Flight Testing A forum for test pilots, flight test engineers, observers, telemetry and instrumentation engineers and anybody else involved in the demanding and complex business of testing aeroplanes, helicopters and equipment.

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19th January 2009, 05:27 — #1 (permalink)

Milt

Join Date: Oct 2003
Location: Canberra Australia
Posts: 1,143

Hazards of Gas Turbine Exhaust Plumes

Would you have any hesitations in flying a lighty or a chopper through the exhaust plumes of gas turbine powered electricity power generator/s.? If so, how close is too close?

Many units are mounted vertically and all seem to have vertical exhaust stacks.

Hazards may be extreme at close quarters from high velocity high temperature gases at depleted oxygen levels and much turbulence.

Do any sites have warnings and no-go areas.

I expect that some navy chopper pilots have learned the hard way in close association with gas turbine powered ships.

Perhaps no-one has yet considered flight testing.

Reply

19th January 2009, 12:48 — #2 (permalink)

Shawn Coyle

Join Date: Dec 2001
Location: Philadelphia PA
Age: 58
Posts: 1,218

Great point.
Plumes of any sort can hide hazards. I'm reminded of the piston engine guys who found that humidity was a lot higher a long way downwind of the steam plumes from electrical power generating stations.
Air temperature being higher is also an issue - affects performance quite a lot, especially turbine engine performance.

Reply

19th January 2009, 16:37 — #3 (permalink)

FlightTester

Join Date: Jan 2008
Location: Wichita, USA
Age: 46
Posts: 91

IIRC our military low level charts used to have areas of plumes/gas vents etc published in them.

Reply

19th January 2009, 16:43 — #4 (permalink)

steve_oc

Join Date: Dec 2004
Location: Aberdeen
Posts: 55

Doesn't help for onshore, I'm afraid, but there is good guidance for offshore operations in UK CAA CAP 437

CAP 437: Offshore Helicopter Landing Areas - Guidance on Standards |

Publications | CAA

CAA Paper 2007-02 The visualisation of offshore gas turbine plumes is also worth a look

CAA Paper 2007/02: Visualisation of Offshore Gas Turbine Gas Plumes | Publications | CAA

Reply

19th January 2009, 17:28 #5 (permalink)

Wwyvern

Join Date: Sep 2004
Location: Berkshire, UK
Posts: 55

The CAA stuff is probably a good bet. In 1987, on behalf of the CAA, an independent research company studied "Helideck wind flow distortion and hot gas plume dispersal in relation to helicopter operational difficulties when operating to offshore oil/gas production facilities."

We didn't do actual flight testing, but did computer modelling and pilot experience studies, plus simulator examination of pilot reaction to taking off from and landing on offshore decks, with simulated turbulence from structures and gas plumes.

One of the documents we had hold of was a study undertaken by BP on the effects on gas turbine engines of flying through plumes. BP may still have a copy of that in their archives.

Reply

19th January 2009, 19:16 #6 (permalink)

west lakes
Cleverly disguised as a responsible adult

Join Date: May 2007
Location: 230 DCS (original location) 4.0
Age: 52
Posts: 396

If talking about land based sites, most, if not all, of these have a heat recovery system within the exhaust gas stream to heat water and power a steam turbine.

Combined cycle - Wikipedia, the free encyclopedia

this being the case the heat recovery will lower the final output exhaust plume to a fairly low figure.

Reply

20th January 2009, 10:56 #7 (permalink)

Agaricus bisporus

Join Date: Dec 1999
Location: UK
Posts: 780

Suggest you run this thread on Rotorheads, the offshore people deal with these things every day.

Reply

22nd January 2009, 17:16 #8 (permalink)

corsair

Join Date: Oct 1999
Location: Ireland
Posts: 454

You may find this interesting:

Air Accident Investigation UnitFull List of Reports

A Jetranger flew into the exhaust plume of Ringsend power station in Dublin and came down on the beach.

Reply

22nd January 2009, 19:12 #9 (permalink)

Rich Lee

Join Date: Jun 2003
Location: USA
Posts: 267

There have been many incidents of engine power loss associated with oxygen depleted air. These have involved exhaust plumes from gas turbine and coal powered plants. There have also been engine power loss incidents associated with volcanos.

Reply

15th February 2009, 19:59 #10 (permalink)

ianp

Very real hazard on offshore platforms. I am not very experienced on rigs but one day went through the exhaust of one in Morecombe Bay, the

Join Date: Dec 2005
Location: Wiltshire
Age: 45
Posts: 56

loss of lift was quite noticeable. Unsure whether you need to focus your research on the effect on engine power or the local rapid increase in density altitude due to heating and subsequent loss of rotor performance. My money is on the latter.

Reply

15th March 2009, 06:23 #11 (permalink)

MotoMoto

Join Date: Mar 2009
Location: Somewhere Nice
Age: 31
Posts: 9

I have run across a stream of oxygen depleted air and loss of power is quite noticeable. I fly high performance helicopters and this is something to really look for, specially in confined areas near coal mines or any other area where oxygen might be at a minimun.

Reply

15th March 2009, 06:37 #12 (permalink)

Bushfiva
Hippopotomonstrosesquipidelian title

Join Date: Oct 2006
Location: is everything
Posts: 700

Quote:

> confined areas near coal mines

Sorry, can you explain that a little or point me to an explanation? Do you mean methane displaces oxygen, or is something else going on?

Reply

16th March 2009, 13:38 #13 (permalink)

barit1

Join Date: Feb 2005
Location: flyover country USA
Age: 67
Posts: 2,626

I suspect that the power loss in such an exhaust plume is more due to the elevated air temperature than oxygen depletion. I say this because, in every engine control system I'm familiar with, the control will adjust fuel flow to maintain RPM (or some other selected parameter like turbine temperature) regardless of fluctuation in O2 content.

Your OAT gage in the cockpit may not respond fast enough to give you a true picture of temperature changes.

Reply

20th March 2009, 13:43 #14 (permalink)

Double Zero

Join Date: Mar 2006
Location: West Sussex
Posts: 1,046

Possibly of interest,

Alex Henshaw used to navigate Spitfires he was testing back home using the power station cooling towers (and their plume) as a guide to Castle Bromwich - he remarked he was a little concerned that as he let down over a chimney, one day he might end up inside it !

Reply

20th March 2009, 15:42 #15 (permalink)

staplefordheli

Join Date: Jan 2008
Location: Rutland
Age: 46
Posts: 26

I think Corsairs posted link to the AAIU report of an identical incident to the question posed is excelent reading
It is not just the heat and condensation but the fact that the stream is less than a 1/3 of the recommended safe oxygen content for turbine (or for that matter piston) operation. Note though the AC was very close and in a low forward speed.
Perhaps all exhaust flues should be painted red and white as is the norm in the Eastern block countries
There is a nice new gas turbine plant with very high flue stack right alongside the East side of the A74m 1 mile north of Lockerbie Dumfries. I point this out as it is a popular transit route for low level rotarys following the A74m North to South on VFR running from Carlisle to Scotland, however at cruise speed and at a FL of 1000ft or greater I doubt that the contact time with the depleted air would ever be enough to cause a flameout.

Last edited by staplefordheli : 20th March 2009 at 15:47. Reason: forgot some text

Reply

21st March 2009, 20:49 #16 (permalink)

Double Zero Join Date: Mar 2006 Location: West Sussex Posts: 1,046	Seeing as plumes by their nature generally show themselves above cloud, isn't painting the towers red & white a bit late ?! This is supposedly the 21st Century, so how about beacons or marked GPS charts...

25th March 2009, 12:26 #17 (permalink)

Milt Join Date: Oct 2003 Location: Canberra Australia Posts: 1,143	Beside the freeway from Melbourne to Avalon down under is a twin stack gas turbine power station running on diesel. There is no visual evidence of the exhaust plumes. A recent addition to the exhaust stacks are 4 flashing beacons around the tops of each stack. Does anyone know whether the beacons are a regulatory requirement and is there a NOTAM specifying overflight restrictions?

25th March 2009, 20:13 #18 (permalink)

Irish_Stu Join Date: Jul 2007 Location: Belfast Posts: 79	*If talking about land based sites, most, if not all, of these have a heat recovery system within the exhaust gas stream to heat water and power a steam turbine.* *Combined cycle - Wikipedia, the free encyclopedia* *this being the case the heat recovery will lower the final output exhaust plume to a fairly low figure.* Not strictly true. Granted, most of the GT power plants built nowadays are "Combined Cycle" (where the exhaust heats water to power a steam Turbine), however there are still a fair few "Open Cycle" plants around. I work at one such plant, and the GT exhaust exits the top of the chimney at around 500 degrees celsius...

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As these are anonymous forums the origins of the contributions may be opposite to what may be apparent. In fact the press may use it, or the unscrupulous, or sciolists*, to elicit certain reactions.

*"sciolist"... *Noun, archaic.* "a person who **pretends** to be knowledgeable and well informed".