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Foreign Affairs, Defence and Trade Committee
Joint Strike Fighter Inquiry
Department of the Senate
PO Box 6100
Parliament House
Canberra ACT 2600

RE:THE PLANNED ACQUISITION OF THE F-35 JOINT STRIKE FIGHTER

Dear Chairman and Committee Members,

Please find enclosed a supplementary submission. This submission addresses the relevancy of the 5th Generation ZOCT Metrics table presented by Air Power Australia on Tuesday the 22nd of March 2016. I trust it will be of use to the committee in their deliberations.

I commend this to the committee.

Best Regards

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The 5th generation ZOCT metrics table. Does it actually matter?

One of the most interesting topics that emerged from the public hearings into the inquiry on the Joint Strike Fighter was the Air Power Australia 5th generation metrics table. It certainly provoked a spirited response from parties such as the Sir Richard Williams Foundation, Lockheed Martin and the Department of Defence. The key question to be addressed is does it matter?

A review of open source information shows that the material presented in the Air Power Australia 5th generation metrics table is accurate. The following information puts the analysis beyond any doubt:

Su-35S Avionics - https://youtu.be/rBe4YXmBusU

A demonstration of the Sukhoi Su-50 PAK-FA at MAKS 2015 - https://www.youtube.com/watch?v=hU1sG0bueeE

Also here is an in-depth analysis of the potential of the Sukhoi Su-50 PAK-FA,

Overall analysis - http://www.ausairpower.net/APA-2010-01.html
Analysis of the Stealth characteristics - http://www.ausairpower.net/APA-2012-03.html

These analysis performed by Air Power Australia on the Sukhoi Su-50 PAK-FA, have been cited in military dissertations by the Greek, Finnish, Canadian and United States Air forces. It should also be noted that the first analysis was published on the 15th February 2010. This has accurately predicted the performance potential of the Su-50 that is now coming to fruition.

The less than modest aero propulsive performance of the F-35 is also not in question. This includes a sustained turn rate of 4.6g and the results of the Basic Fighter Manoeuvres test conducted in January of 2015. Pitted against a twin seat F-16D with drop tanks, the F-35 was found to be at a distinct energy disadvantage. As I noted in my first submission, this is something that can not be corrected with software modifications; it is hard built into the design of the F-35.

Advocates of the F-35, such as Dr Andrew Davies of the Australian Strategic Policy Institute, argue that such parameters, particularly aero propulsive performance, are now of secondary importance in air combat. They contend that;

- the F-35 will be invisible to radar in aspects and across all bands;
- the AIM 120D AMRAAMS will hit their target every time; and
- data fusion gives the F-35 the information advantage.

The key question is whether or not these claims stand up to close scrutiny.

Firstly one of the worst kept secrets about the F-35 is that the stealth of the aircraft is limited. It can be readily shown that the stealth of the F-35 is optimised in the forward aspect in the X and Ku Bands only. If this wasn't the case, the US Navy and Boeing would not be lobbying so aggressively for the next generation Growler despite their acquisition of the F-35C. Also on September 9 2014 the Royal United Services Institute published an article called "The limits of stealth". The author Dr Igor Sutyagin has a Masters in physics and was on officer in the PVO (Russian Air Defence Forces). In the article he stated,

"Unlike Western states, Russia has been constantly developing low-band radar technology since 1930s and has achieved impressive results. By combining modern radar signal shapes and radar-return processing algorithms, modern Russian low-band radars have an error box small enough to enable surface-to-air missiles (SAMs) or air-to-air missiles (AAMs) with active or infrared seekers to be flown near enough to low-observable targets to acquire them and initiate terminal homing."

He then comments specifically on the susceptibility of the F-35 to L-Band radar detection.

The F-35 can also be detected when its weapons bays doors are open. The following link illustrates this,

https://youtu.be/4amnP87r1a8

Take a look at the time stamp from 1-7s. This is the time it takes to open and close the weapons bay doors. The total time elapsed is 6s. How will the F-35 remain invisible during a weapons release event? This is a particularly pertinent question if the weapons bay doors need to be opened on multiple occasions, or opened in flight due to thermal concerns as identified in the 2015 DOT&E report. This is a very real concern for the F-35s that will be based at RAAF Tindal in the Northern Territory.

Another key question is whether or not we can be assured that the AIM-120D will eliminate its target every time. This is a critical because the Sukhoi Su-35S and Su-50 PAK-FA can supercruise and manoeuvre at 58000 ft to 60000 ft [(1)(2)]. In contrast, the F-35 has a service ceiling of 50000 ft [(3)]. Due to its less than modest acceleration performance [(4)], the F-35 will most likely have to launch its AIM 120D from a cruise condition of Mach 0.8 and an altitude of 40000ft. The typical burn time of an AIM-120 motor is 10-15s [(5)].If the target is at a range of 50 - 100 km, the AIM - 120 will be gliding and having to climb. Even if the AIM 120D is fitted with a two pulse stage motor and the second stage fires closer to the target, it will still be compromised on speed because of the altitude differential. This gives the defending pilot extra time to respond effectively to an AIM 120D attack. Given these circumstances, how can it be guaranteed that the AIM 120D will eliminate an opponent that can do this: https://youtu.be/D9Mocle6Wzk?

An interesting counterpoint is that an AIM 120D launch from an F-22 will have none of these liabilities. This is because the F-22 can supercruise and operate at an altitude of 60000 ft. Consequently, the missile will be launched with greater kinetic energy and it has altitude parity. This greatly enhances the probability of the kill. It also illustrates that aero propulsive performance is just as critical in Beyond Visual Range (BVR) engagements as in Within Visual Range (WVR) engagements.

While some will claim that the Su-35S and Su-50 don't have the sensors or electronics to defeat an AIM 120D attack, there is a vocal body of opinion in the USAF arguing to the contrary: http://nationalinterest.org/feature/the-russian-bear-roars-the-sky-beware-the-deadly-su-35-11799

Despite these deficiencies, F-35 advocates claim its data fusion and information advantage will save the day. If the F-35's software is ever debugged, its sensors and networking features should give the pilot a good view of the battle space (assuming that data fusion platforms such as AWACS are in place, and the F-35 is not subjected to cyber or jamming attacks). The critical question remains: how will this be effective if you can be detected whenever you have to release a weapon or you can be seen by counter stealth radar? Furthermore, how are you going to guarantee you can kill an opponent- even if you have the information advantage - when you have neither the altitude nor speed advantage? This is critical because missiles such as the AIM 120D, when launched from an F-35, will have to overcome a significant kinetic energy differential to eliminate a prospective

adversary such as the Su-35S and Su-50. This makes an AIM - 120D kill far from a foregone conclusion.

It is for these reasons that the Air Power Australia 5th generations metrics table is a relevant piece of analysis. Airframe performance is critical in any analysis of air combat capability, and dismissing its significance is naive at best. THIS APPLIES NOT JUST IN WVR ENGAGEMENTS BUT IN BVR ENGAGEMENTS AS WELL. If the stealth of the F-35 is ever compromised - and its missiles don't perform as advertised - the F-35 will have no option but to fight its way out of a corner. The F-35's less than modest aero propulsive performance greatly limits the effectiveness of its primary air-to-air weapon: the AIM-120D AMRAAM. Given these facts, it is no surprise that the former head of the USAF Air Combat Command, General Mike Hostage stated on February 3 2014: "If I do not keep that F-22 fleet viable, the F-35 fleet frankly will be irrelevant. The F-35 is not built as an air superiority platform. It needs the F-22."

References

1) Su-35S Performance Data - https://en.wikipedia.org/wiki/Sukhoi_Su-35
2) Su -50 Performance Data - https://en.wikipedia.org/wiki/Sukhoi_PAK_FA
3) F-35 Altitude - General Mike Hostage - “The F-35 doesn’t have the altitude, doesn’t have the speed [of the F-22]," - http://aviationweek.com/blog/f-35-stealthier-f-22

and source on Maximum Altitude of 50000 ft

http://aviationweek.com/awin/f-35-jsf-testers-report-progress-problems

4) An analysis was done by Air Power Australia of the F-35A Transonic acceleration time from Mach 0.8 - 1.2. The results can be found here,

http://www.ausairpower.net/jsf.html

This work was also referenced in this report,

http://nsnetwork.org/cms/assets/uploads/2015/08/F-35_FINAL.pdf

The relevant curve is attached at the end of this presentation. The acceleration time was 60s with a 50% fuel load and 2 AMRAAMS. This was verified in the Pentagon DOT&E 2012 report when the acceleration time was increased by 8s after flight testing showed it would not satisfy the original specification.

The other point that needs to be raised is technically the F-35 could make a missile launch at 50000ft. However if the threat is detected at a cruise condition of say 40000ft and Mach 0.8 could the F-35 get 50000 ft in a time that is tactically viable? This is a key question to be addressed because if it takes in the order of 60s to accelerate from Mach 0.8 to Mach 1.2 at 30000 ft how will it perform when it is at higher altitude and having to climb?

5) AIM 120 Motor Manufacturers -

Orbital ATK - https://www.orbitalatk.com/
Nammo - https://www.nammo.com/what-we-do/rocket-motors/amraam/amraam/

The committee should be able to go straight to the source to verify the AIM 120 Motor Burn time.

A Open source analysis - AIM-120C-5 Performance Assessment for Digital Combat Simulation Enhancement - Funk and Tyrell 2014

Comparison: Acceleration Performance at 30,000 ft - ISA