

# Blues Skies Podcast

## Season 1, Episode 32

LCA Part 2 - Suneet Krishna: from filming  
first flight to weapons release

PR Ganapathy:

Hello and welcome to the Blue Skies Podcast. I'm PR Ganapathy, your host.

It is my great pleasure and delight today to continue our series on the light combat aircraft, the Tejas, with another test pilot who's flown that aircraft extensively. Group Captain Sunit Krishna was involved with the program almost from the first flight onwards, has flown it extensively.

He was commissioned into the fighter stream of the Indian Air Force in 1989 as part of the 144th pilot's course, became a test pilot in 98-99 as part of the 21st Test Pilots course and left the Air Force officially in 2012, but continued to fly for DRDO / ADA on the Tejas. And so about 26 and a half years, 45 different types of aircraft, about 5500 hours of military aviation. We're going to have a fascinating conversation with him today. But first things first. Welcome to the program, Group Captain Krishna. Thank you so much for speaking to us.

G/C Suneet Krishna:

Hi. Good morning, Guns. It's my pleasure to be here today and speak to you and indirectly to a lot of enthusiasts who follow the Tejas program and other programs. And it's really a pleasure for me to be here and speak to all of your guests.

PR Ganapathy:

Wonderful and the pleasure's all mine. So like we do with most of our guests, we'd love to get to know them, get to know their background. So I'd love to hear where you grew up, what your influences were and what motivated you to join the service. And what was some of that initial arc of your career? Which aircraft did you fly wherever you posted leading up to when you became a test pilot and got involved with the LCA growing up.

G/C Suneet Krishna:

So indeed, I have to go back a long way for this. Well, I was born in Jalandhar in Punjab, where my dad was working at that time. Later we moved to Indore in MP, where I did my schooling. Coming to motivation for joining NDA. Okay. Frankly, I had no clue about military service. It just happened that I appeared for the NDA written exam as a practice exam for my engineering entrance. And later when I was called for the interview, I went to Mysore just because they were giving a free second class return ticket to me. So I went there, went

through all that and got selected. But when I actually got selected, then I started thinking about it. And I've always had a lot of interest in aircraft and all flying machines and their working. So when I was selected as an Air Force cadet, I immediately left my engineering and joined NDA. And then, of course, you just go through the grill and go through training and graduate. I graduated from NDA. Then I went to the Air Force Academy. I flew the Kiran Mark 1 and the Kiran Mark 2 jet trainer.

PR Ganapathy:

Okay. So you were an all jet batch in that sense?

G/C Suneet Krishna:

Yeah, we were all jet batch and then commissioned in the fighter stream and it was 1989.

PR Ganapathy:

I've always wondered about your first flight ever operating an aircraft, being a jet. What is that like? Because I started off in a basic Cessna 150, which is a nice, easy, gentle aircraft for somebody to learn on. But Kiran is quite a complex machine because it's a jet. What is it like?

G/C Suneet Krishna:

It is actually... you don't have time to think about it. When you go into an aircraft, you're so busy, you get so busy and especially the initial days you are repeating things and learning things and it becomes like a drill and there's not really too much time to look around and enjoy the flight. But over a period of time when you do your first solo and then that is a time actually, you start enjoying the scenery around and you start enjoying the aerobatics and then it goes on and flying is amazing. It just frees you in different ways and lets you do so many things up in there all alone.

PR Ganapathy:

Very true. Super. So after commissioning, commissioning into the fighter stream?

G/C Suneet Krishna:

In those days we went to the MOFTU that is the MiG operational flying training unit and in those days there was no intermediate fighter trainer like the Hawk nowadays. So we were directly sent to fly the MiG-21s at MOFTU and it was a little jump to fly a frontline fighter like the MiG-21, which is definitely not one of the easier aircraft to fly as a rookie fighter pilot. But then there was no choice in those days and we started flying and for about a year and a half we flew the MiG-21 and then I later flew the M-23 BN and MiG-27 while serving at 10 Sqn, and later 222 Sqn in the Air Force, underwent a few in service courses along the way, including the Pilot Attack Instructors course at TACDE.

And then somewhere around 1998, I was selected to undergo the 21st experimental test pilot course at Ace and graduated one year later, as you mentioned.

Ganapathy:

You always had not just an interest in aircraft but also in how they work. Was that the

motivation to become a test pilot, to peel those layers of the onion a little more?

G/C Suneet Krishna:

I was actually always interested in flying machines. The technical aspect of flying machines, systems, they fascinated me and in the squadron also we always looked up to the senior test pilots who were serving in the squadron and we felt that the test pilots are in connect with the future and they always have interesting things to do and see things which in normal squadron you don't really experience those. So there was kind of something that you have to be the best to be a test pilot and you always try to achieve that and it's a dream. It was something like that for me.

Ganapathy:

Lovely. And the Test Pilot's school is quite an intense thing and you go back to differential calculus and so on and so forth. But you were an engineer. Did you find it easier than most others? And what was TP School like? Which aircraft did you do your preview on? And if you can just describe what the preview is all about.

G/C Suneet Krishna:

Yeah. So it's like that we joined the military thinking that was the end of studies. But contrary to the common belief, you realize that in the Air Force, military, studies never stop. And even when you rise to a very senior positions, you're always going through exams for everything that includes promotions, flying proficiency, and so many in service courses and so on, and just always got to pass some exam and study for them.

So the experimental test pilot course is actually approximately eleven month course, and it is definitely one of the most grueling courses in the Air Force, Besides studying advanced aerodynamics, mathematics, electronics, you end up flying so many aircraft types and all concurrently.

And the test pilots and the test engineers actually engineers actually undergo the course together. So it's kind of an exposure into each other's world, and we get exposed to various aspects of aircraft design, system design, weapon systems. And there's so many flight test techniques in the design of aircraft. So you actually go through learning all those it's jampacked course.

There's a lot of assignments and there's a lot of report writing which are part of the course. And essentially, it gives you a great confidence in handling various types of aircraft that include fighters, transport types, light aircraft, and even an exposure on to Rotary aircraft. I mean, you never otherwise flown a helicopter or something, but you also get an exposure to a lot of future technologies.

You get to visit few flight test facilities and aircraft industries in other countries as well, and you get to get an overall perspective of future of aviation as such.

And you asked me about the preview aircraft. Yeah. Every student pilot at the end of the course, he is assigned an aircraft which he's not never flown, and he has to fly that aircraft

as a new aircraft, and he has to fly it, assess it against the laid down qualification requirements, and the end of the assessment, you got to write a thick report. It's more like a thesis, and then present it in front of audience, including some kind of a jury who question you. And it's more like defending a doctorate wherein everybody in the audience is basically trying to take your pants off. So for me, it was the Mirage 2000, and I'd never flown it, it's a very modern aircraft and a beautiful aircraft, and I flew that, wrote my report, defended my thesis, of course, and graduated.

Ganapathy:

I'm sure there were people in the audience who are very familiar with that aircraft and passionate about its strengths and very defensive about its weaknesses.

G/C Krishna 11:45:

Essentially, fighter pilots are guys with big egos and people who have actually flown that aircraft in the squadron, they're really passionate about it. And if you say anything critical about that aircraft, they don't want to listen to it and you go into big arguments. But, yes, it's part of the course and you bring out the shortcomings and you say, okay, it's an exercise, that's all.

Ganapathy:

And so after that, typically test pilots spend time in the FPS, the Flight Test Squadron, isn't it, where you're testing new aircraft and systems, did you?

G/C Krishna:

So all of us, after we graduate from the Test Pilot's School, we go and serve in the Flight Test Squadron, and then we are assigned different trials on different aircraft. So each trial is actually a team of test pilots and test engineers and you are asked to undertake certain tests and trials for certification and assessment. So that's what we did. And I served in the flight test squadron at ASTE.

Ganapathy:

What are some of the interesting things you were involved with at that time?

G/C Krishna:

Yes, actually, in 99, as soon as we graduated, Kargil was already on and Kargil operations had begun and ASTE got majorly involved in testing of various weapon systems. So obviously, I too became part of teams who are integrating and testing some of the weapon systems on the MiG-27 and the lightening laser designator pod on the Mirage 2000. Right.

Ganapathy:

The one that was finally employed to devastating effect on those Pakistani bunkers.

G/C Krishna:

Yeah. On the Mirage 2000, the new laser designated pod was integrated and the laser guidance kits were put on the dumb bounds and the same aircraft, actually, once the certification got over, the aircraft were taken up to the squadrons. And finally the squadrons

dropped the same weapons to destroy the targets on Tiger Hill and all those nearby positions.

Ganapathy:

It must have given you a lot of satisfaction professionally, that what you're working with goes into implementation immediately, immediately after the course, you get to do so many trials.

G/C Krishna:

It was really an opportunity for us and to see those weapons being used and then successfully and to great effect, it is very satisfying.

Ganapathy: 14:38

Changing Gears now to the LCA, the LCA program, where was it at? How did you get involved with it initially and what were some of your initial experiences with the LCA program?

G/C Krishna:

So LCA, the light combat aircraft testing was essentially being carried out by the National Flight Test Center, which was part of the Aeronautical Development Agency, and ASTE was kind of involved to give feedback on various design aspects and overall monitor the progress of the program. So initially I got involved in the Tejas program as an ASTE representative to give inputs on various design aspects. I had to attend various design review meetings, fly the flight control development simulators, etc. Then at some time I was attached full time to the National Flight Center because they needed more support, more people there. So I became part of the team and was contributing to the flight test effort towards the LCA first flight, so that was the whole only thing that time. I was a young Squadron Leader and helping out the senior test pilots in design activities and things like that. And slowly I gained experience and became a full time member of the team. I joined the NFTC on deputation from the Air Force and then it was a full time LCA Tejas.

Ganapathy:

So I want to take you back to almost to the day a year ago. Sorry, 21 years ago. The first flight, I think you with Air Marshal, that time Wg Cdr Nambiar, were in the chase Mirage and you were filming it. So just tell us what the mood was like building up to the first flight. What was that experience? What was the first flight like, put us in the cockpit with you, so to speak.

G/C Krishna: 16:40

Yeah. Before the first flight, actually, there was a big build up towards the first flight. There are series of activities and there were a series of full performance engine runs, followed by many taxi trials. Initially low speed taxis and then followed by high speed taxi runs. And just before the first flight, there was a final high speed incident where the nose wheel was lifted off the ground and then put down and the aircraft was decelerated. So that was like, okay, now we are ready for the first flight. There were numerous meetings to finalize the first flight profile. And once it was done, the flight team formulated all the SOPs, the telemetry communication protocols and finalized all the contingency actions and also flying the chase

and where the chase should be positioned and for filming and things like that, and for support. So all the protocols were worked out and the drills were practiced.

And there was also the final first flight safety review by certification agencies and all the heads of design teams and things like that to decide whether we were ready for the first flight. Yes, there were little apprehensions, but overall the NFTC and the senior leadership was quite confident that it was time to put the aircraft in air and we could conduct the first flight safely at NFTC.

There was a lot of excitement and on the day of the flight, of course, it was full house with the Defense Minister, Mr. George Fernandes and Chief of Staff, who had both come down to witness the first flight. And that added to the excitement. I had the opportunity to fly on the Mirage 2000 chase, along with then Wg Cdr Raghu Nambiar and my responsibility was to film the Tejas first flight in the air and carry out close inspection of the aircraft in the air to look for any abnormalities, any oil leaks and things like that. So that was how it started. We had the briefing and then we walked [to the aircraft]. Just went like a drill and it was extremely busy. So we got airborne first and then joined up with the LCA as soon as it lifted off the ground and then stayed along with the Tejas on its first flight. Throughout the flight, till landing. It was a beautiful sight to see our own tiny little white painted aircraft flying so majestically. In the air, and it looks so amazing in the air. And the landing was perfect with no surprises. Huge celebrations followed the event. It was a big milestone, and the stage was now open for the long journey for the testing, a lot of publicity pictures, photographs, congratulations, all that followed.

Ganapathy:

When did you get to first fly the aircraft and what are some of the things that you were doing at that time? I presume that first flight is a very restricted kind of a set of maneuvers that could be performed, and then you all kept gradually expanding the envelope, so to speak, right?

G/C Krishna: 20:20

Yes. That was like any other program. So you initially are very conservative when you fly the very limited envelope. So after the first flight, the Technology Demonstrator 1, the LCA TD-1. It flew about twelve flights, and then it was grounded for modifications. So these twelve flights were essentially flown by Wg Cdr Kothiyal and Wg Cdr Rajeev Nambiar.

Subsequently, both the officers got posted out to take up new appointments in the Air Force. And meanwhile, the LCA Technology Demonstrator 2 came up for engine runs and taxi and all and preparations for the first flight. So Wing Commander Tarun Banerjee and self, we got involved in that. And Banerjee did the first flight on TD Two, and thereafter I flew TD Two on its fourth flight. And of course, TD-1 came back into the program later and we started flying TD-1, TD-2. And then later I did the first flight of the Tejas Prototype Vehicle 1, and then secondly on the Limited Series Production Vehicle number 4. And now there was then Group Captain Bhaduria, Wg Cdr Tyagi, they all also joined the program, and this was a big team, and we continued handling all these aircraft.

Ganapathy: 22:00

Now TD-2 itself, if I recall correctly, you were involved with demonstrating that at Arrow, India. That must have been fairly early in the program. So what is that experience like and what are the sorts of maneuvers you were capable of doing at that point?

G/C Krishna:

The moment the Tejas was flying, everybody wanted to see it at the air show and because it was our program and everybody wanted to see and it was kind of a lot of excitement about it. But at that point, the aircraft was cleared to fly only a very, very limited envelope and was even less than 2G. No inverted flying was allowed. Only up to very low speeds were allowed. You couldn't do any high speed runs. And so whatever in that when we started flying, we start showcasing LCA in more like turns and lazy turns and just to show that the aircraft was present at the Airshow. So it started like that. And of course, there was excitement and we built a profile to showcase whatever we could. And subsequently every airshow, we improved on [performance] our as per the available envelope. And the demonstrations became more exciting and more spectacular to say.

Ganapathy:

Yeah, great. Now, you were also involved with the formation flying trials, I was told, and it's a very unique aspect of military aviation compared to civil aviation, that formation is how you guys fly most of the time. And I presume that's an important thing in aircraft and the quality of an aircraft. What are you testing for when you're doing formation flying trials? What are the issues that you should be aware of?

G/C Krishna:

So formation flying is an essential part of military flying. I mean, a lot of tactics are based on formation flying. So if I have to fly information, they should be easy to fly. That's a requirement. In formation and maintain position. And the first opportunity to fly formation came for the naming ceremony by the Prime Minister of India, Mr. Vajpayee. And that is when we actually started flying in formation. And for the demonstration, we took off in two aircraft formation and then did a few turns around in formation and that's how it started. And then subsequently for a lot of fly pasts and all we did in formation.

But essentially you are testing the aircraft for flying in close formation, for position keeping and maintenance and ease of maintaining that. And if there are any problems or if there are any design improvements required to do that task, so all that gets assessed and it's taken care and care of in the flight control design. And of course, we have a lot of opportunities flying in formation, and we even did few photo shoots.

Ganapathy:

in formation flying. What are you doing differently from regular flying that you're testing for that the aircraft has to have qualities about?

G/C Krishna:

So the thing is, the aircraft is a high gain flying. When you're trying to maintain position with respect to the other aircraft, you're giving continuous control inputs. It's manual flying. So

you are entirely going by the lead aircraft, maintaining position. The formatting aircraft just stays in, maintains his position. And to do that, he has to virtually all the time, your controls are moving, so your stick is continuously moving, your throttle is continuously moving. So the flight controls, as well as the engine is going through a lot of grill. Right. So you see that there are no problems, there's no unwanted oscillations. We call it the pilot induced oscillations. He doesn't end up giving... there's no tendency to overcorrect. All this should be easy to maintain formation. So it should be like... without undue effort. So that makes it a good aircraft which can stay in formation nicely and fly, including maneuvering in formation.

Ganapathy:

Got it. Now, you had a hydraulic failure fairly early in the test cycle. Tell us about that. What happened? What were you going through at that time? How did you deal with it?

G/C Krishna: 27:20

How do I say. Tejas, the aircraft, the flight controls and many other systems are operated hydraulically. So they just have basically two totally independent hydraulic systems. Okay. And all the flight controls, the undercarriage, the brakes, they all operated hydraulically. And it was about the 16th flight on the LCA. As soon as I took off for our test flight, I put my undercarriage up and I had a hydraulic one failure pop up on my warning display. And instinctively the moment it happened, because now you can lower undercarriage only on the other hydraulic system. So instinctively, I just lowered my undercarriage and turned down wind, slowed down my speed to come in back for an immediate landing. But as soon as my undercarriage came down and locked, I had a hydraulic two failure. Now, this was like an improbable thing. You cannot have two hydraulic systems failing at the same time. But luckily my undercarriage was down and locked. And now I knew that there was a very limited control authority available and most of the hydraulic systems are not available. I was in communication with the telemetry. They told me that both the hydraulic system, the fluid had leaked out and the isolation valves had opened, sorry closed. In that sense, when I landed, I was heavy weight, but I had no brakes, I had no nosewheel steer to maintain direction and the shimmy dampers had no hydraulic fluid, so the the aircraft went through, experienced a lot of nose wheel vibrations, very severe vibrations, wherein even the head of display just came off the mounting. And we had a lot of broken things around. But yes, at the end, I could use the parking brakes to stop while on the runway. And the good thing was we could find the exact reason for it. And because the gear was down, we could land back because otherwise I would have had to eject and we would have had the first ejection on that aircraft. And of course, when you lose the aircraft, it's very difficult to find out what was the exact reason for the failure. But in this case, because the aircraft was on the ground, we could identify the exact reason, which were basically two hydraulic flexible hoses in the undercarriage bay, which one of the hoses just gave up because of extreme flexing. And the hydraulic fluid actually coming out to such a high pressure cut through the other hose and caused the second hydraulic failure. I mean, improbable, but it happened and led to some design improvements. And of course, we had a much better design now and all the rectification took place. It was exciting, but I think the good thing was recovered and nothing was lost, right?



Ganapathy:

Very nice. Now, moving on to this carefree handling or carefree maneuvering of the aircraft, which, as you've described, the first flight had very limited range in terms of the speeds you could go or how much bank you could put on or how much G you could apply. And then that kept expanding. So what is this carefree maneuvering? How do you determine how you can do that? And what's that process like? How do you test it?

G/C Krishna:

Just to simplify the thing... Yes. Tejas we slowly opened up the full envelope. And in the full scale engineering demonstration phase, we opened up till supersonic and the Max altitude, et cetera. And then the envelope kept opening. And when the envelope was fully open, in terms of Max altitude, Max speed, Max G, and things like that, the other requirement was that aircraft should be carefree to maneuver. So what is carefree actually? In a conventional aircraft, the cockpit controls are directly linked to control surfaces, on the wings, on the rudder, through link rods, cables, and all the older generation aircraft. But Tejas being a fly by wire aircraft, the control input from the pilot first go to the flight control computers. And then, depending on various aircraft parameters, actually, the computer sends out the command signals to the aircraft control surfaces to deflect and give out the optimum maneuver to say whether it's a turn or it's a pitch movement or whatever.

So the pilot really doesn't have a direct link to the control services. This enables, because there are now computers in the loop, the computers always know what are your... they always know what is the aircraft, speed, aircraft, altitude, what are the limits? And you can put the limits in the software itself so that now the computer does not allow the aircraft to exceed any of these parameters. Whereas in a conventional aircraft, the pilot has to himself observe the boundaries of low speed. He has to prevent aircraft from stalling, even the limits of pitch, attitude, or maneuvering. He has to follow those limits. Okay. And it is possible that in the heat of the moment, he can exceed. And aircraft may lose control if you exceed in certain cases. Whereas in the fly by wire aircraft, you can now build these boundaries in the envelope, and now, actually, it takes off the load of maintaining or keeping within the limits. And the pilot can actually maneuver the aircraft in a carefree manner.

The issue with this is that, designing the control boundaries, is that you cannot be too conservative in these boundaries. Otherwise, you lose out on the performance. Then you're limiting the aircraft to go to the extremes. That is where the testing comes in. So you got to test the aircraft to find, what are these boundaries? So in a careful, progressive way, you take the aircraft and you test the aircraft to find, what are the limits? What is the low speed limit? What is the stall limit? What is the pitch limit and where should you be putting these boundaries? And now, during the testing, you find the boundaries. So you give additional authority to the pilot to take the aircraft to those limits. Test that all is okay. Then you build these limits and test out the aircraft again to see that these limits will never be exceeded by a squadron pilot during the normal course of operations and operational flying. So it's a big process, a long drawn process that goes through a lot of iterations and changes and things like that, and that's how Tejas today is quite a carefree aircraft. There are a lot of safety features in the flight controls, and the pilots can really maneuver it without any fear of exceeding these limits. In some sense, it's definitely making the aircraft much safer for the

average pilot.

Ganapathy:

But is it going to take an edge off the really good pilots? Does it do that?

G/C Krishna:

No, I don't think so. Because first of all, it lets you maneuver the aircraft to almost the designed limits. It actually takes it there in a much more effective way. And it gives you much more pleasant handling qualities. And a lot of variations which normally happen from aircraft to aircraft, are taken care of, and they're hidden from pilot knowing because the system takes care of all those. And this makes it much simpler and efficient,

Ganapathy:

Reduces the workload of flying, allows them to concentrate on the mission,

G/C Krishna:

On the mission. Absolutely

Ganapathy: 37:05

Right. So "mission" gives me a good segue into my next set of questions, which is the purpose a fighter aircraft is to fight, which means either deliver weapons to the surface or anti aircraft, Air to Air, and you were involved with a lot of that work. So I just love to hear the work that you did, starting with maybe the R 73 missile that you were involved with firing, both unguided as well as guided with maneuvering target and things like that. So just love to hear your experiences on that.

G/C Krishna:

Yeah. As you said. Rightly, a fighter aircraft is no good without the weapon systems. I mean, it's not designed for an airshow. Finally, you have got to fight and fire and destroy the targets, whether in the air or on the ground. So as required, The Air Force wanted a long list of weapons systems, both Russian and Western origin, to be integrated on Tejas. And all those weapons have to be integrated in all the desired modes of attack, modes of delivery. Luckily, because I stayed in the program for long, I got to fire almost every weapon from Tejas and to take it to certification and release to service. So we integrated a lot of air to ground weapons. And for the air to air, we integrated the R 73 missile.

The R 73 is basically a close combat missile of Russian origin. And initially, the R-73 was only integrated way back in 2005-06 in the boosted, non guided mode. Basically, it was a dummy missile to map the missile plume characteristics, how it affects the aircraft structure or engine airflow. Air Cmde Harish did that firing, which is unguided firing. And later in the second phase, the missile was now fully integrated with the aircraft avionics systems. So then we started firing a lot of dummy missiles, initially to check out the plume characteristics, and we fired them in the corner of the flight envelope, the Max altitude, Max speed, just to cover the full envelope for the certification process and then after we proceeded with the guided firing so you can actually fire the missile in different modes wherein you can actually slave the missile head using your helmet mounted display system which is a dash system on

the Tejas or you can actually use the radar system to guide the missile so there are both modes available. So the first guided firing was done on a flare bomb target which was released from another aircraft and using the HMDS I achieved an off-boresight lock on on the target and then fired the missile. It was a successful launch and kill. And we fired several more missiles in that mode later and then subsequently I fired another R-73 on a maneuvering target which was representing a flying aircraft. So the flare target was actually towed by a Lakshya drone which was launched from a Navy ship of the Goa Coast and the target was actually picked up on the multimode radar on the Tejas and then I got a lock on the target and fired the missile and the good thing was we captured the entire sequence of the missile on the infrared camera and it was really a wonderful sight to see the missile fly to the moving target, explode as it hit it and then destroy the target completely. It was awesome to see that. Of course then we fired many many more missiles and of course then we fired a lot of air to ground weapons initially all the dumb bomb, practice bombs and then 1000 pounders, some Russian 500 kg bombs and things like that and of course we integrated the laser designator pod and the laser guided bombs on the Tejas which was successfully integrated and released to service.

Ganapathy: 41:30

Right. And you mentioned something about the helmet mounted display system. Can you tell us something more about that? And was this the first aircraft in the Indian Air Force inventory to have such a system?

G/C Krishna:

Helmet mounted display systems are... the most modern fighter aircraft have the HMD system. So they have different origins. So some of our Russian aircraft have had helmet mounted sight so they are not a display system but just a sight on the MiG-29 and the Sukhoi-30s wherein the helmet sight is used to slave the missile or other sensors. Later on the Mirage 2000 and then on the new generation HMDS was integrated on the Tejas. So in this system it is actually on the pilot visor the entire flight parameters and slaving and sensor information is projected, okay, on the visor itself. So the pilot is not really constrained to look inside the cockpit on his display, on the multifunction displays and to look for these parameters. He can actually while scanning the skies around he can still see all the aircraft parameters and he can do various tasks of slaving his sensor and things like that, without having an obligation to look inside and that really is a game changer because especially in a close combat scenario, he can slave these missiles and sensors to really off-bore angles whether in the air or on the ground. And it's a game changer in that sense.

Ganapathy: 43:28

Fascinating. And this was developed by us from scratch or is there something, some components of hardware we bought off the shelf.

G/C Krishna:

The HMDS, integrated on the Tejas is the Dash system, which is of Israeli origin and the system is bought from them but integrated by our people and there's a full calibration process on the aircraft. So basically the aircraft always knows where the pilot is looking. So when you move your head around, the aircraft knows what the pilot is seeing and where is

he looking. And the sensors can be slaved to look wherever the pilot is trying to look or point them.

Ganapathy:

Right. And does this now obviate the need for a HUD [Heads-Up Display] or is there still a HUD that is in the...

G/C Krishna

In the latest series of aircraft, they have kind of taken away the head up, but due to the accuracy requirements in certain phases of flight on Tejas, we still have the head up and maybe within even modern systems that someday it will obviate the need of head up.

Ganapathy:

Fascinating. Wow, great. Tell me about the LGB. What was that firing like? I'd also just like to get a sense in the program what are some of the things that you encountered which you then took back to the engineers and then they modified and then it got better. Give us a sense for some of those things with some concrete examples, what sorts of improvements were made.

G/C Krishna:

Okay, so I'll start with the LGB. Okay, so the LGBs are basically the laser guided bombs and they're essentially the dumb bombs and like 1000 pounders or 500 kg bombs, dumb bombs, which are fitted with a laser guidance kit. So it is basically a sensor fitted on the nose of the bomb and on the tail you fit some kind of fins and which can kind of guide the ballistic trajectory of the bomb as it falls down. Okay, so on the aircraft you actually carry a laser designator pod and in our case on the Tejas, we integrate the Lightning LDP, again Israeli pod. So the pod has got actually the cameras, it's got a CCD camera as well as a forward looking infrared camera, and they are mounted on a gimbal so the image can be stabilized. So the pilot basically acquires the target on his multifunction display. You can Zoom in, Zoom out, you can move the cursor around and you can pinpoint on the target where you want the bomb to fall. Okay? So the pod has a laser range finder and a laser designator as well. So when you put the cross on the target and you kind of designate it, the pod actually continuously emits laser beam to that point and illuminates that spot. Okay? Now the kit on the bomb actually acquires the laser spot. And when you drop the bomb, the guidance vanes actually on the bomb, they actually guide the bomb in such a way that you follow this trajectory to seek that laser spot on the ground and the bomb actually goes and hits that laser spot and that enables that gives you kind of pinpoint accuracy. They say you can put a bomb through a window. Otherwise, bombs are affected by a lot of ballistic characteristics, the winds and things like that. So there's always a scatter. But when you put a laser guided kit on a bomb, actually you can put it through a window and destroy pinpoint targets. You would have seen some footage of bombs going, getting dropped in Kargil and through the bunkers. Actually, you can just drop one bomb instead of dropping like ten bombs of conventional types and destroy target.

And as you said, I mean, going back to designers, the entire testing is meant for that. You actually design, test, find the faults, find some bugs and you just go back to design, improve,

change the software, come back and it's an iterative process. It just keeps happening all the time. So every system actually goes through a series of upgrades and changes, gets tested till it gets certified. So that happened all the way, applicable to all the systems and it just continued. Till we had the full certification on the aircraft.

Ganapathy: 48:33

Okay, great. So we've spent almost an hour, and I want to thank you for your time. But before I let you go, you've been an active fighter pilot in a Squadron. There is this weapon system platform that you have developed. Knowing the threat environment that's out there as a Squadron fighter pilot, what is your assessment or sense of the fighting platform, both for surface weapons as well as Air to Air, against the sort of threat environment is likely to face. What's your assessment?

G/C Krishna:

Okay. I would say Tejas is a very, very capable platform and it is the first of all, it is designed and developed absolutely as per the Indian Air Force requirements. Every design aspect is actually reviewed and approved by the Air Force. And this is a process which will continue through its life. There will always be new weapons systems coming in, there'll be new changes, new systems will keep getting integrated on the aircraft and it will stay as Indian aircraft for Indian Air Force primarily. Ok?

And it is a small aircraft and obviously there are certain limitations to what it can carry and how much it can carry. And so it fulfilled the requirements what Air Force laid down for it. And I think it has really come up quite well as a design as an aircraft to fulfill those requirements.

And it is heartening to see the aircraft fly successfully. And with the squadrons now and you get good feedback, you hear good things about the aircraft and they're happy with the design, they're happy with the handling qualities, they're happy with the weapon accuracy, they're happy with the radar performance and things like that. And of course, during the course of service there'll be a few additional requirements that will come up. There'll be additional systems which may need to be integrated and that will keep happening on the program and it's live program. It will continue to be like that.

And of course, the new Mark 1A and Mark 2 designs are really going to take the aircraft to the next level.

I really feel that the aircraft is very capable for its size and it is very contemporary and I've had the opportunity to fly several other platforms and I think Tejas really holds its position.

Ganapathy:

Wonderful. You touched upon Squadron feedback. So what are the jocks in the squadron, on the frontline, what are some of the things they are saying with it? And have you seen them do things with the aircraft that you've been pleasantly surprised by how they've been exploiting what you created?

G/C Krishna:

The good thing is we have very good simulators to train the pilots and the new generation is definitely much more adaptive to new electronics and systems and displays and they are quick learners and they really adapt to the aircraft quite well and to see them, the squadrons flying in various exercises and missions, and they're quite operational now and fully ready.

So it's nice to see that. And people have talked and spoken about how good the autopilot works and how it reduces the workload and how well the systems are integrated and the weapon system, how easy it is to... the radar has a very good performance. There is a very positive feedback on those lines. And of course, there'll be always something we could have done better. There'll always be some feedback on that and that will keep happening as you fly it more and more and more operationally. There will always be some good feedback coming in and the people who are in the design now will take care of it. That's a good thing. We are an indigenous program...

Ganapathy:

That's the beauty of it, is that you don't have to go back to a British Aerospace or a Dassault if you want to make any changes, you just go back to Bangalore and in some cases it may just be a case of changing software.

G/C Krishna:

That's the important thing about having indigenous design and owning a design to say you can do whatever whenever.

Ganapathy:

Fascinating. Wonderful. Thank you so much, Suneet. It's been a delight talking to you. I want to thank you for your service. I want to thank you for the time you've taken to speak to me today and I'm sure the audience is going to thoroughly enjoy this conversation. Thank you.

G/C Krishna:

Guns, thank you so much for giving me this opportunity through this platform to speak to the audience who are so fascinated by aviation and their interest in Indian aviation definitely is a big morale booster for those involved in indigenous programs and I thank you very much and all good wishes. Happy New Year. And Jai Hind.