Swissair Flight 111, MD-11 at Halifax

Flight 111 was en-route from New York to Geneva when it crashed into the Atlantic Ocean near Halifax, Nova Scotia on 2nd Sept 1998 - with the loss of all 229 lives.

Swissair111

How long do you have? In this case 16 minutes after the crew became aware of smoke in the cockpit, the aircraft crashed into the sea 8 km south west of Peggy's Cove.

The localised high heat source was later identified as coming from a source above the cockpit door. The sheepskin seat covers of both the observers and F/O's seat were later recovered and found to contain drops of melted plastic embedded in them.

Summary

Swissair 111 emergency arose swiftly

Washington (Reuters) - Eleven minutes before Swissair Flight 111 crashed off the coast of Nova Scotia, killing all 229 people aboard, flight attendants were serving dinner and the pilots still believed they could land safely, ABC News reported Wednesday.

Already wearing oxygen masks by this point, the cockpit crew began running through an emergency checklist to determine where the smoke filling their cockpit was coming from, ABC said in a report based on the plane's voice and data recorders.

The first step was to turn off all but the emergency lights in the cabin. Flight attendants were then told to use flashlights to pick up empty meal trays.

One attendant announced that the plane would land in Halifax, Nova Scotia, in 20 to 25 minutes, and the passengers remained relatively calm, ABC reported. But up front something was very wrong...

In the cockpit six minutes before the crash, both pilot Urs Zimmerman and co-pilot Stefan Loew scrambled for the radio to declare an emergency and say they needed to land immediately, ABC said.

The data recorder then picked up problems with a flight control computer and other systems. Within 30 seconds, the co-pilot reported that he had lost all his main instruments.

Seconds later, both data and voice recorders stopped working, and there was no further communication with air traffic control. Six minutes later, the plane hit the water.

Information gleaned from the recorders suggests that an electrical problem in the overhead panel of the cockpit may have been the source of the problem.

The pilots had smelled smoke about 20 minutes before the crash, but the co-pilot appeared to find nothing amiss when he checked the electronics bay under the cockpit, saying there was nothing ``down'' where he looked.

At that point, a flight attendant told the crew she could smell smoke from the cockpit but not the cabin, ABC reported.

It said the flight data recorder showed no indication of fire from the engines or cargo holds.

Within three minutes of smelling something, the captain indicated on the recorder that he could definitely see smoke in the cockpit, and the first distress call requesting a landing was made a minute later.

Press reports last week said investigators studying the wreckage of the flight had found pieces of a type of thermal and sound insulation implicated in at least four airline fires. The insulation was probably used in the electronics bay and other areas where heat could be a problem.

Investigators believe that heat and possibly flames spread through portions of the cockpit and the front part of the cabin.

They have found ``heat-distressed'' wreckage from the cockpit and the forward cabin interior.

Smell Smoke? Land Fast

In the wake of the Swissair crash, the two largest operators of MD-11s in the U.S. are instructing pilots to land quickly if they smell smoke or encounter major electrical problems. Delta and FedEx have put out the word to "land now, troubleshoot later." The FAA has urged since 1980 that pilots smelling smoke should get on the ground ASAP... AvFlash

Questions about Insulation

but no Evidence

Swissair has confirmed that insulation which played a role in fires on four other jets was installed on the Flight 111 MD-11. Although metallised Mylar insulation is FAA approved, McDonnell-Douglas recommended last year that it be replaced with a more fire-retardant type at "the earliest possible maintenance period." No evidence has been found so far that the insulation contributed to the crash. Meanwhile, FAA Administrator Jane Garvey wondered why the Mylar meets her agency's requirements while the manufacturer suggests it be removed. Jim Foot, a lead investigator, is also not moved by early blame heaped on Kapton wiring insulation. "We have to deal with facts. You can run off at the mouth all you like about this or that, but if you don't have the facts, it doesn't mean anything."

Airlines request Insulation Briefing

Washington, Oct. 15, 1998
The Air Transport Association (ATA) has requested an immediate briefing from the Federal Aviation Administration (FAA) on the technical details of their call to replace insulation on much of the world's commercial aircraft fleet.

"The FAA has determined that existing FAA test criteria for insulation is inadequate ... at the same time, the FAA has told the press that insulation in virtually all of the world's 12,000 passenger jets will have to be replaced," wrote ATA President Carol B. Hallett in a letter to FAA Administrator Jane Garvey. "We are anxious to review the FAA's data on both Mylar, foam and other forms of insulation, since this will assist us in addressing this issue in an expeditious and thorough fashion."

FAA cracks down on Wiring again

Two years after the crash of TWA Flight 800, the fallout continues. NTSB investigators believe the Boeing 747's centre fuel tank may have exploded due to electrical sparking. Boeing disputes that, saying the wiring has not been conclusively linked to the crash. Despite Boeing's arguments, the FAA last week ordered airlines to retrofit hundreds of Boeing 747s with shielded wiring around fuel tanks and cabin switches. In a separate order, the FAA gave airlines 60 days to inspect wiring around the fuel tanks of many Boeing 737s.

The latest Swissair disaster has made me realise again that nowadays, the only real nightmare scenario for the modern airliner is a smoked-filled cockpit with zero visibility in a pressurised environment!

It is therefore perhaps a good time - and this is also the right in-house forum - to start a discussion on procedures or additional simulator training to come up with a drill that will make it possible for us to "see again" in such a situation.

Many, many years ago, I had a Volkswagen Beatle. I had jerry-rigged a cassette player under the dashboard. Doing 120km per hour in the left lane on the German autobahn, my "hi-fi system" caught fire, and within seconds the car filled with heavy smoke. I could not see a thing, which made my emergency stop on the right hand shoulder very exciting, and that was with four wheels on the ground, and a straight autobahn ahead of me!

If you just think about it, a number of the more recent fire situations on commercial airlines (Turkish Airlines/Valuejet) have been initially caused by ignorant cargo or malfunctions of small electrical components, with disastrous results.

Just try to imagine, you are cruising at 39,000 feet, completely relaxed, and suddenly and in a time frame of only minutes, you are engulfed in smoke, trying to get your oxygen mask on, trying to establish communications, and get some sort of checklist going, and above all keeping the blue side up, and all of this while you cannot see a thing. Just close your eyes (I am very good at that part!), try to imagine yourself in this situation, and think about what you would do next. I am sure that we all have our own ideas on this matter, and perhaps even steps that we would follow, so let's talk about it.

Capt Ruud van der Zwaal

I feel very much for this Swissair crew... one of the toughest things in this business is "breaking out" of routine. We are so trained/conditioned to comply/obey SOP's and ATC etc... that when this pressure is combined with the natural inhibition of not wanting to do anything which will later be criticised in an inquiry as un-necessary... then we are subject to immense pressure to hang on to routine as long as possible. In the case of fire or sabotage, this maybe too long!

DC3 Fire that killed singer Ricky Nelson

Having read through most of the posts regarding in-flight fire I need to add my observation from experience. I was the co-pilot of DC-3 N-711Y which was owned by singer Ricky Nelson and I was the only one on the flight deck when the fire that killed him and his band broke out. Three main points to make. One, when the cockpit fills with smoke so dense you can not see the instrument panel or outside the airplane it is impossible to use the check list. Two, none of the items on our check list addressed the situation that we found ourselves in. Three, use of oxygen from plastic diluter demand masks in the presence of hot corrosive smoke and open flame is incredibly stupid. The answer to our situation (in so far as there was any answer) was simple. Get the airplane on the ground in one piece before it burns itself out of the sky (and before the crew passes out). Nothing else matters or is in fact possible. Using hand held fire

extinguishers would have been pointless as the fire was under the floor. And, the time needed to pursue this had it been feasible would have detracted from our ability to get the airplane on the ground. On opening the side windows, it fans the flames no doubt about it. But it is the only way to see to get the airplane down, and the only way to keep the crew from suffocating. Matter of priorities. The landing was accomplished after most of the fabric had already burned off the elevator surfaces, and we were setting fire to fields we over flew by dropping molten metal in them. The best estimate of the NTSB investigators I spoke with was we had perhaps 45 seconds of controlled flight left available to us.

There is much more to the story than this but some of the things I took from this experience are that our training for these situations is made up by ground bound people who have no experience in dealing with problems in flight.

It is most often make pretend training to give the impression of addressing some imagined situation. Use of written check lists in the midst of a desperate emergency is impossible and often pointless, (it doesn't address your situation).

Use of oxygen may be deadly rather than helpful (it would have killed us, my David Clarks melted into my left ear). Total loss of visibility is never addressed in training and yet is almost inevitable with a fuselage or cabin fire. Fact is, total loss of visibility makes the airplane un-flyable, how do you train for that? Also picking a "suitable" landing site is a pipe dream. You put it down on the first flat place you find and hope it will fit (in our case it did). Seeing to the passengers safety or comfort is impossible, their only safety lies in getting the airplane down in one piece. There is more, but the idea should be clear.

Kenneth R. Ferguson.
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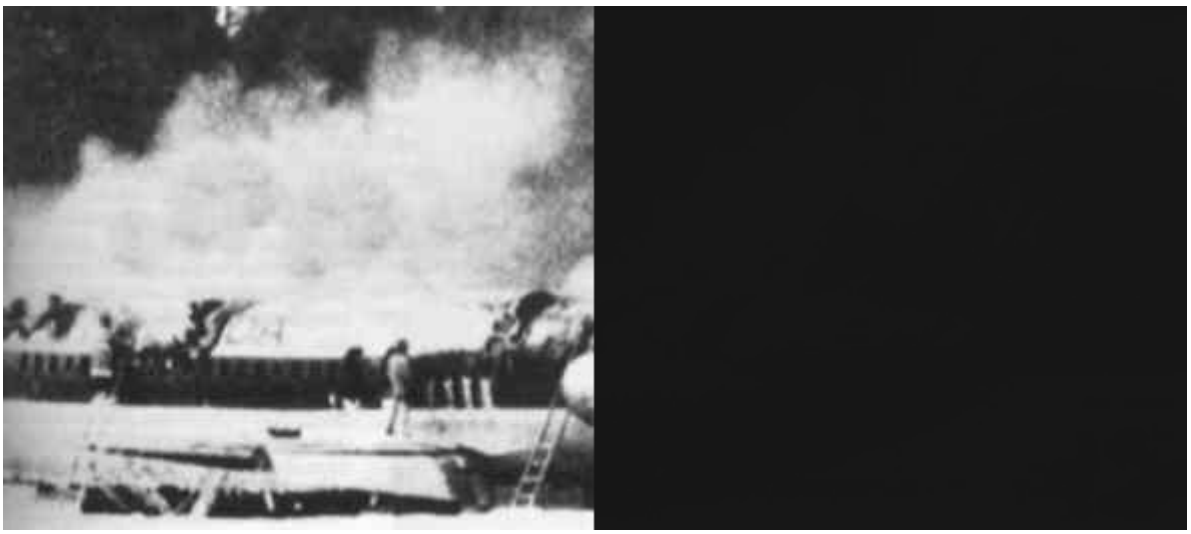
Fire in the Rear Toilet
Air Canada Flight 797
Greater Cincinnati, June 2nd 1983

Air Canada Flight 797



Air Canada Flight 797

Air Canada 797 had 41 passengers on board on a flight from Dallas to Toronto and through to Montreal. The rear toilet fire occurred on the cruise at FL 330, just south of greater Cincinnati Airport.

At time 18:51 three snapping sounds occurred... three circuit breakers had tripped for the left hand toilet flushing motor. The Captain tried to reset the circuit breakers. Subsequently he tried twice more - but the circuit breakers would not reset (note: SOP's provide for only one attempted reset).

Smoke was soon discovered in the rear toilet. The Flight Attendant advised the Captain - and the first officer went back to inspect the problem. The Captain put on his oxygen mask.

In the real toilets the crew found no visible flames - but thick black smoke was present.

The flight attendant fired a CO2 fire bottle into the toilet - although the First Officer could not gain access to the toilet because he did not have his smoke goggles with him. The flight attendant then reported to the Captain that the smoke was subsiding.

Between 19:05 and 19:07 the cockpit master caution warning went off. The left and right AC + DC buses failed. About the same time the F/O came back to the cockpit and also reported that: "its getting much better" This report caused the captain to delay his descent! Then the emergency bus failed along with the cockpit voice recorder and flight data recorder - while still at FL 330.

Seventeen minutes after the first circuit breaker popped at 19:08 the Captain declared "Mayday" and began a rapid descent. This was five and a half minutes from the first advice of fire by the F/A. This proved to be a critical time lapse.

The aircraft squawked 7700 but the transponder was also not working due to bus failure. During the descent smoke came into the cockpit - as the cockpit door was open.

The weather at Cincinnati airport was reported scattered cloud at 2,500 ft, broken at 8000, with 12 miles visibility and light rain.

At 8,000 ft. on descent the emergency inverter and emergency DC buses failed. From this point on, the only flight instruments available were the standby AI and the ASI. The stab trim had also been lost due loss of electrical power.

The aircraft was still in solid cloud at 3,500 ft - with only two basic flight instruments... and black smoke coming into the cockpit.

The cockpit smoke was getting strong. The First Officer opened his side sliding window to clear smoke - but had to close it again due to the noise. He subsequently tried this a few more times.

Perspiration was fogging the Captain's smoke goggles and he had to keep lifting them to clear his vision. The stab trim was inoperative. There was pitch darkness it the smoke-filled cabin.

The First Officer was instructed at 3000 ft to make sure the cabin was depressurised for landing ~ however he also turned off the aircon packs. This was not a good move... as it stopped the flow of fresh air into the cabin.

Visibility was now zero in the passenger, cabin due to the heavy black smoke.

At 19:15 the aircraft was level at 2500 ft. The Captain had trouble seeing his instruments - but he later commented: "We were steered to the airport by the most capable controller I have ever heard".

With very little instrumentation and extreme conditions, the Captain made an excellent landing on the runway.

After shutdown the pilots could not get back into the cabin due to a thick wall of black smoke. Both pilots then had to leave the aircraft by the cockpit sliding windows - the First Officer first followed later by the Captain.

The cabin crew's efforts in supplying many passengers with wet towels was instrumental in keeping people alive.

After landing the cabin crew opened both forward doors and popped the slides. Passengers opened 3 of the 4 over wing exits. However the smoke was so dense many passengers couldn't find the exits.

As soon as the doors and windows opened, oxygen made the smoke much worse, and within 60 to 90 seconds there was a flash fire in the cabin.

At the last moment the flight attendants' exited the aircraft using the forward slides.

Six minutes after landing it was realised that 23 of the 41 passengers were dead - mostly still sitting in their seats. The entire interior of the passenger cabin was gutted by fire.

There was still 5,500 kilos of fuel remaining on board which did not ignite.

Fire source

Fire from the toilet went upwards into the gap between the lining and roof. It may have been started by a cigarette dropping into an area in the toilet where there was discarded paper. The exact source could not be determined in the investigation report.

The Halon fire extinguish in the toilet had fired - but it did not retard the fire.

Timing

18:51 Rear Toilet c/b's trip

19:03 +12 F/A first advises cockpit of fire in the toilet.

19:05 +14 Master Caution: Loss of L & R AC + DC.

19:06 +15 First report of an electrical problem to ATC.

19:08 +17 "Mayday" and Rapid Descent commenced.

19:15 +24 2,500 level in the circuit.

19:20 +29 Approx. touchdown time.

60 to 90 secs after doors opened - flash fire in the cabin!

Note on the time between 19:03 and 19:08
The Captain delayed initiation of descent because of the two reports that the situation was improving. In fact the fire was out of control... feeding out of the aircraft through the toilet service panel and also up into the ceiling loft, between the cabin lining and the fuselage skin.

This underestimation of the seriousness of the fire, as relayed to the Captain, caused a 5 min delay in the activation of rapid descent.

The accident investigators later determined that this time delay was a critical factor between life and death - for those unable to exit the aircraft in time.

Credit:
This report is a brief overview taken from "Air Disaster" Chapter 9, by Mac Job. Aerospace Publications Volume 1, ISBN 1 87561 196 (Australia).

Brief Reports

Fumes in a DC9 cockpit

This was at night with cockpit lights progressively going out and an acrid odour coming into the cockpit... it's a pretty unpleasant experience. In this case I was able to isolate the ignition source by tripping the correct c/b's in time. However the fumes continued

for quite some time after this due to smouldering wire looms. We realised that fire source troubleshooting can be a real problem if the fire reaches self sustaining temperatures before the ignition source is isolated.

This raises Sim training questions such as with the Avionics Smoke drill... If you shed one side of the electrics, how long do you wait to determine if you have killed the ignition source? What if there are wire looms still smouldering after the ignition is removed?

In the Sim we may not have the benefit of synthesised smoke and if we do, we are normally told when the actions are successful etc? This presents quite a challenge for realism.

(See Air Canada 797 report above).

Captain Peter Kentley

Studies of in-flight fires by British Govt.

Air accident investigators have concluded that there is a tremendous lag in appreciation by air crews of the danger of smoke in the cockpit.

British investigators found that crews often believe they have the situation under control only to find later that they have a fire which increases exponentially in minutes with catastrophic results.

B747 Fire and Ditching near Mauritius

At the end of 1987, I was waiting to take over from an incoming crew in Mauritius. They were flying an SAA 747 Combi from Taipei loaded with freight & passengers. NINE hours after leaving Taipei they called Mauritius declaring they had smoke in the cockpit and asking for an emergency descent to 14000'. (sound familiar?)

I rushed to the tower to see if I could be of assistance - the last we heard from Captain Dawie UYs was when he read back the QNH 12 mins after his first transmission.

Later after pulling the wreckage from 3,000 meters of water and re-constructing it in a hanger, the investigation authorities discovered the fire had originated in the cargo hold.

Why am I telling you this? Because we did an extensive investigation after this tragedy to resolve problems of smoke and fires in aircraft. Something important came out of that research: HISTORICALLY, If you have a cabin or cargo fire and aren't able to

extinguish it within TWO MINUTES from it's start time you WILL NOT BE ABLE TO EXTINGUISH IT.

Further, if you have an inextinguishable fire you have historically, ONLY between 4 & 14 minutes to land/ditch & evacuate - if you fail to do this IN THIS TIME FRAME the fire will have destroyed the aircraft. The SAA combi lasted 12 minutes.

Apparently the Swiss Air flight disappeared from radar also within that time frame. ICAO, FAA & other records show that all A/C that were lost to fires in the cabin succumbed within this time frame. SO - WHAT DOES THIS MEAN TO US ?

In my opinion we should take the first item on our checklist "LAND AS SOON AS POSSIBLE" VERY VERY SERIOUSLY. If we have not found the source of the smoke and extinguished it within TWO MINUTES, I would not worry about dumping fuel unless I could do it without wasting one second. I would probably leave any outstanding/ongoing checklists to my F/O while I concentrated on finding the most suitable emergency place to land - attempting to do so within 15 minutes of the first smoke/fire warning.

Aircraft manufactures and the airline industry should in addition ensure that their smoke/fire checklists are AS SIMPLE AS POSSIBLE, (besides ensuring adequate legislation/training/fire detection/protection etc are as up to date & efficient as humanly possible). Our associations world wide should continue to pressure these organisations to conduct extensive research into this problem so the future of our industry and the human lives involved are absolutely protected.

Capt. Tony Snelgar

Smoke in an F27 - Twice!

With regard to on board fires. In December 1971 on start up at Tindal in an F27 (Australia - Northern Territory). As we hit the starter button to start the first engine there was a noise of electrical sparking and a fire started at the first officer's feet. It was extinguished using the cockpit fire extinguisher. The aircraft was then totally dead electrically. It turned out that the connection on the battery, which was just above the first officer's feet, was loose. When we tried to start the engine the loose copper end fitting on the wire melted, and the burning molten copper fell at the first officer's feet. In their wisdom the company decided that the connection had been loose since the manufacture of the aircraft as it was fairly new at the time.

(This happened again to a B767 on 28 May 1996, when all EFIS and Flaps were lost - Ed).

In July 1974 between CBR and SYD in an F27 we had smoke in the cockpit coming from an indeterminate source. It got to the stage that we had to put on the oxygen masks. The TAA F27 did not have smoke goggles. We could barely see due to the

smoke affecting our eyes. (Smoke goggles were fitted to TAA F27's as a result of this incident). On the assumption that fire needs oxygen I elected to depressurise and try to reduce the oxygen available to whatever was burning.

As we did so there was a big POOOF and the cockpit was suddenly full of burning embers. The uniforms of both myself and the first officer were peppered with small holes from the embers.

You may remember that I raised the subject of the flammability of our uniform material at a Tech Council meeting after this one. It turned out that the aircraft had had a cabin blower changed a month before. A rag was put into the cabin blower mounting to keep it clean while the blower was off, and was not removed before re-installation. Over time the rag found it's way to the cockpit foot warmer, which is nothing more than an electric radiator bar installed into the cockpit air vent ducting. Being cold, the first officer put on the pilot's foot warmer. The rag started to smoulder creating our smoke. We couldn't tell where it was coming from because it was from the vents - which were out of sight. When we depressurised it was enough to eject the burning embers into the cockpit. Lots of fun for a while and the aircraft smelt of burning rag for days afterwards.

Capt. Bruce Read

How Fast can you get from FL330 to Landing?

On one occasion I was over Amsterdam at 35,000 in an MD80 when I received the following call from Mastericht ATC:

"Transwede 326, we have a message from Stockholm that there is a bomb on your aircraft set to explode in 15 minutes... what are your intentions."

This really got my attention. In a situation like this you have to make a very fast decision... either take time to activate trouble-shooting procedures - or - descend below FL100 (or MSA) ASAP. In this case of a specific flight number and a specific deadline there may not be enough time to make further enquiry and analysis.

In this case we landed in Hamburg within 14 minutes from receiving the ATC call... 80 track miles flown during a rapid descent - followed by one orbit at 3000 feet and a straight in approach.

No bomb this time... but after reading about Swissair I am glad the decision was made to work out the answer on the ground! For info, German security took 4 hours to work out whether the warning was real or a hoax... with all info available, including phone contact with Stockholm and sniffer dogs etc. During this time Security expressed the view that they believed the threat was serious.

In mentioning this it is recognised that security procedures vary from Company to Company. In this case the Company was very supportive of all the crew involved.

Comment... it's one thing to get down in 14 mins in Europe or North America... quite another thing in some of the places we overfly on long haul!

Capt Peter Kentley

How Fast can you get from FL 390 to landing?

I was flying from Sydney to Singapore. Just after Tindal (Northern Australia), we had an Aft Cargo Fire warning. This was my first conversion line flight on the B747-400. I had the shock of my life as this is "only supposed to happen during Simulator training".

I ordered the fire extinguisher bottle to be fired. The training Captain then took over, as this was company policy. We were at cruising at FL 390 and I then assisted him with the diversion and with other non-essential flying duties such as the PA to the PAX etc.

Anyway, to cut the story short, we took 22 minutes from FL 390 to landing in Darwin after extended vectoring. On the ground it turned out to be a false warning - but I'm very glad to have had the experience, as the Swissair smoke accident was fresh in our minds.

I agree with the various contributors to this forum that smoke or fire is serious and that there is no time to troubleshoot. Our survival lies in the speed in which we get on the ground.

Capt. Tay KH

Avionics fire in a Convair

I once had a very useful discussion with a highly respected Captain - Basil Bradshaw (he has since left the company). Many years ago when flying a Convair over Germany, he experienced smoke in the cockpit. Shortly afterwards he was in an emergency descent - and landed on a the German airfield.

I recall that he said there were times during the descent when he had trouble seeing his co-pilot. When the emergency evacuation was completed, his Convair was engulfed in flames.

It is obvious that his early initiation of the descent was a key to saving his life. I asked him for his reason for initiating the early descent? He suggested that I study the smoke procedures ~ which merely tells the pilot to troubleshoot!

To identify the culprit generator/electrical bus would involve:

1. Substantial waiting time.

2. Identifying the culprit generator/electrical bus. All you can do then is pray that the culprit unit burns itself out.

Once he was clear about what the smoke checklist does, it changed his attitude towards smoke, and hence his early descent.

Capt Tommy Soh

Smoke For Thought

In 1986 the FAA published an internal Advisory Circular that stated, (quote) "Incidents of fire and smoke that cannot be extinguished continue to occur. New and modified smoke and fire procedures should be formulated, considering that the fire or smoke exposure may be continuous" (unquote).

Up-to-date, nothing has been done. In May 1927, the smoke evacuation procedure on Charles Lindberg's "Spirit of St Louis" was to open the window. Today on an Airbus A340 it is still the same.

The accident statistics themselves indicate that it is now the time to open serious discussions about the effectiveness of existing procedures. Only in the USA, over the last 5 years, the FAA have had approximately 4000 smoke reports. (Yes, you read that correctly, 4000!). These figures include all types of operations, commercial and non-commercial, but exclude the military. Thirty percent (30%) resulted in unscheduled and emergency landings.

We are led to believe, by the aircraft manufacturers, that existing smoke evacuation procedures work. However, those pilots who were involved in in-flight fire emergencies with dense smoke in the cockpit, and who could have given us valuable feedback on the effectiveness of such procedures, are all dead.

The common factor in almost all fire emergencies resulting in total hull-loss with fatalities, is that the time frame between the first indication that something was wrong (i.e. smell, circuit breaker tripping), and the fatal crash, is anywhere from several to a maximum of 18 minutes. Present emergency procedures depend on isolating the possible cause of the fire, and evaluating the result of such action. This takes time, and, armed with the above knowledge, time is precisely what we do not have.

And, the fire risks are increasing. The present no-smoking regulations on board aircraft are welcomed by many. However, these smoking restrictions have resulted in concealed smoking by passengers, and in some cases even crewmembers, increasing the risk of an in-flight fire. (How many lavatory smoke alarms did you have lately?).

As I said earlier, it is time to start discussions on this topic. Hear are some thoughts...

I believe that the first line of the checklist, "land as soon as possible", is the most important consideration, with the emphasis on "as soon as possible", and in my opinion should override other limitations such as overweight landing. I would rather be alive to

defend my decision making than otherwise. What this means if our nearest landing runway (suitable or non-suitable) is more than 30 minutes away is that a controlled crash landing or ditching is perhaps the only option. Obviously this is a decision that few people would like to make.

In a case of dense smoke in the cockpit I wonder how, in the first place, you can read the different items on the checklist, and secondly how you can find the relevant controls on the overhead panel. I don't even want to think about the guy who has to fly the aircraft and most probably without an autopilot, due to checklist actions, and without any visual reference whatsoever. In such a situation I believe that the first action is to get rid of the smoke which brings you to the last part of the checklist – "If cockpit window opening required".

This checklist on an A340 requires a minimum of six switch actions, highlighting my main concerns again that -

a) I may not be able to read the checklist, and

b) I may not be able to identify the switches on the overhead panel!

I think that we should be trained in some lifesaving, zero vision memory drills in which we are able to open the outflow valves (to depressurise the aircraft, enabling opening of the cockpit window), and at the same time initiating an emergency descent with the use of the autopilot. By closing your eyes and trying to find the manual pressurisation selection switch, you will realise that some prior practice is essential.

Capt Ruud van der Zwaal

Voice recorder and ATC transcripts
of some random smoke accidents

1970 Swissair DC9: explosion with smoke in the cockpit. "Please help us down. We have smoke in the cockpit. We can't see".

1983 June DC9: Air Canada, Cincinatti. "Can't see a thing. We have smoke in the cockpit.".

1985 December DC3: crash with Ricky Nelson on board. "I have smoke in the cockpit, I have smoke in the cockpit. I can't see".

History of In-Flight Fires

Statistics

According to a study by the International Water Spray Research Management Group... during the 1980's and 1990's there were approx 95 fire related civil passenger aircraft accidents - and fire claimed about 2,400 fatalities in these accidents. Similarly US Government figures reveal that approximately 16% of all US transport accident aircraft accidents between 1985 and 1991 involved fire - and 22% of the fatalities in these accidents resulted from the effects of fire and smoke.

NTSB data also indicates that between 1982 and 1988 there were 10 aircraft accidents attributed to carbon monoxide inhalation in which 3 pilots were incapacitated and 7 were impaired.

The following is from: http://www.airlinesafety.com/faq/faq8.htm

Accounts

1947, October 24th
A United Airlines DC-6 crashed, while attempting to make an emergency landing at Bryce Canyon, Utah. They almost made it, but the fire burned through the controls just short of the airport, killing all 52 on board.

1947, November 11th
An American Airlines DC-6 successfully made an emergency landing at Gallup New Mexico, after fire broke out in that plane's air-conditioning system. None of the 25 on board was injured, although the plane sustained major fire damage. The investigation of that near tragedy was eventually combined with the United crash above. Both fires were found to have been caused by the same defect in aircraft design: The improper location of the overflow vent for the #3 alternate fuel tank. When fuel was transferred into the #3 tank, it was possible to have some overflow out of the vent for that tank. The airstream then carried the overflow fuel (very high-octane gasoline) directly into the air intake scoop for the cabin heater. The design and testing of the DC-6 fuel system was found to be deficient and in violation of the Civil Aeronautic Board's existing regulations.

1948, June 17th
A United Airlines DC-6 crashed near Mt. Carmel, Penn. after the crew discharged CO2, in response to a fire warning, into the cargo compartment. When the nose was lowered, to make an emergency descent to the nearest airport, the CO2 leaked out of the cargo compartment. Since it was heavier than air, it accumulated in the cockpit, asphyxiating the crew. All 43 on board died. The investigation and subsequent litigation revealed that Douglas Aircraft designed a dangerous fire-fighting system and had reason to know it could render the flight crew unconscious. The fix, to correct that danger, was to install a "dishpan" dump valve that would instantly depressurize the airplane as part of the fire-warning checklist. It was located along side of the First Officer's foot, to allow any CO2 to flow out of the cockpit before it could accumulate to asphyxiation levels.

1964, July 9th
A United Airlines Vickers Viscount 745D, crashed near Pariottsville, Tennessee, killing all 38 onboard. It suffered an uncontrollable fire in flight, which apparently started below the passenger floor. The ignition source was never determined, but some thought the plane's battery or something in a passenger's luggage the most likely cause. Like the DC-6, the Viscount had a CO2 fire extinguishing system that proved

lethal to the pilots. The CO2 bottles were located behind the F/O's seat. Testing, after the crash, revealed a lethal amount of CO2 could be discharged into the cockpit even though it was supposed to go into the lower baggage compartment. The fire eventually burned through the controls, but it is likely that everyone was either unconscious or dead prior to ground contact. The plane was seen, flying erratically for a lengthy period of time, before the final plunge.

1971, August 8th
An Aloha Airlines Vickers Viscount 745D flew a routine flight from Hilo, Hawaii to Honolulu, Hawaii. After taxiing clear of the landing runway, the stewardess informed the captain of smoke in the cabin. The fire trucks were called and the passengers evacuated. As the captain was about to leave the cockpit, he noticed he could move the control wheel to the full aft position, even though the control ground lock had been engaged. The subsequent investigation revealed the left nickel-cadmium battery had suffered an undetected short which lead to a thermal runaway. It melted the metal around it so rapidly that the flight control push rods were burned through in about two minutes time. Had that plane still been flying a few minutes more, none of those on board would have ever seen their loved ones again.

1973, July 11th
A Varig Boeing 707, enroute from Rio de Janeiro to Paris, was forced to land short of the runway at Orly airport, only 5 minutes after reporting a fire in the rear of the cabin. The smoke was so thick in the cockpit that the pilot had to look out the opened side windows to make the crash landing. He could not see his instrument panel or out the front windshield. Of the 134 on board, only the 3 pilots, 7 cabin crew and 1 passenger survived. All others were asphyxiated and burned. The accident report found the probable cause to be a fire that originated in the washbasin unit of the aft right toilet, either as a result of an electrical fault or by the carelessness of a passenger. [Editor's translation: a passenger smoked in the blue room and then threw the lighted cigarette into the trash can.]

1973, November 3rd
A Pan American 707-321C cargoliner, crashed, just short of the runway, at Boston Logan International Airport, killing the 3 pilots on board. Only 30 minutes after taking off from New York's JFK Airport, the pilot reported smoke in the cockpit. The smoke became so thick that it "…seriously impaired the flightcrew's vision and ability to function effectively during the emergency." The captain had not been notified that hazardous cargo was aboard. The NTSB said, further, that a contributing factor was:

> …the general lack of compliance with existing regulations governing the transportation of hazardous material which resulted from the complexity of the regulations, the industrywide lack of familiarity with the regulations at the working level, the overlapping jurisdictions, and the inadequacy of government surveillance.

1976, August 6th
An Air Chicago Freight Airlines, Inc., TB-25N (B25 bomber converted to a cargo carrier), crashed while attempting an emergency landing at Chicago's Midway Airport. Both pilots and one person on the ground were killed. The left engine suffered a massive failure in its power section, starting a fire that could not be extinguished. The NTSB found the probable cause of the accident to be:

…the deterioration of the cockpit environment, due to smoke to the extent that the crew could not function effectively in controlling the aircraft under emergency conditions. The smoke and fire, …propagated into the bomb bay area and then into the cockpit.

1980, August 19th
A Saudi Arabian Airlines, L-1011, returned to Riyadh, Saudi Arabia and made a successful landing, after reporting a fire in its C-3 cargo compartment. However, after landing, no doors opened and no one evacuated. All 301 souls on board perished, including 15 infants, from the inhalation of toxic fumes and exposure to heat. There were no traumatic injuries. Just prior to landing, the captain ordered his crew not to evacuate and he failed to shut off the engines after the aircraft was stopped. Other findings of the accident investigators:

There was an extensive history of fires originating in aircraft cargo compartments where loose baggage and cargo are carried.

The cause of the fire could not be determined.

The pilots failed to don their oxygen masks.

The captain failed to understand the seriousness of the situation.

Both the F/O and the F/E had been dropped from their training programs and/or terminated and reinstated. Their actions, during the emergency, were not helpful to the captain. "Reinstatement in a flight position of terminated crew men is not desirable."

Comment from Capt John Irving:

"I am the ex-Saudia captain that took the rapid response team, including the head of the airline, Capt. Ahmed Mattar, to the accident site. I carried a number of the bodies off the burned out plane.

Five years ago I retired from Saudia after 16 years as a B-747, L-1011 and B-737 commander.

The flight was from Riyadh to Jeddah and the pressurization system's automatic controller was set for a landing at Jeddah (sea level) and was not reset for the return to Riyadh (2,100'). As was normal, the Cabin Rate Controller was set to minimum so when the plane landed with about 2 PSIG differential pressure the cabin altitude started climbing but only at the selected rate of 150 feet per minute.
As a result the A/C landed pressurized and even when the cabin crew tried to open the doors the cabin differential pressure prevented the plug type doors from opening. With a Cabin Rate selected at 150 feet per minute and the Landing Altitude incorrectly set for sea level (-200 feet), instead of Riyadh's 2,100 feet (-200), it would take about 9-11 minutes for the cabin to depressurize enough to allow the doors to be opened. At .125 PSIG differential pressure these doors will not open. The cabin crew died before this time elapsed."

1982, February 21st
A Pilgrim Airlines deHavilland DHC-6-100, (commuter flight) made an emergency landing on a frozen reservoir lake after fire erupted in the cockpit. The fire destroyed the aircraft after impact. One passenger was killed, while the captain, F/O and 8 passengers sustained serious injuries. One passenger escaped with only minor injuries. The fire was caused by the "deficient design of the isopropyl alcohol windshield washer/deicer system and the inadequate maintenance of the system…The ignition source of the fire was not determined."

1983, June 2nd
An Air Canada, DC-9-32, made a successful emergency landing at the Cincinnati airport after discovering smoke in the aft lavatory. The NTSB concluded the fire had burned for 15 minutes before the smoke was first detected. Source of the fire could not be determined. Miscommunication, between the captain and the cabin crew, caused a delay in the declaration of an emergency. The NTSB determined the plane could have landed 3 to 5 minutes earlier, at Louisville, if the descent had started as soon as the captain was made aware of the fire. It took only 11 minutes to make the landing, after the emergency descent was first initiated. The smoke was so thick in the cockpit, they had to depressurize and repeatedly open and close the cockpit windows, to see the instrument panel. The captain's shirt was on fire when he evacuated. Twenty-three, including all the crew, evacuated and survived. But, 23 passengers were overcome by smoke and died as the plane burst into flames shortly after the doors were opened.

(See Air Canada 797 report above).

1985, December 31st
An in-flight cabin fire forced rock star Rick Nelson's chartered DC-3 to make a forced landing near De Kalb, Texas. Only the pilots survived, with critical burns. Rick Nelson (son of Ozzie and Harriet Nelson), his fiancee, four members of his band and his soundman perished in the fire.

1986, March 31st
A Mexicana Airlines B-727, with 166 onboard, crashed after an overheated tire finally exploded in the wheelwell, tearing through fuel lines and electrical wires. The resulting fire eventually rendered the aircraft uncontrollable. There were no survivors.

1987, November 28th
(See seperate report above)
A South African Airways 747-244B Combi (both a freighter and passenger liner at the same time), while enroute from Taipei to Johannesburg, crashed into the ocean approximately 150 miles northeast of the island of Mauritius, after the pilot reported smoke and the loss of much of the electrical system. All 159 on board were killed. The breakup of the plane was so extensive, only five bodies could be identified. Only the cockpit voice recorder (CVR) was recovered. That, along with the video tape of the wreckage on the ocean floor, and the recovery of a few parts, enabled investigators to conclude the fire had started in the front pallet area of the upper deck cargo hold. They could not determine what started the fire.

1988, February 3rd
An American Airlines, DC-9-83 captain received a report from a flight attendant that smoke was present in the cabin. The cabin floor, above the midcargo compartment was hot and soft, requiring the flight attendants to move passengers away from the

affected area. The captain, aware of a previous flight's problem with the auxiliary power unit, which caused in-flight fumes, was skeptical about her smoke report. Thus, he did not declare an emergency and completed the flight in a normal manner. However, after landing at Nashville, he called for fire equipment to meet the plane. The flight attendants then evacuated all 126 on board while fire crews extinguished the cargo compartment fire. That compartment was found to contain a 104-pound fiber drum of textile treatment chemicals. The undeclared and improperly packaged hazardous materials included 5 gallons of hydrogen peroxide solution and 25 pounds of sodium orthosilicate-based mixture. The NTSB determined the fire was caused by the hydrogen peroxide, in a concentration prohibited for air transportation.

1988, July 27th
A Peninsula Airways Metro Liner III (commuter flight), took off from the Anchorage, Alaska airport and soon detected a wheelwell fire. The pilot wasted no time in making an emergency landing back at the same airport. All 8 on board escaped injury. It was a very close call. The fire burned through the left aileron control tube and engine nacelle. The left wing flap was damaged and the left fuel tank was severely scorched from excessive heat. "The flight did not end in a catastrophic explosion because the tank was nearly full of fuel and the fuel-air mixture in the tank was too rich to support combustion at the early stage of the flight."

1990, January 5th
A passenger checked three boxes weighing a total of 455 pounds, from Anchorage, Alaska, to his address in San Francisco. He labeled them "personal effects." When the cargo was being off-loaded from that passenger plane, shotgun shells fell out of a cardboard box. The cargo handlers took the shipment to an FAA special agent. Upon further inspection, that agent found an extensive variety of rifle and shotgun ammunition, signal flares, a camping lantern with gas in the tank, a can of butane fuel, primer caps, smokeless black powder, and CO2 cartridges. The majority of the ammo appeared to be quite old and had corrosion on the shells. I have never heard of what, if any, action was being taken on that case.

1991, July 11th
A Nationair DC-8-61, an international charter flight from Jeddah, Saudi Arabia, to Sokoto, Nigeria, crashed as it attempted to return to Jeddah. All 261 on board died as the in-flight fire burned through the control cables while the plane was on its final landing approach. Some bodies fell out of the plane while it was descending through 2,200 ft. The plane took off with some tires under-inflated. It was not known if the captain was made aware of that situation. A long taxi, combined with a hot day, caused the tires to fail on the takeoff roll. The resulting tire-fire spread into the aircraft after the gear was raised. The captain's delay in turning back to the airport, once he was aware of smoke in the cabin, may have sealed the fate of everyone on board.

1996, May 11th
A Valujet DC-9, crashed only minutes after takeoff from the Miami Airport. It is probable that the fire was burning in the cargo hold, fed by an illegal shipment of oxygen generators, before the plane took off. There was no warning, until the flight attendants yelled to the cockpit that the cabin was on fire, because the plane was not equipped with fire/smoke detectors or a fire suppression system for its cargo compartments. The FAA had refused to act on many previous recommendations, by the NTSB, which would have required smoke detectors and fire suppression systems in all passenger liner cargo compartments. The NTSB said that oxygen generators had been

tied to at least 3 previous airline fires. In 1986, an American Trans Air DC-10 in Chicago, was destroyed by the fire that erupted from just one oxygen generator which was still in the back of a seat being shipped in its cargo compartment. Fortunately, the fire occurred while the plane was being serviced, so there were no injuries. The FAA did not disseminate the information, learned from that fire, to the airlines with enough emphasis on how dangerous oxygen generators can be. Nor did the FAA ban them from shipment on passenger liners until after the Valujet crash, which killed all 106 onboard.

1996, September 5th
Federal Express DC-10 Cargoliner. The crew declared an emergency and landed as fast as possible after becoming aware of smoke coming from the cargo hold. They escaped with their lives, but the plane was destroyed by the fire that spread rapidly after they evacuated. The fire came from hazardous material aboard, but the NTSB is still not certain of the ignition source.

1996
I was reviewing the flight papers for my planned flight from Paris, Charles de Gaulle Airport, to Washington, Dulles Airport, when I was handed a Hazardous Materials manifest which informed me that "auto parts" had been loaded in the cargo compartment of our B-777 passenger liner. I asked the agent "what is hazardous about auto parts?"

He flipped some pages in his manual and said "they are starters." I inquired further; he flipped some more pages and replied "engine starters." I still didn't understand why engine starters would be considered hazardous material. He flipped some more pages and declared "they are cartridges." With a bit more persistence, I was finally able to determine that they had boarded 24 pounds (net weight, excluding the packaging) of EXPLOSIVES!

The "auto parts" were actually large explosive cartridges that generated enough force to turn over a large piston aircraft engine several times. I remembered the Flight of the Phoenix, where they had only a few of those cartridges to start the engine after they built a new plane out of the wreckage of the one in which they crashed. I couldn't believe such a shipment was legal on a twin-engine passenger airliner that had to fly across the Atlantic Ocean, hours from any emergency airports.

The agent assured me it was legal. He said the FAA had granted a "special exemption" for my airline to carry those explosives in our cargo compartment. I told him they didn't get any special exemption from me. I ordered the removal of those cartridges. To this day I cannot understand how the FAA could allow such a shipment, much less to permit explosives to be labeled as "auto parts." (All emphasis is that of the author).

Credit for this historical list:
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Fire in Flight

Operational Considerations

Personal View Point
by: Capt Bill Melvin

Whether in flight or on the ground, a fire is extremely hazardous and must be dealt with promptly. Pilots should give some thought of how they would handle a fire at particular times, such as on the ground, in flight near an airport or in flight over remote areas or the ocean.

In recent years, Harry Bombardi and Gary Shirley of Delta Air Lines have shown that many fire procedures are basically wrong in shutting off the air supply to the cabin. They have shown that the best chance for survival is to maintain cabin airflow while de-pressurizing. This applies whether in the air or on the ground.

There may be cases where a fire warning exists and there is no confirmation of a fire. This can be a particular problem for a warning of a fire in an engine which can not be observed by the flight crew. Depending upon other conditions, the flight crew will have to evaluate the risks involved in selecting the best course of action.

Fire On The Ground

The best place to have a fire is on the ground, but there have many cases where such fires have resulted in a major disaster with considerable loss of life. It cannot be over emphasized how rapidly a fire can spread. It is important to maintain airflow to the cabin to avoid smoke inhalation by cabin occupants.

It is also extremely important to be certain the cabin outflow valves and/or cabin exits are open before shutting down the engines. In one case, the engines were shut down with the outflow valves shut. The cabin was so tight that the doors could not be opened and with the engines shut down it was impossible to establish power to open the outflow valves. Although all passengers survived the landing, they and the entire crew perished in the subsequent fire because the cabin exits could not be opened.

It is assumed that all flight crew members are well acquainted with the appropriate emergency evacuation procedures for the aircraft they are qualified on.

Fire In Flight

A fire in flight should be treated as an extreme emergency. If there is immediate confirmation of the fire such as detectable smoke or fire, there can be no question of the seriousness. Pilots should immediately declare an emergency. Although you should ask for any information you need such as the closest piece of pavement long enough to land on, you shouldn’t ask for permission to do anything. Tell the ground controllers what you intend to do and request assistance as desired. It is distressing to read accident reports of catastrophic fire in flight where the flight crew never declared an emergency, never squawked 7700 and asked for clearance to the airport. In such a condition, the sky is yours. Make everyone else get out of your way.

Now comes the hard part. Suppose you are over the ocean. If you have certain confirmation of a fire, you must immediately prepare for an ocean ditching, while hoping that your fire fighting procedures are effective in putting out the fire. However, you cannot delay your emergency decent and preparation for a ditching. The accident records are full of cases where an entire aircraft was lost by delaying a decision to put the aircraft down. Historically, if any aircraft fire can not be extinguished, there is only about 10 minutes available to evacuate the aircraft with any chance of survival.

Suppose you are over the ocean and you don't have confirmation of a fire. You have a fire warning on the center engine of a three engine aircraft. Knowing how the system works you should consider this a valid warning, but should you risk an ocean ditching if there is a chance the warning isn't valid. What to Do? What you need is information. Is the fire warning valid?

If near a coastal area, you should immediately squawk 7700, declare an emergency on the controlling frequency if being used and again on the guard channel. Immediately request an intercept if available. Many countries maintain fighter aircraft in coastal areas with rapid response and intercept capability. Otherwise try to get contact with any other aircraft in the vicinity to establish a visual inspection.

Meanwhile you should be preparing for an emergency descent and ditching. However, if the chance of a visual inspection from a nearby aircraft is possible, it may be best to maintain altitude for this purpose.

Other conditions must be considered. Is it possible to make it to a nearby landing area? What is the condition of the ocean? North Atlantic in the winter or South Pacific in the Summer? Day or Night?

If a ditching is required, assistance from any ocean vessel is desirable. With modern navigation equipment, position reporting prior to a ditching should not be a problem.

Ocean Ditching

After World War II, the U.S. Navy and Coast Guard experimented with different techniques to determine the best method of ditching in the open ocean. They sank a whole squadron of seaplanes. Generally, there will be two distinct wave patterns. One will be the major pattern of waves with high peaks and deep troughs which is caused by major ocean effects. In addition, there is the effect of the prevailing wind which almost always is different. This results in smaller waves on top of the major waves. Careful observation will establish the fact that if there are small breakers, the white foam will fall down the backside of the wave, leaving streaks pointing in the direction the wind is coming from.

The best way to land in the open ocean is parallel to the major wave structure as close into the wind as is possible. The major waves will rise and fall beneath you. You should attempt to land on top of a wave as it passes under you. The aircraft will then settle down into the trough without the waves breaking over. The worst case scenario is to land into the face of the major wave pattern, i.e., perpendicular.

If possible, the aircraft should be established with thrust holding off above the waves using the radar altimeter to hold about 50 feet. As the crest comes up, select reverse thrust. This will make a big splash, but it will put you on top of the wave where you want to be. Nose attitude is important as you don't want to be too high or too low. Holding the aircraft off and dropping it in is the technique used by Navy and Coast Guard seaplanes for open ocean landings. If the sea is relatively calm and you feel confident in holding altitude, 25 feet on the radar altimeter makes a softer landing.

Also, it would be better to use the spoilers to put the aircraft down as is done with sailplanes, but there is no known recommendation by manufacturers for using this technique. Neither is there any known recommendation to use reverse thrust. You will have to decide the risk involved depending upon the magnitude of the waves you are trying to land on. The major point is that you want to land on top of and parallel to the major wave system.

A modern air transport will float a long time if it isn't flooded inadvertently, which brings up another subject. Do not under any circumstances land in the water with the gear down. This was a mistaken concept passed around a few years ago and it is extremely dangerous. If in doubt, ask any pilot of amphibious aircraft about the danger of landing on water with the gear down.

Several years ago, a B-727 hit the water on a non-precision approach to Pensacola, Florida. The pilots misread their altimeter and inadvertently hit the water. Upon stopping, the top of the fuselage was sticking out of the water. All passengers survived the landing, but a number of them died from fuel vapor inhalation in the evacuation because the fuel tanks ruptured which was due to fact that the landing gear was extended.

After landing in the water, it is important for the cabin crew to determine the water line before opening emergency exits. Most transport aircraft have never been landed in the water, but the manufacturers have usually done water tank tests with models. On some older aircraft it may be difficult to close a cabin door once it is opened, especially if water is rushing in. If the aircraft has overwing exits and immediate evacuation is not required, this is an excellent choice for evacuation. A commercial transport should float a long time if the openings are closed to water as much as possible. This means landing with the outflow valves closed, but with some other means of assuring de-pressurization of the aircraft. A cockpit window or hatch may need to be opened.

If fire and smoke are in the cabin, it is important to maintain airflow as long as possible, but it also necessary to land with the outflow valves closed and not have the situation where the cabin doors can't be opened due to cabin pressure. Each aircraft will be different, but if some thought is given to the problem with an understanding of the issues, it should be possible to devise a plan for each individual aircraft.

There have been cases where a military aircraft crashed at sea during aircraft carrier operations and the aircraft had to eventually be deliberately sunk because it wouldn't sink by itself. A deliberate water landing should have the best chance of assuring structural integrity, especially if the landing gear is retracted and the landing is properly executed.

Remote Land Areas

If an emergency landing is required in a remote land area some consideration should be given to a water landing. The two major causes of death in aircraft accidents are fire and impact, both of which can be minimized with a water landing. Many remote areas have no good landing area, but have reservoirs, lakes, etc. which might make a good landing spot if the aircraft can be safely evacuated after the landing. It may be possible to land in shallow water or close to a shoreline or island where the risk could be minimized.

Without a major wave to deal with, the aircraft can be flown onto the water. However, a major problem with water landings in open areas is inadequate reference for depth perception which makes it difficult to determine height above the water. This can be solved by having the non-flying pilot call out radar altitudes. Also, pitch attitude is extremely important in a water landing. The aircraft should touch down in a relatively flat attitude with the nose slightly raised. Too low or too high can result in disaster.

Capt Bill Melvin