatrain

It turns out the Grumman 1938 flight manual was correct and the later civilian version of an approved flight manual was devoid of the critical warning

ANOTHER LESSON NOT LEARNED. The product was 40 years old when the accident happened and still the product was defective under a Prosser 402a reading. It is said that this case was used to argue that a statute of repose was needed.

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NORTHWEST 255 and SPANAIR 2055

There is no problem so complex that it cannot simply be blamed on the pilot.

— Dr Earl Weiner

NWA 255 a MD-82, in August 1987 at Detroit, Michigan crashed on takeoff, killing 155, because the flaps were not set to a takeoff position. The warning horn failed to activate. This same accident reoccurred 20 years later WHY?

Spanair 2055 crashed on takeoff in August 2008 at Madrid Spain. It was an MD-83, that crashed, killing 156, because the flaps were not set to a takeoff position. The warning horn once again failed to activate .This same accident occurred 20 years earlier –WHY?

The honorable Jim Burnett was NTSB chairmen for the NWA 255 investigation

His report pinpointed the fact that the Take off warning system was susceptible to a single point failure in several design aspects including a R2-5 relay and in a power circuit breaker. In this accident, they did not fault R2-5 relay, but focused on the circuit breaker associated with that singular circuitry. The pilots had simply forgotten to lower the flaps for take off.

In Spanair the pilots forgot to run the checklist correctly and forgot to lower the flaps. This time the CIAC in an interim report has pinpointed the Alarm system failure as being caused by the R2-5 relay switch. The pilots had simply forgotten to lower the flaps for Take off.

The questions still to be answered is whose fault was it that the airline twenty years later had not received a temporary recommended procedural checklist fix issued on September 1, 1987 by McDonnell Douglas. (a procedure where the Take off warning was to be tested every flight rather than once a day.) It is noteworthy that the Spanair aircraft was not manufactured until 1993. It is also noteworthy that Spanair was not a airline in 1993. Boeing had acquired McDonnell Douglas in the time frame after the first accident. Whether the change in ownership is a factor is not known at this time. What is known is that nothing was done to fix the aircrafts single point failure potential. What else is known is that Spanair never received the warning of September 1.1987, nor did they obtain checklist procedures wherein they would check the take off Warning System every flight

A further question to be answered is why did the manufacturer, once armed with several notices of defects (NOD)s and R2-5 relay failures, did it not fix the critical take off warning system. A pilot dies with his mistake. A pilot has a short period of time to recognize and correct errors before they become fatal. In this case, the manufacturers and operators of this MD-80 series equipment had twenty years to fix something learned in a tragic accident two decades earlier.

LESSONS NOT LEARNED

> *The high level of safety achieved in scheduled airline operations lately should not obscure the fact that most of the accidents that occurred could have been prevented. This suggests that in many instances, the safety measures already in place may have been inadequate, circumvented or ignored.*

— International Civil Aviation Organization, 'Accident Prevention Manual, 1984

A 757 was cleared to fly an instrument approach to a particular Columbian city. The pilot and co pilot were only marginally familiar with the

particular approach which was changed at the last minute from what was regularly flown. The instrument procedure required the pilots to rely on a onboard Flight Management display system which was a little like a computerized map quest where the pilot would be supposed to load a certain route into the computer so as to get an appropriate map display.

What the pilot did not comprehend and catch was that at this airport he was cleared to fly a ROZO one approach and then was cleared to fly direct Rozo (a Low frequency LF radio navigation facility) and thence fly the remainder of the approach as printed

In the United States –it was standard to have the low frequency radio be annotated with a single letter…thus Rozo would be signified by letter R. The pilot in his haste to find the new route reverted to his training and inserted R into the computer and in his haste failed to read the print out distance which should have been about 15 miles.

The R he inserted was for a airport 154 miles away and 90 degrees off course. The aircraft turned the wrong way and ran into a mountain..

The United states had made the rules standard through out the USA that an NDB would be a single letter. The pilot inserting the numbers had only recently become an International pilot and may not have been trained that in International flying the International insert would be that shown on the approach plate .In this case R-O-Z-O.

It was a single mistake that initiated a sequence of events that turned fatal….After the accident all International pilots were reminded of this difference during recurrent training

A Lesson not Learned

AIRCRAFT CABIN FIRES

The FAA had rules about interiors of airliners-Ergo if an interior caught fire it should self extinguish if the heat source was removed-The materials were resistant or retardant in nature. It is a fact since WWI that the aircraft design engineers recognized that airborne fires had serious consequence potentials. The private planes such as Cessna 172 in 1970 had no such rules. A Cessna caught fire and burned in two minutes killing the pilot and causing bad burns to his wife who survived a crash landing.

THE NTSB only concerned itself with why the plane ignited –Due to maintenance error pliers shorted out a battery lead. They failed to ask why did the fire spread so fast , All aircraft manufacturers at the time the Cessna 172 was built knew of the existence of less flammable materials for use in aircraft interiors.

The fix costs 98 cent a lb as additive to plastic moldings- Same with internal rugs. Now general aviation aircraft come equipped with more fire retardant interiors

Fuel air Vapor ignitions (explosions)

On or before 1970 the U.S, Air Force had several explosions and fuselage fuel tank fires because tanks were devoid of fuel or almost empty and boost pumps were running. The air Force cited several possible ignition sources and concluded the safe way to run the tanks was with several inches of fuel, thus all of the ignition sources would be covered.

More than twenty years later the US Air Force in 1989 forgot the lesson and again blew up another B-52 by allowing a boost pump to run in an empty tank while doing touch and go landings. The Air Force again upped the amount of fuel required to remain in tank bottoms.

It is noteworthy that in 1996 TWA 800 had an empty but vapor laden tank explode-TWA did not keep a fuel reserve-Rather their procedure was to run 747 tanks dry. It is also noteworthy that the center tank Of TWA had only a few gallons in it when the engineer started a scavenge pump to remove that fuel. Seconds later that tank exploded.

> *The National Transportation Safety Board determines that the probable cause of the TWA flight 800 accident was an explosion of the center wing fuel tank (CWT), resulting from ignition of the flammable fuel/air mixture in the tank. The source of ignition energy for the explosion could not be determined with certainty, but, of the sources evaluated by the investigation, the most likely was a short circuit outside of the CWT that allowed excessive voltage to enter it through electrical wiring associated with the fuel quantity indication system.*
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> *Contributing factors to the accident were the design and certification concept that fuel tank explosions could be prevented solely by precluding all ignition sources and the design and certification of the Boeing 747 with heat sources located beneath the CWT with no means to reduce the heat transferred into the CWT or to render the fuel vapor in the tank nonflammable.*
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> *The safety issues in this report focus on fuel tank flammability, fuel tank ignition sources, design and certification standards, and the maintenance* and aging of aircraft systems

Source NTSB Probable Cause report TWA 800

Surprisingly it appears Boeing Military Aircraft Company was not in contact with the Boeing civilian company, The KI sawyer aircraft accident findings and litigation evidence were readily available 6 years before TWA 800. More over wire bundle chaffing and crosstalk was a well documented phenomena as well. Which ever scenario you chose to believe there is a lesson not heeded.

The FBI agent in Charge was been quoted in *'The Wall Street Journal,' 22 July 1996* concerning probable cause potentials in the TWA 800 crash. "I think the least likely thing . . . is mechanical. I mean, that's just common sense." Statements like that show incredible bias or worse incredible ignorance of investigative forensics to be used in aircraft investigations. He, more than others, should wait until the evidence is gathered before announcing a causal opinion. It is appropriate for a Talking Head to opine but certainly not the FBI investigator in Charge who was vested with governmental authority.

LESSONS NOT LEARNED

Most airlines changed procedures and now leave fuel in the tanks such that electrical fuel gauges, and fuel pumps remain submerges cooled and incapable of sparking.

A-6 Wing fatigue

The venerable A6 Intruder aircraft was a day or night all weather attack aircraft that was designed by Grumman Ironworks Bethpage Long Island, New York, in the early 1960s for use in the Vietnam War. Thereafter, it was the most proficient night all weather ordinance delivery system in the world. It was so good in fact that the navy kept extending its life because no other aircraft could do the job as proficiently. The problem was the metal in the wings were fatiguing and the Navy used an onboard G counter to decide when aircraft would need visual and NDI inspections and repair or even wing replacements. The aircraft was ageing and yet it was needed in the fleet.

Then the manufacturer's gurus approached the navy with a novel concept. They convinced the Navy that after the long fleet history of the aircraft that there was no need to count actual g forces sustained by the individual aircraft. Rather individual over G limit flights would warrant checks but for all routine fleet use flights the numbers of gs' sustained over time was predictable and if averaged would suffice. This in turn would save mechanics time and Navy Money.

The new plan was put in force using Fleet g averages. What the slide rule jock safety engineers did not figure out the flaw in their program. They forgot all about the shore based training unit aircraft.(RAG replacement Air Group) They either totally forgot about them or they made the wrong

assumption in believing that carrier shipboard landings would always result in harder landings and a faster build up of high g usage. They thought fleet pilots subjected the aircraft to more strenuous flights than din Nuggets back in training.

That flawed engineering assumption killed intruder aviators. The G's were building up much faster in training aircraft than fleet birds. The boys at the Training command were teaching everyday the very high g maneuvers so neophyte "Nugget" aviators would know all aspects and the design limits they could fly to. Out in the fleet they flew milder missions with far fewer Gs being pulled. After two funerals it was also admitted that the nugget trainees were far more likely to overstress an Intruder than his experienced fleet counterpart

Truth was readily known that training command aircraft in replacement groups are subjected to more gs, more often than fleet birds. In fact that difference had always been well documented. It was the boys in the Washington Systems command who flew slide rules instead of aircraft who once again mucked things up. They had the data, they simply did not apply lessons learned and documented.

JUST CUZ THEY SAY IT IS SO – DON'T MAKE IT SO.

The fundamental problem is government people—pointy-headed bureaucrats—telling people what to do. There is an environment in this city (Washington DC) of people unwilling to admit their mistakes and move ahead. The attitude toward rule-making has been so curtailed that common sense recommendations now take years and years.

—James Hall, NTSB, 1996.

The government in the form of the FAA regulates our industry, and it is tasked to promote safety. For the most part they do a good job. However, they are a massive administration and massive anything's are bulky and slow moving. Just because they say it is safe, don't make it safe.

Revisit the Delta Airline 191 crash for a second as well as the earlier Eastern JFK disaster. The FAA at that time said fly-landing speed (bug plus 5 knots) was adequate excess speed. Subsequent to Eastern JFK wind shear crash a Wind shear Symposium was sponsored by ALPA and the industry. A BOEING 727 test pilot said about wind shear.

"Don't get in it, but if you do the best way out is to fly at a speed flaps fifteen +15kts for energy, while at landing configuration." This would amount to about flaps 30 plus a whole lot of margin. He stated his opinion was off the record since FAA and ALPA as well as your company then had different dangerous plus 5 procedures.

Now they have gotten around to saying reference speed plus ½ the gust speed plus all the wind up to 20 kts. I say add what is needed for safety and if you Don't like it get the heck out of Dodge.

Years earlier, when Ops. bosses were Line pilot professionals, Chief Pilot Glenn Sage said to a group of Houston pilots complaining about the FAA bug plus 5 ruling. " I can defend you for running off the end of a runway at 25 kts. I can bury you if you hit ¼ mile short in wind shear."

The answer is simple and easy to understand. If you know about it in advance get the hell out of there. If you get into wind shear assume it will get worse and therefore initiate wind shear go around early. If you really get into it follow the printed wind shear procedures, it is the best chance for survival. Kinetic energy preservation is a chance to live.

Just because the guy in front of you made it do not assume you will. A Thunderstorm is so dynamic and changing, especially the kind with micro bursts that all bets are off in such instability. Here again, if you had a lot of fuel you would have more options.

Everything your company has told you about creating time for decision-making is fuel dependent. If you have fuel you are in no hurry. So what if you safely request holding away from the storm? Who's to worry about that? Making schedule is manifestly unimportant when weighed against safety issues. Besides you and the rest of the crew get paid by the minute! Not only is the FAA a cumbersome and slow. Most of its employees are not qualified to fly their desk let alone an airplane. So remember the FAA guy who made the rules is not going to get hurt unless he pours hot coffee on himself or falls out of his chair. His rules can kill you. Delta 191 was working feverishly to maintain bug plus 5knots airspeed. That FAA generated fallacy helped kill the airplane.

IX
About the Author:

Capt M.P.Pappy Papadakis was a first tour Navy carrier pilot and a second tour R and D test pilot. He became employed as an airline pilot January 1970. He is type rated in 737, 727, 757, 767, L1011 and 767 -400. He has flown 23,000

hours. He has investigated, evaluated or litigated over 400 aircraft accidents. He is a Fellow of the International Society of Air Safety Investigators. He is a Trial Lawyer and former chair of the A.T.L.A. and State Bar of Texas Aviation Sections. He did ALPA safety work for twenty years. (1972-1992). He has authored two books. " Air Crash Accident Reconstruction and Litigation", McCormick and Papadakis, Land J, 1996,1998. and " Civil Trial Practice, Winning Trial Techniques, Papadakis, Land J, 2000"He is an Independent consulting Attorney and Of Counsel for the Brent Coon Law Firm whose aviation litigation Department is located in Houston Texas.

SAYINGS THAT MAKE AVIATION SAFETY SENSE

- Just cuz the government tells you so, Don't make it true.
- Take offs are optional - Landings are mandatory.
- "I'd rather die than look bad"… will kill you.
- The obvious is usually wrong.
- Doing it correct is better than having to explain it later.
- If you Don't know get help.
- When you ask a question, listen to the answer.
- They can be wrong, but so can you.
- The place for a fight is on the ground.
- Look at the whole herd before you chose a horse to ride.
- It is better to learn from the mistakes of others.
- Aluminum snowstorms are bad.
- From my vantage point in the cockpit, what seems acceptable risk to others appears very unacceptable to me.
- Remember… the lowest bidder built this airplane.
- Studying electro-static discharge is far better in a lab than in a thunderstorm.
- Take my word for it, go around thunderstorms.
- Let somebody else be the pathfinder.
- I can hardly remember the last time I was paid to be a test pilot.
- In the Northern Hemisphere why do navy pilots say it is better to always fly west of big thunderstorms in the morning and east of them in the afternoon? …It keeps the sun out of your eyes.
- Your jet airplane will only make a very small dent in the back of the ship. Never be low
- Gravity never loses.
- When they say hurry up, it is the time to slow down.
- The FAA is the dog… you are the fire hydrant.
- Keep the blue on top.
- Fly over mountains not through them.
- Keep take-offs and landings in one to one ratio.

- Never get low Never get slow
- Pilots always arrive at the scene of the accident first.
  Lawyers second.
-
- High is a bolter…low is scrap metal
- If you F---- up, lawyers will grade your papers.
- Speed is life. Altitude is life insurance.
- It only takes two things to fly: airspeed, and money
- New FAA motto: "We're not happy, till you're not happy."
- If something hasn't broken on your helicopter--it's about to.

- The similarity between air traffic controllers and pilots?
  If a pilot screws up, the pilot dies.
  If ATC screws up, the pilot dies.

Basic Flying Rules:
1. Try to stay in the middle of the air.
2. Do not go near the edges of it.
3. The edges of the air can be recognized by the appearance of ground, buildings, sea, trees and interstellar space. It is much more difficult to fly in the edges.

Unknown Navy Carrier landing signal officer to carrier pilot after several unsuccessful landing attempts: "You've got to land here son. This is where the food is."

If you fly don't stall
If you stall don't spin
If you spin don't crash
If you crash don't burn
Keep Pensacola Green