Fire Onboard: A Pilot's Worst Fear?

OPSGROUP Team
10 August, 2021

Ask a pilot what their worst fear is and one of the responses you will probably hear the most is FIRE! Ironically, an aircraft's engines only actually work when they are "on fire" so not having a fire "onboard" could be problematic…

But a fire in the cabin or cargo hold is a rather different deal. So, here is a look at what many consider to be one of the most challenging and concerning problems they could encounter in-flight.

For those who don't think it is that scary.

A CAA study back in 2002 looked at aircraft crashes due to fires onboard and discovered a rather fearsome statistic – the average time it took for an aircraft to become **catastrophically uncontrollable was under 20 minutes.** Various fire tests saw that a fire allowed to spread through the aircraft's overhead area could become uncontrollable in just 8-10 minutes.

The average time for a crew to get their aircraft onto the ground was around the **17 minute mark.**

So, not much time to spare.

The infamous Nimrod ditching (a favourite CRM example of decision making) shows how quickly a fire can disable an aircraft.

The problem is aircraft are built to burn.

Aircraft skin is thin and can burn fairly rapidly with high temperatures

Well, not literally, but there is a significant amount of flammable, combustible and generally burnable bits onboard. Add in the fact there are very hot bits (the engines) linked to big chambers full of fuel and the risk of an un-contained fire suddenly seems a lot worse.

Un-contained being the important word here.

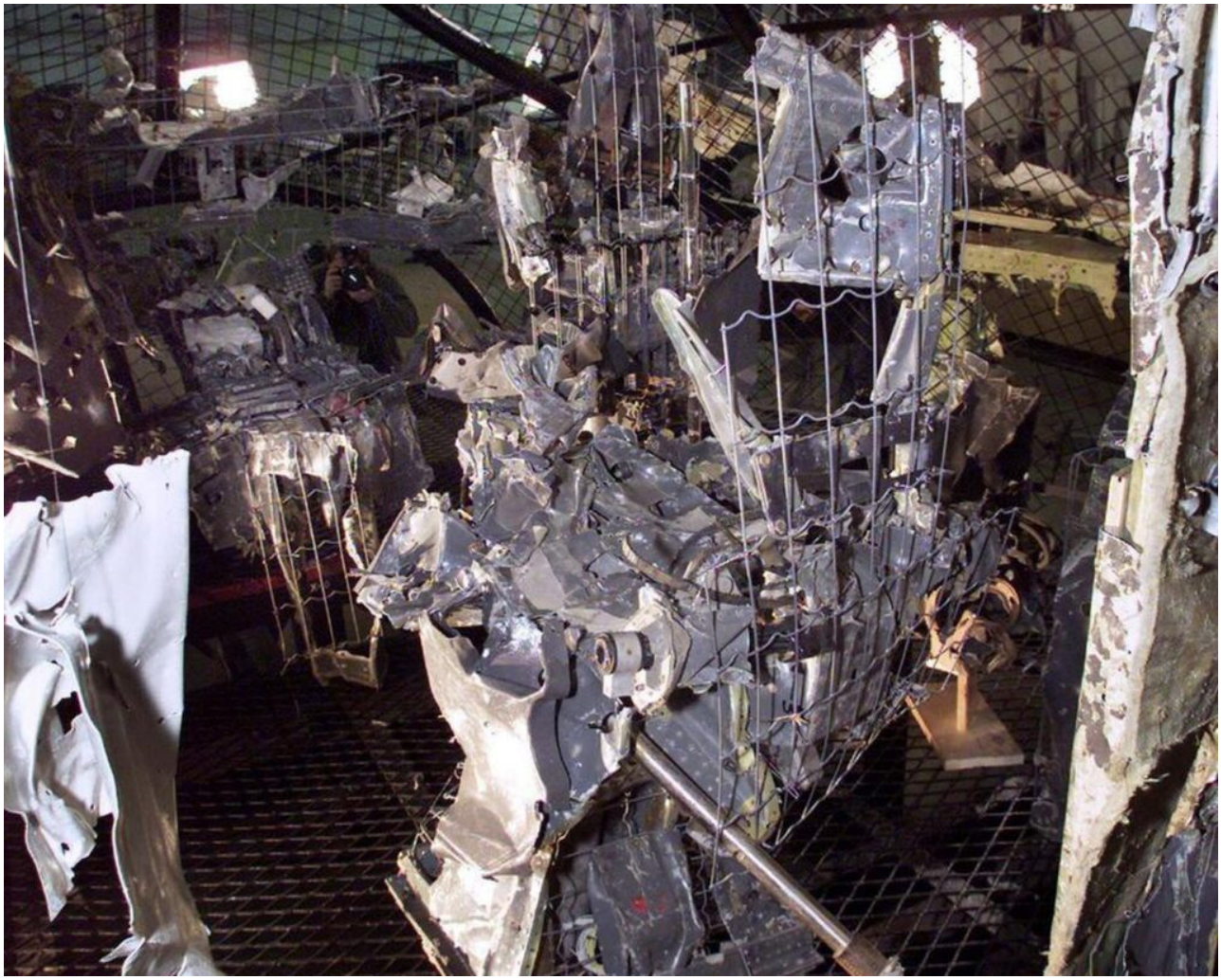
Engines have fire identification and protection systems in them. So do cargo bays. So do cabins for that matter (Cabin Crew make wonderful fire detection and fire suppression systems). Aircraft interiors, and cabin fire fighting procedures, and the monitoring of Dangerous Goods transit have also developed significantly over the last decade or two.

So, the means to prevent or control fires before they become uncontrollable have increased.

Unfortunately, though, **so have the number of devices coming onboard which could start a fire** in the first place.

Lithium Ion batteries burn hot. They are hard to put out, and every passenger on your flight probably has at least one, probably nearer three of them (phone, second phone, computer, tablet, smart luggage, spare power banks, watches, electric toothbrushes…)

And of course phones are not the only potential fire hazard onboard. There are ovens (hot), hydraulic fluid (thankfully not in the cabin, but very flammable), electrical things (seats, tvs, lights), waste bins (in toilets for hiding illegally smoked cigarettes in), oxygen systems (a food delicacy for fires) and a multitude of wires.



Interior from the Swissair 111 accident in 1998 – caused by faulty wiring

An FAA study from 1995 to 2002 found reports of **nearly 400 wiring failures**. 84% of these were burned, loose, damaged, shorted, failed, chafed or broken. And this is probably not a representative number given how many might go unreported.

The Swissair accident was due to faulty wiring, with a secondary prominent factor being the flammability of materials that ignited and propagated the fire. The crash occurred just 16 minutes after the first alert message.

Let's take a look at what can burn in the cabin.

Seat coverings, blankets, cushions, other furnishings, clothes… basically everything inside the cabin can burn.

In 1993 a Northwest Airlines B727 had a fire in the cabin and it turned out they were using 100% polyester blankets. Polyester actually melts more than burns, but it gets really hot when it does and tends to set alight to everything else around it. The incident led to the FAA developing new fire performance test methods and criterion for all blankets.

Interesting fact: Emirates actually make their economy blankets out of recycled plastic bottles. 28 of them per blanket.

Her hairspray is the most flammable thing, closely followed by the 1970s fabric

Actually, the burning ability of everything onboard is now monitored.

Since 1990, aircraft interiors have had to comply with a **maximum total heat release of 65 kilowatt minutes per square meter**, and specific optical smoke density of 200. Basically *burn less, burn less hot, and put out less smoke if they do burn.*

The current rules for what everything should be made of, and how burny/smoky/toxic they can be are contained in FAR/JAR/CS 25.853.

An FAA fire test with 5000 lithium ion cells

Crew training is important as well.

The training and ability of the crew to both fight the fire, and evacuate the aircraft is strictly monitored. The FAA require that an airplane can be **evacuated in 90 seconds.** For big commercial aircraft (these are Boeing stats) this means the **slides have to be able to inflate within 10 seconds** (15 if it is a big wing slide), and they need to be able to support 60 people sliding down at once.

It doesn't take into account the huge heap of people at the bottom of the slide, but once they are out and away from the fire all bets are off.

90 seconds to evacuate 500+ people

But accidents still happen.

Between 1990 and 2010 there have been **18 major accidents involving in-flight fires** which resulted in fatalities. During the 1990's, the US saw, on average, one flight a day diverting due to smoke; and a report by IATA suggests there are more than 1,000 smoke related events annually.

That's about 1 in 5,000 flights which is a pretty big number when you consider how many flight you will do in your career, or how many movements there are worldwide every day.

In 2010, a UPS B747 freighter crashed in Dubai following a main cargo deck fire which ultimately led to loss of control of the aircraft. The pilots were incapacitated earlier however due to the rapid build up of smoke in the flight deck.

What to do. The important bit.

1. Troubleshoot.

Finding the source should be a top priority. That means working out where the smoke is coming from.

If it is coming from something **avionics** related then you are going to want to **switch it off.** If it is something in the **cabin** then it might be locatable, reachable and extinguishable. Don't forget to get your crew to check the lavs.

The terror…

2. Communicate.

One of the biggest challenges in dealing with a fire in the cabin is the communication between the cabin and the flight deck.

- Ensure there is a communicator in place who can pass messages to you and keep you updated.
- If you are trying to establish the severity of the situation, ask open, non-leading questions:
    - "How much smoke?" could lead to *"lots/loads/not as much as you'd see at a rock concert in the 60s…"* . Instead, try "How many rows of seats can you see?"
- Establish whether they can see where the smoke is coming from, if they can get to the source, and if they can put it out:
    - Ask about the colour, the smell, and while troubleshooting make sure you leave enough time for them to identify a change (after turning stuff off or on).

3. Keep flying!

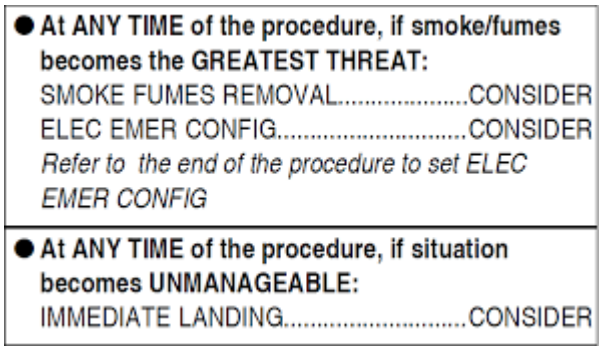
Don't forget to keep flying – one pilot should focus on the fire procedures (or on the comms with the cabin) while the other flies the aircraft! This probably means aiming for an airport.

Declare an emergency – this can be downgraded later if the situation improves, but get the support you need early on.

If there is an autoland option you might want to set up and plan for that in case the smoke in the flight deck builds up too much.

4. Don't forget…

You have **two procedures –** one for sourcing and "fighting" the fire, and one for dealing with smoke (and fumes). If you need to, suck that smoke out!



On the ground.

Your Ops Manual will have a required **RFF category for airports**. However, this is based off the equipment available at an airport (and the response time). A Captain can chose to disregard this if the only option does not meet their RFF requirement.

The emergency isn't over until you and the passengers are safely off. If the cabin is filling with smoke then a top priority is getting those engines switched off so your cabin crew can evacuate. If in doubt, evacuate!

Depending on where the fire is (and how the wind is blowing) you might need to avoid evacuating through certain doors. **Getting folk away from the aircraft is critical.** The main injuries resulting from the Emirates B777 accident in Dubai were some inhalation from passengers and crew, and heat stroke from the firefighters – it took 16 hours for them to bring the fire under control.

What to do earlier…

1. Have a plan

This means knowing what airports are around that you could go to if you suddenly, urgently need to.

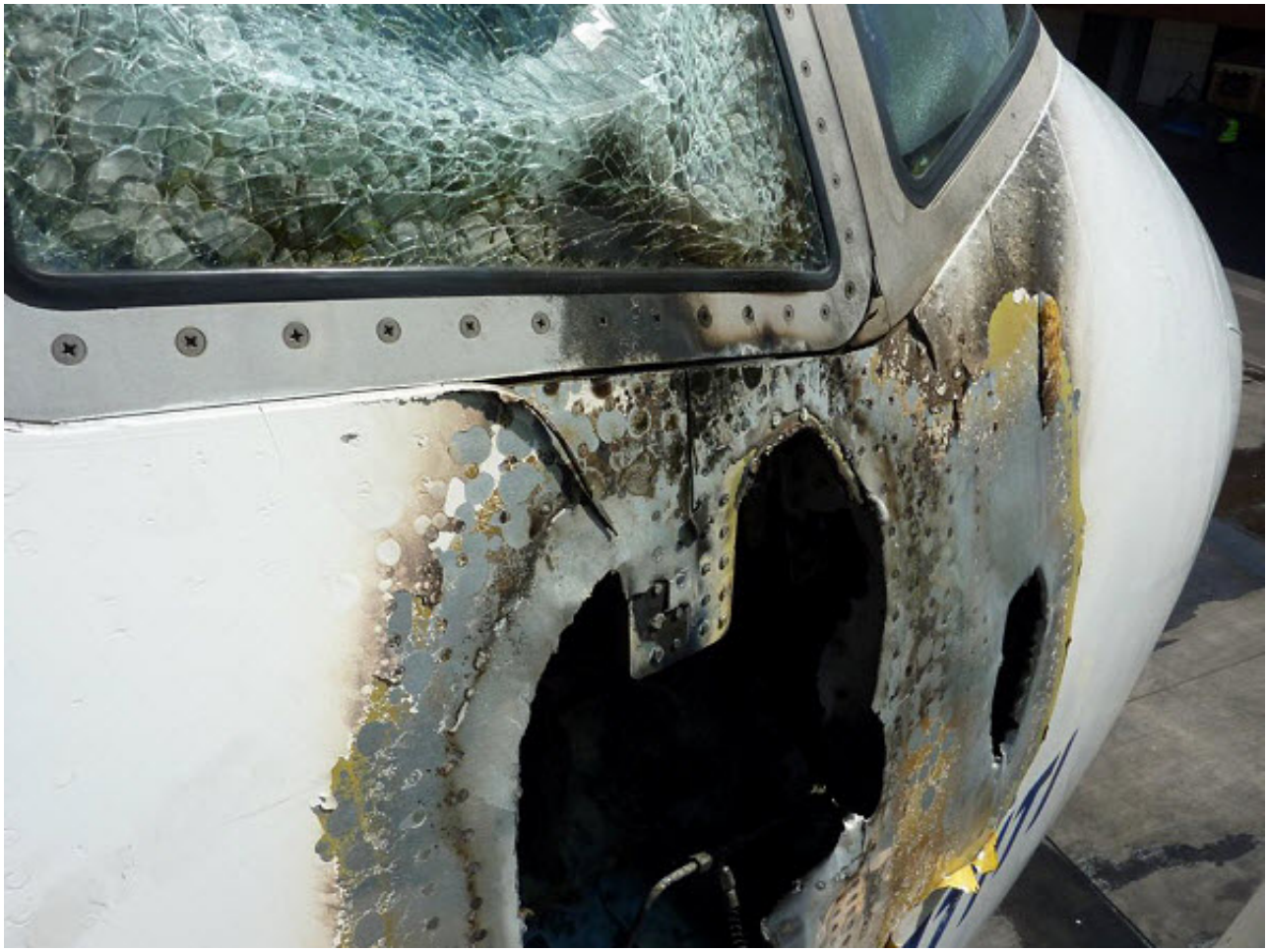
- Check the weather and Notams en-route.
- Have something in the box ready (if it is a difficult airport to route to, or there is airspace to avoid, or if a straight in visual might not be an option).

2. Know what equipment you have onboard.

Know what it is, where it is, and how to use it:

- **Halon:** Great for electrical fires, not so good for you. If you are using this in the flight deck, get a smoke hood or oxygen on first.
    - Remember **PASS:** Pull the pin, Aim at the base of the fire, Squeeze the handle or lever, Sweep it about from side to side like an aggressive elephant.
    - EASA are recommending the removal and substitute of Halon Extinguishers because of their mean effect on the environment, and also on people.

- **Oxygen masks:** If there is smoke in the cabin, don't drop these thinking it will help your passengers breathe better. Oxygen + Fire = not a good result, and their masks are not designed to keep smoke and fumes out anyway.
- **Smoke hood:** You look like a weird spaceman in it, and sound like Darth Vader, but this is a very important bit of equipment.
    - If you are on the ground and evacuating, use this before doing the cabin checks.
- **Fire Sock:** For putting things in. Usually has some gloves nearby for picking the hot burning thing up with.



Fires can burn through aircraft skin, control surfaces and control cables and wires.

False Alarms

These do happen.

An IATA study saw **2,596 reports of fire/sparks/smoke or fume occurrences**. Of these, **20% were false warnings**, which meant 11% of the in-flight diversions were due to false warnings. 50% of cargo compartment fire warnings were also false.

Air spray is a common culprit for causing false alarms in toilets.

But – if you get a fire warning, treat it as real unless there is some very, very obvious something to suggest it is not.

FIRE!

They critical thing is to be prepared. Have that airport option in mind, know where to find the procedures (and familiarise yourself with them), and make sure that if it does happen, you and your team are ready.

A fire onboard is a time issue. Being prepared and ready will hopefully give you those extra minutes that could make a big difference.

Burning desire to read some more?

- The **RAeS** have two papers entitled 'Smoke, Fire and Fumes in Transport Aircraft'**.** Part 1 is a reference paper with a lot of scary accidents discussed in it. Part 2 covers training recommendations. If you never read anything else on this subject, at least read these – most of the reports referenced in this article are pulled from these.
- Boeing's Evolution of Airplane Interiors is quite an interesting read on the testing and cabin interior requirements.
- A briefing on Bad Air, Fumes and Contamination takes a look at other dangerous fumes that might be swilling about in your aircraft.

Flying outside the Procedures

OPSGROUP Team
10 August, 2021

Aviation is full of procedures. We fly by them, sometimes we kind of live by them. But other times there are situations where we need to disregard them. So when is it ok to throw the rule book out the window?

In an airplane, never.

In the literal sense anyway, given the risk of opening a window mid-flight and getting sucked out. But what about in the less literal sense?

Procedures are not there to stop us just doing whatever we want. They are there to keep us safe, to make sure everyone is operating to the same standards and to provide pilots with a guideline of what they should do in ***most situations.**

Why the asterix?

I will come back to that. But for now, that reasoning makes sense. If every airplane did what it wanted, flew how and where it wanted, the sky would be a messy mass of chaos. So, we have procedures and we have them so we know what to do, when to do it and how to do it.

More importantly, everyone else knows as well. Which brings us back to the "most situations" comment.

We cannot expect there to be a procedure in place for every possible event. They are there to offer guidelines and standards, but they are not designed to cover everything.

And they are definitely not supposed to **remove the need to think.**

So what should we think?

Well, thinking about situations where we might be without a procedure, or where there is a procedure but it no longer leads to a safe outcome is a good place to start.

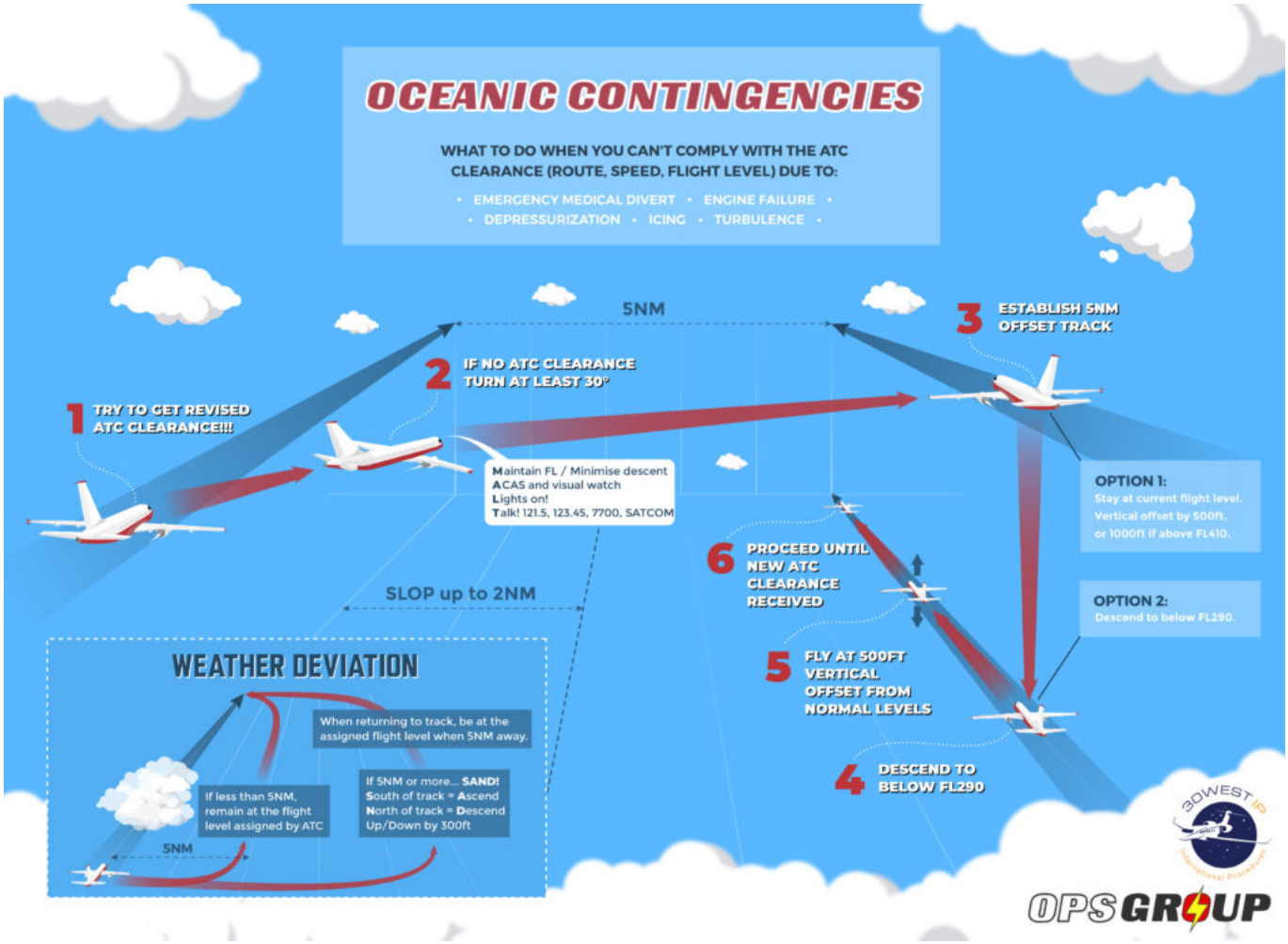
Let's take a look at **ICAO Doc 007** – the "bible" for the North Atlantic. It is quite clear on a lot of things – for example, what the **contingency procedures** are if you experience some sort of emergency while flying in the NAT.

We are talking some busy airspace out there, with a lot of aircraft flying on specific tracks, and so the last thing you want is aircraft barreling across them setting off TCAS warnings as they zoom off on a diversion.

So NAT Doc 007 lays out some procedures to follow. Things like turning **30 degrees off track and offsetting 5nm**. And one that says –

"W*hen below FL290, establish and maintain 500' vertical offset when able and proceed as required".*

Ok, great, it is pretty clear. Get yourself down to below FL290, establish on your offset, and now go where you need to go.



But…

What if our emergency is a decompression, and we are right out in the middle of the NAT where routing at 10,000ft the whole way to an airport might turn into a fuel problem?

Do we still need to get to FL95 before starting a diversion?

There might not be a black and white, right or wrong answer, **but this is the point** – there are situations where there isn't necessarily a procedure telling us what to do, or when to follow another procedure.

So this is something we should probably be thinking about a bit more. The "What If?" things that could happen.

So, what is the rule for breaking procedures?

Is there sort of **a checklist for when we can, can't, ought to or must?** Why isn't there a rule for every time you are allowed to break a rule?

Well, the reason is no-one can think through every situation, and more importantly they shouldn't try to!

The day pilots can only do something if a procedure tells them to is the day you might as well replace them with a computer. We need to retain the skill of weighing up risk and reward, consequence of actions, because there are so many situations out there which are **not going to be black and white.**

NAT Doc 007 document actually states quite clearly several times –

"The pilot shall take action as necessary to ensure the safety of the aircraft…"

And this goes for any procedure, any rule, anytime you are flying.

Just because the book says “No, don’t do that!” never means you cannot do it if it is what you need to do to maintain safety.

The tragic Swissair Flight 111 accident is often raised in CRM discussions as an example of when following procedures to the book **might not lead to a safe outcome**.

But…

Not following procedures because you think there is a quicker, better, easier way to do something is probably not the best idea either.

A Qantas pilot experienced “incapacitating” symptoms after a technical malfunction where they decided to cary out their own troubleshooting, rather than following the checklist.

So, having a good reason to not follow a procedure is important because you are going to have to justify why you broke the rule. **If you need to break it for safety then break it,** but the key seems to be having a **valid, justifiable and safety related reason.**

That is airmanship, and that is why the Commander has final authority. It is also a cornerstone of our pilot licence that we “agree” to accept the ultimate responsibility for the safety of the flight.

Why are we even having this discussion?

Possibly because *we sometimes forget why we have procedures in the first place*.

Unfortunately none of us are immune to this. I can remember several times in my career when **procedure-following took over from common sense.** The time when we shut down an engine with 10 meters of taxi left, ran out of steam, and had to be towed the last 9… *But hey, we still ticked the one engine out taxi box.*

So, all of us stepping back and considering why the procedures are there, and then what we might do when we find ourselves potentially having to operate outside of them, is important.

Which brings us back to the debate about FL95 over the NAT.

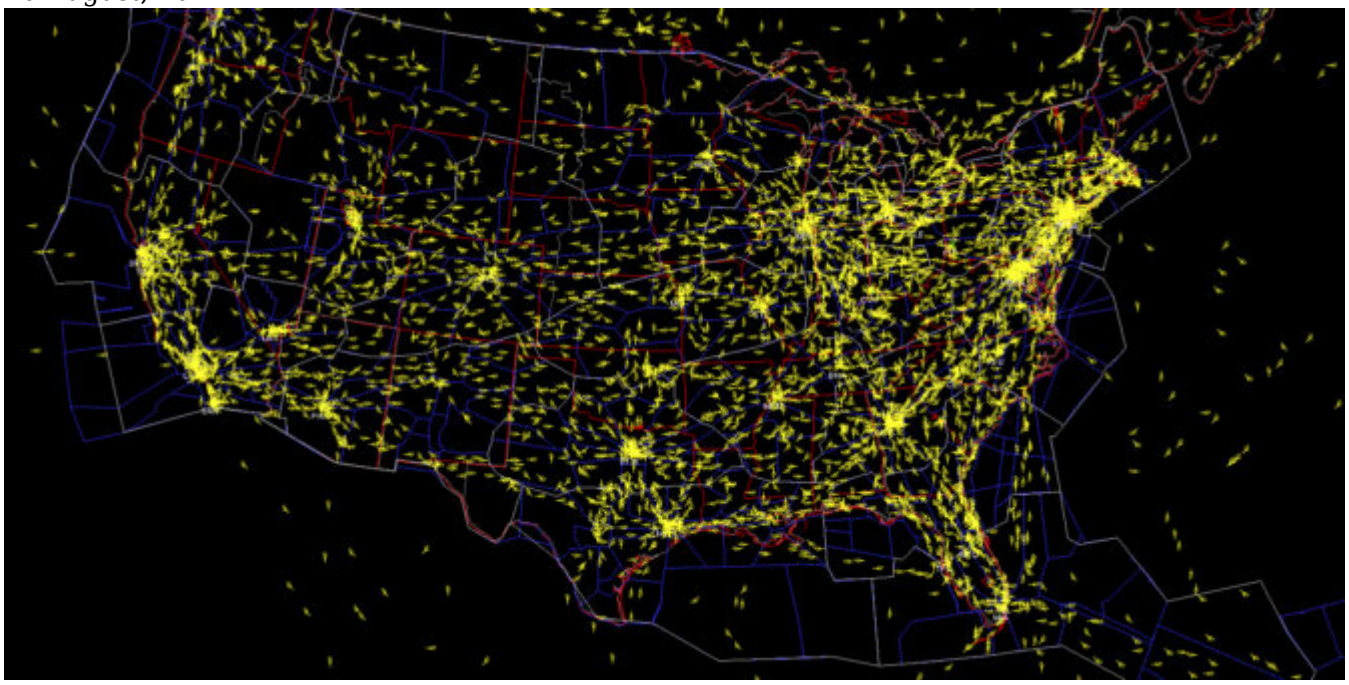
Different folk might answer this question differently. It is going to depend on the day, on you and on the situation, and there probably isn’t a definitive answer to be given.

What is clear is that at some point in our flying career we will all probably find ourselves in a situation where there is no procedure, no clear cut answer, no simple solution, and this is where our **experience, airmanship and judgement** will really be put to the test.

When we end up in that situation we should’t be asking *“What is the risk of me getting into trouble if I do?”* but rather *“What is the risk to my safety if I don’t?”* because all the procedures we fall back on were not put there to be blindly followed, and were not written into stone to keep you out of trouble – they are there to be thoughtfully followed when they keep *your aircraft out of trouble.*

The Gateway to the Skies

OPSGROUP Team
10 August, 2021



If you have not heard of the IFP Information Gateway then here is a little summary for you. It is the Instrument Flight Procedures Information Gateway which is, according to the FAA who run it, ***your centralized instrument flight procedure data portal.***

It's a handy site because it provides you with a single-source, one-stop-shop, first place to visit if you need info on any of the following:

- Charts
- The IFP Procedures plan
- IFP Coordination (forms and things)
- IFP Documents
- IFP Request form – this is where you can submit a request or query on an IFP. SO if you fly somewhere and think an IFP needs creating, amending or cancelling, you can do it here!

And this **isn't just for US pilots** – it is pretty handy for anyone flying into the US who flies IFR procedures.

The Optimisation Project

This is a major project that the FAA are undertaking. They are **reviewing their entire inventory** of equipment and procedures as part of a plan to modernize the National Airspace infrastructure – to improve airspace and airport efficiency and safety.

The NAS covers an area of something like **30 million square miles**, so it is a big project.

What is the plan?

The **introduction of PBN (performance based navigation)** is a big part of the modernization. If you fly into the US then you need to know about this, because it is going to mean **changes to routes and procedures, airspace and equipment** required.

Charts are being updated to remove unnecessary clutter. In 2020 they cancelled 1,000 procedures and took out things like circling minima on charts that no longer needed it. You need to know about this because it will **impact chart validity, and things like minimus** are airports you might use.

As for the inventory check – they are reviewing all the procedures at airports and deciding which to keep, which to cease, and which just plain old need updating. This will start with the **decommissioning of any ancient VORs and NDBs** which no longer support the operations network. You need to know about this because there will be ongoing changes to the approaches available at airport.

Give us some more details on the inventory checks

The FAA are going to review all procedures.

Why?

Well, because having looked over some data they reckon at least **20% of current IFPs have pretty limited benefits** to the NAS. If procedures are not being used then retiring them means lower admin, maintenance and training costs. It also means more efficient and effective airspace management, which means improved safety and access.

Take **KSEA/Seattl**e for example. They have an RNAV RNP approach and a GPS approach for runway 16L. The RNAV RNP was **only flown 17 out of a whopping 191,448 IFR arrivals.**

It has higher minimum and an identical flight path to the GPS approach so there is really no reason for this approach to exist.

RNAV (RNP) Z RWY 16L

SEATTLE-TACOMA INTL (SEA)

APP CRS	Rwy Idg	11901
164°	TDZE	433
	Apt Elev	433

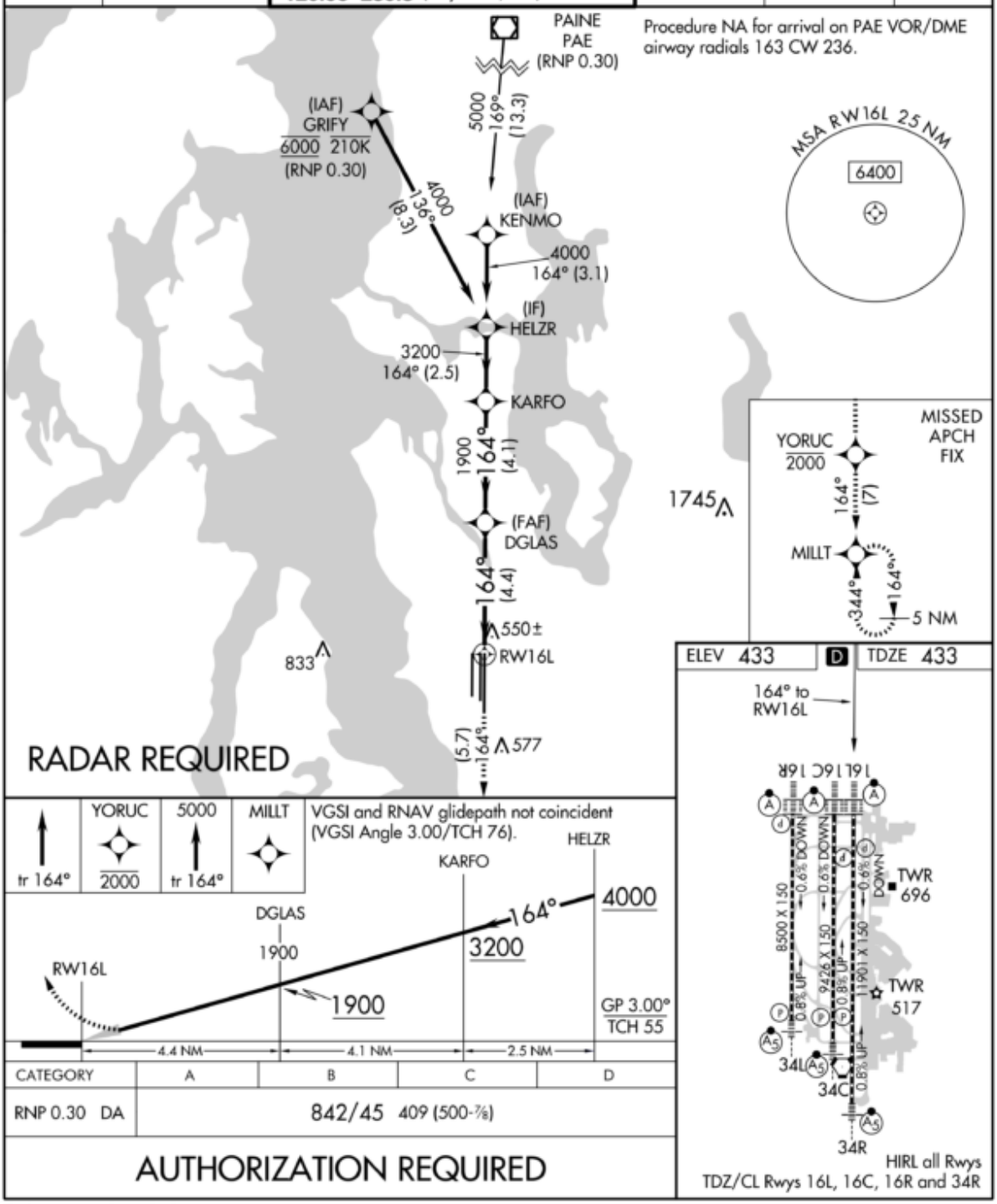
For uncompensated Baro-VNAV systems, procedure NA below -6°C (22°F) or above 54°C (130°F). Simultaneous approach authorized with Rwy 16R. GPS required. Use of FD or AP providing RNAV track guidance required during simultaneous operations. For inop ALS, increase RNP 0.30 all Cats visibility to 1⅜ mile.

ALSF-2

MISSED APPROACH: Climb on track 164° to cross YORUC at or below 2000, then climb to 5000 on track 164° to MILLT and hold, continue climb-in-hold to 5000.

D-ATIS	SEATTLE APP CON	SEATTLE TOWER	GND CON	CLNC DEL	CPDLC
118.0	133.65 273.45	119.9 239.3 (Rwys 16L, 16C, 34C, 34R) 120.95 239.3 (Rwys 16R, 34L)	121.7	128.0	

Procedure NA for arrival on PAE VOR/DME airway radials 163 CW 236.



CATEGORY	A	B	C	D
RNP 0.30 DA	842/45 409 (500-⅞)			

AUTHORIZATION REQUIRED

NW-1, 20 MAY 2021 to 17 JUN 2021

NW-1, 20 MAY 2021 to 17 JUN 2021

KPAE/Paine Field is another one worth looking at. It has a **VOR-A approach which was only flown 95 times out of 10,348 IFR arrivals.** It is under-utilized, costs a bunch to maintain and there are plenty other options. So it is a good one to chop.

What about **KSBA/Santa Barbara** airport and their VOR or GPS approach runway 25? This was also significantly under-utilized, being **flown just 1,732 out of 17,174 arrivals**. However, it is the most commonly used approach for GA traffic, and is the only one available when the wind is favoring that runway. Not such a good one to delete.

The IFP plan won't just review data and statistics, it also engages with the folk using the IFPs to make sure changes are benefiting those it needs to benefit. Santa Barbara won't lose the procedure just yet, although they might get itself a nice new space-based one out of this at some point.

Comments and feedback

If you fly into airports and have comments or feedback on IFPs then get in touch, either by filing in the form, or emailing at 9-AMC-Aerochart@faa.gov. This project is a long, ongoing one, but one that will benefit any operator who flies in or out of the US, and there are **opportunities there to provide input.**

Check out the info

- You can watch the full Stakeholder Presentation here if you want some more info on it.
- You can visit the official FAA IFP site here.