

Blues Skies Podcast

Season 1, Episode 45

LCA Part 4: Gp Capt Ritu Raj Tyagi

Ganapathy: 0:41

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

It's my great pleasure to continue our series of conversations with test pilots who have been involved with the development of the LCA Tejas. And today I'm speaking to Group Captain Ritu Raj Tyagi. Group Captain Tyagi has a long list of achievements, he was commissioned in the fighter stream in 1986, flew for 24 years before moving from the air force into the National Flight Test Center to continue his work on the LCA. While he was in the Air Force, he commanded the prestigious 14 Squadron, a Jaguar Squadron and has flown many many different types of aircraft is a qualified flying instructor as well as qualified experimental test pilot. Welcome to the program Gp Capt Tyagi, thank you so much for speaking to me.

G/C Tyagi: 1:43

Thank you so much. Thanks a lot.

Ganapathy 1:44

We like to get to know our guests by just hearing where they grew up what their background was, what was their motivation to join the service and what were some of the initial training aircraft that you flew, places that you were based at before you became a test pilot and got involved with the LCA program?

G/C Tyagi: 2:02

Yes, so I started like normal, my father was in the central government. So I started my schooling in Kendriya Vidyalaya and I completed in 2-3 Kendriya Vidyalayas in Delhi and Dehradun. For my graduation once again, I moved to Delhi, Delhi University, Ramjas College. In Dehradun the school where I did my graduation from was next to IMA [Indian Military Academy]. The Kendriya

Vidyalaya where I did my class XII from was next to IMA. And I used to see... a lot of students in our class used to get motivated to join the army and in the holidays also when I used to come, there's a lot of army ... retired and serving officers living all around the place where I live, Vasant Vihar... and so it was looking up to them and we used to call them "Uncles" and they used to take us on treks to Mussourie sometimes, we'll go with them and so and while I was doing graduation, I happened to apply for the Combined Defence Services Examination and that time, we saw a movie called Vijeta and this was an Air Force movie and that really fascinated me. You know, like they, say you know, when we are kids all of us sometime or the other want to become pilots you know that is that kind of thing and my boss used to say that and some never grow up they actually go and become pilots.

I saw the movie Vijetha and that inspiration, that kind of thing is separate but getting selected for CDS, qualifying through the SSB, then clearing the Medical and thereafter making it to the merit list, because there are very few seats in the Air Force, I remember about eight or nine seats for the direct entries in that time. And, and I was... hard work, whatever you call it, I was able to make in the first five in the UPSC. And that's how I landed with Air Force, and my Air Force knowledge was very rudimentary. Even then, I thought the F(P) which I have applied for means fighter pilot, you know, although it was Flying (Pilot). So, you see that from that kind of background, you know, it is... And yes, well, and joining Air Force was like formation for me. And joining and thereafter, flying training. And I came very close to being thrown out of flying during my initial training, because sort of the stress and everything and survived and thereafter. Thereafter, there was no looking back and when, after I graduated in... we passed out in 1986 and joined Hunters. That's when actually I thought there is something in life, which I really enjoy and I'm reasonably good at. So that was a really big thing for me, you know, in terms of getting to know myself and not many people are lucky to have a professional which they enjoy and which they feel that they can do it to their satisfaction and to the other's satisfaction as well.

Ganapathy 5:03

You know Air Mshl Rajkumar used to tell me, he said I can't believe that they actually pay me to do this. And I think a lot of you will say the same thing because you all enjoyed your profession so much. And then you went from hunters to jaguars, I believe?

G/C Tyagi: 5:20

Yes, Hunters to Jaguars. You know, I feel that I've been singularly fortunate... only two people used to go to Jaguars, and I was third when we were in OCU, and somehow one other vacancy came up and I went to 14 squadron, another two guys, my coursemates, they went to 5 squadron. And previous course only two people went to Jaguars. And I saw Jaguars when I was a cadet in Jamnagar. It taxied in and I looked up at the aircraft and oh! I just couldn't believe that such a beautiful thing can exist, it was taxiing with that engine sound... The pilot was that time

was Flt Lt Mata. He showed us the aircraft and I said, "Oh, I wish I could get to fly this aircraft." And it came true, you know, a couple of years later. So that was something really amazing.

Ganapathy 6:05

It is a very beautiful aircraft. Yeah. Then FIS and then you did an instructional tenure also.

G/C Tyagi 6:12

... and then instructional tenure. I was there for 1½ or 2 years. And from there itself, that was in 1996, when I applied for the Test Pilot's Course and got selected.

Ganapathy 6:28

I'm just wondering... why did you choose to go down the test pilot path because it will take you in a slightly different track from the career fighting squadron kind of a path, what was your motivation?

G/C Tyagi 6:43

You see, somehow I met people, like, incidentally, W/C Rajiv Kothiyal was my instructor, in Bidar. I was his pupil. And we'll talk about later... and the kinds of people I met who were test pilots, like, you know Ajit Agtey, Shekawat, there were people that I came across, many people who were test pilots, you know, when I when I was in my formative years in the Air Force... And I said "my God, these are the kind of people who would like to be," you know... as a human being, as a professional... you know, as a senior officer. Look, whatever you call it, you know. So I'm not generalizing, I'm just saying that, you know, the test pilots who I met, inspired me, you know. I looked up to them, I said, "Oh, wow, what it would be like to learn, to go through that kind of course, which made them like this, you know, and, and so I just want, I just wanted to do one course, that's the test pilot course and I applied the test pilot course the moment I became, I earned enough qualification it - seven years of service, thousand hours of flying, green rating, that kind of thing. And I went there. And Harish Nayani was the STFI there. And he said, Son, you're too young. Please do some professional course and come. All thought I did reasonably well in my, you know, selection, written examinations and you know, all those things. And he said, Listen, you why don't you do your instructional course, or FSL or something, some course and then come back later, you have enough age in your hand. And so that's the only thing I wanted to do, actually, you know, in the Air Force. And to do that I had to you know, do the Qualified Flying Instructor's course and wait come back again three years later for the selection.

Ganapathy: 8:24

Right. How did you find the test pilot course and which aircraft did you preview at the end of the course?

G/C Tyagi 8:33

End of the course, it was MiG-29. And test pilot's course is like you know, it's like... it's like... I would say a good marriage, you hate some time and you love some time. So somehow you go along together, you know, and thank God it's for one year, right? So there are moments who hate it. Why you know, why did you volunteer because things got really rough sometimes. I was only with two children doing the course. Even instructors didn't have two children. My daughter was three months old when I joined the course and I had a son who was four and a half years old and my wife at home so and we were living in civil, in that area close to Viman Nagar. With kutcha roads and everything, I had only a two-wheeler. I would be coming back sometimes in the rain and you know and trying to not let your two wheelers that Chetak, the good old Chetak, skid. It was sometimes frustrating some time enjoying, you know... so, I would say it was a kind of there were moments you... you like to say you know, yesterday what is called tough times are today's good old days.

Ganapathy: 9:44

Definitely I think that that picture you just painted for us I think you know for a lot of the audience who think fighter flying and test flying is all about glamour I think you know, outside the cockpit you know one has to live normal lives and like everyone else, and thank you for that

G/C Tyagi 10:02

...everyone else. And test pilot's course is minimum 12 hours a day of work. You know, when everyone packs up six o'clock in the evening is when you sit and you start. And for the tomorrow's preparation briefings and this and that...

Ganapathy: 10:16

...heard about report writing and studying and yeah...

G/C Tyagi 10:20

...so report writing, I stayed for two days in school building to complete my final report. And I didn't come home, I said, "I'll come back with my report". And so I came back at one o'clock in the morning, and I told my wife, "please wake me up at seven o'clock, I have got to go and get this report to my instructor" who's Air Marshal Tiwari, the present Deputy Chief. So... and my wife in the morning, she said, she didn't wake me up. She took the report, took her Sunny [scooter] went to his house and said, "I came to give this report because if I wake him up, he'll start doing something else and start correcting something." And it was lying in that envelope, and he said, "Where's the report?" And he was quite shocked to see my wife early in the morning at his doorstep. That's the way life is. These are the incidents you remember later in life. And we had a good fight when she came back. I said "why did you do this?"

Ganapathy:

So okay, and so I presume after that you spent some time in the flight test Squadron and the TP school

G/C Tyagi: 11:26

One and half-two years in Flight Test Squadron (FTS), and one year in the test pilot's school after that. Three years after, after completing my course. And those two years, once again, like I said, I've been fortunate I was only pilot from Jaguars around that time. There are a lot of projects on Jaguar. So the [inaudible] integration, the ELTA radar integration, the weapons which were integrating, so I was, means I had my hands full and my mouth full also. So that was that was a good time. And yes, very busy time I did a lot of detachment, for weapons and other things.

Ganapathy: 12:08

In fact, we were interviewing AVM Nanodkar, and he was saying that whenever the Air Force gets any new weapon system, Jaguar is often the platform of choice to test it on and integrate it with and so I can understand you would have had a lot of work. Great. So fast forwarding a little bit sir to the LCA. What was your first encounter with it and was that when you were posted to NFTC or even before that way involved in some way with the program?

G/C Tyagi: 12:38

LCA, well not before that, although in 2001 when the first flight happened and you know, we were across the runway when the first flight and every pilot's... test pilot's dream is to fly a prototype aircraft and we all dreamt that. And incidentally, in 1994, when I came for the selection, I came for selection, Air Cmde Harish Nayani was the STFI at that time and right now Air Mshl AP Singh, Airm Mshl Vikram Singh, Cmde Maolankar, right, they also came for selection in 1994 along with me, then I was sent back you know, and the CTP that time Ajit Agtey said... we were all standing in a class, and there was an LCA model in the cupboard... he said "one of you luckily will fly LCA ." And among all those people in that classroom that day, I see how many have flown LCA?

Ganapathy: 13:33

Yeah. Wow. And in fact part of this series of interviews, I'm speaking to Air Cmde Nayani as well as Cmde Maolankar, and so it's fascinating that you say that.

G/C Tyagi: 13:46

... and I was doing my staff college in 2003 to 2004 and from there, you asked for a posting, a choice posting... and normally for my seniority people are going for the commander of the squadron and I wrote NFTC. And I wrote that I want to fly LCA. And then the people from P-staff, they said "listen, son, you should be going for your command now, you know. From there you can come to FTC the other way." I said: "Sir, whatever the case may be." They said, "You should be interested in career..." "It's not that I'm not interested in career, but you know, there are certain things beyond, and to fly LCA my will be my first choice." He said, "are you sure? you know..." and he told me "you know, there are two things in life..." I remember he said "... there are two categories in life...", you know "one is to get what you want, and one is to not get what you want. You know, I hope it doesn't happen like that to you if you get this." I said "No, sir, I'm very sure what I want." And fortunately, Group Captain RKS Bhaduria, later Chief, he was the boss there at that time. And although we have never worked together, but being in Jaguar, he knew me whatever. And he said, Okay, send him here. So that's how my stint with LCA started in 2004. And we were doing FSD Phase one. I think we had done some 60 or 75 flights at that time.

Ganapathy 15:25

Right. So for the audience who don't know, what FSD is, can you just explain that phrase?

G/C Tyagi 15:31

Full Scale Engineering Development and at that time, the thing was, there was a sword hanging over our head. We have to complete... we have to prove certain technologies, you know, and then the further sanction for the program will come, you know, and rest of the world felt in any case that we are wasting our time, you know, and, you know, including quite a few in the Air Force.

And, and sincerely when I came here, I also came, you know, like, it's a more a research and development program, see what you can do, we never had this notion that you know this aircraft, one day, will be inducted in the Air Force, or it has to be operationalized or what. And the same with ADA you know, HAL... although there was excitement, there was this thing that we are doing something new and exciting. And we are doing it after a long time, so we didn't have any template to follow. And it was good and interesting. But if I, if I look back I can remember that time, we didn't have this kind of vision, you know, of course, there were steps, you know, we were determined to get this engineering model to prove this FSD phase one so that we can qualify for full scale development.

And the initial flying was, I would say, quite limited, limited in terms of envelope and what it could do.

And I remember first time, I think that time, the bank angle limitation was 60° when I did my first solo way back in July 2004. So and 3G was the control law that time.. 16° or 14° angle of attack. And so it was very, very, in terms of flying part, it was, I would say just short of boring. And you went up, you did something... No, some, flutter test points and other things. And they're trying to try to do something. And it was very difficult for me to understand, you know, what's the final game of it. But it was good to be good to be in this kind of atmosphere. It was good to be, you know, flying was less, in that... once again, in during that time because of necessity, we were accelerating flying and I could fly in that one year, I could fly 44 sorties, which was quite a bit. One year, almost every week, I flew one, that was quite a bit, but it was standard for those times. And then from there I went, because I could stay only for one year, and then I had to go for command of 14 Squadron in Ambala by 2005. So that was my initial break with a lucky break, you can say.

Ganapathy: 18:17

Right? And was that when you encountered those landing roll problems? Or was that when you came back?

G/C Tyagi 18:26

Yeah, it was there in that time. And later on also, it was there, you know, it was... the most difficult part for me was landing.

Ganapathy: 18:35

So just... I think the LCA is really unique in that it has a brake-by-wire system and also steer-by-wire. And so can you explain what the landing roll problem was? And what were you experiencing what were those sorties like?

G/C Tyagi 18:51

My main problem was that the moment I used to land and there was a tail chute to augment the [inaudible], you know, and it used to go and what they call wobbling. It used to go and sort of wobble around the circles behind the aircraft. And the nose wheel steer law, which was there to define the nose wheel steer, the way it was, you know, the way it was at that time. And the kind of pilot I was, other people didn't find it that difficult. I used to be... my hand used to be on... after landing, on the tail chute jettison lever. And I used to regularly get into PIOs on the landing roll, with crosswind and other things.

Ganapathy: 19:40

So for the audience who don't understand can you explain what that is?

G/C Tyagi 19:43

That is Pilot Induced Oscillation ... it's like when you give me input, you actually you go out of phase with the aircraft motion. So let's say the aircraft's nose goes to the left. You give the right input, but you tend to increase the input so much that when it goes to the right, before it reaches that side, you again apply the counter input. So somehow the amplitude of that inputs get increased and then you can have... but so you stop. before it goes little, you know that two inputs were given, you stop, you just stay put for two seconds and everything becomes normal, right?

It's not that the aircraft was doing it, you are doing it, like, so and to go through that and I and I was and I did whatever I could to research this thing how the control laws are, how the F-16 is... they also have you know, a similar undercarriage, they also have... they don't engage the chute at high speeds, that's what I read that time, that it automatically disengages at high speeds. And we did a lot of trials, the limits on landing roll, level, how to [inaudible] it. And finally, when I came back again, after like, 2007, seven, even about 2010, 2011, 2012, because it's a very minor requirement to test. And it's a very tedious testing, the steering... is testing nosewheel steer on ground, you know, to start up, you run up around the runway. I wouldn't say

monotonous, but it's hard work. It's ground testing of process, there is hard work. Running up the long runway then cooling your brakes and then doing the runs. But someone has to do the work. Later people also understood that this is the way and now today what we have in terms of the way the slopes are, high speed, low speeds, and of course to chute stabilized. So all those things combined, I used to be quite scared of the landing roll.

Ganapathy: 22:15

Was this first fly by wire aircraft that you were flying on a regular basis? I presume you've flown the Mirage at some point in your career? Sukhois also?

G/C Tyagi 22:26

No, I haven't flown Sukhois as first pilot. Only from the rear seat. Mirage of course, I had flown. Before you start flying the LCA, you are sent to Mirage to fly 3-4 sorties to see how the fly by wire behaves and feels. But practically, if you have to say that this is the first fly-by-wire.

Ganapathy: 22:53

What are the major differences you found between the, say, the Jaguar and this and a fly by wire aircraft, did you feel any sense of loss of control or loss of being directly connected to the aircraft

G/C Tyagi 23:07

You see like Jaguar, first that the stick moves very little. So, but it takes maybe one hour of one flight to get used to it. And what's it called, the beauty of Fly-by-wire what I would say, or any control system is that it comes the way you predict it for a large number of people. [Inaudible] If there's something which needs to be closely controlled, all the while doing it. And if you if you have that kind of system, and most of the people feel at home now in a very short time, right irrespective of their backgrounds. And so that's the beauty of fly-by-wire.

You know, we all came from different backgrounds, from different cockpits, from different fighter aircraft. And it was single cockpit, there was no twin seater variant where you could get... of course, RTS (Simulator) and everything was there. But once you get airborne, it's a different story. So this is the whole thing that most of the people who came from all also many different backgrounds, they felt at home, in this in this cockpit, right? And in a very short time. The complexity of whole thing you know how quadruplex, this, that all, those theories, the people

who do it finally, a pilot is the least educated person in that whole atmosphere. The person who's flying it today in the squadron. Right? And if he can do it with ease. That's, like making the thing simple from that complexity. So that way I think it was amazing to be at home, you know, from the first instant. And of course, it was much, much, much more simpler than Jaguar to fly or to land or take off. And before that like, as far as, once we had the envelope expansion. And when we could do actually aerobatics in this aircraft later, about a decade from then... [Before that] the most pleasure I had flying in an aircraft was a hunter, right? And then thereafter it's the LCA. And the pleasure, the real pleasure of you know, being integrated to the aircraft as if the wings are on your shoulder. So that kind of feeling you get in that, you know, like you the machine is not something different from you. Like in Jaguar, the machine was different from me, you know? Because it was designed to scare the enemy, not for the flying pleasure. So, yes, flying that also was beautiful in the sense that there comes a time in your life when you have some experience that you feel that you can do anything with this aircraft. So that kind of high, I had. And but this I can relate Hunter the kind of pleasure I used to get flying, doing aerobatics, throwing around the aircraft, that kind of pleasure, I could correlate where two decades apart this is the thing, you know, which actually makes a what's called the Flying pleasure.

Ganapathy: 26:49

Amazing. Very nice. Now Sir, you were involved with some of the high altitude trials for the aircraft. At what stage did that happen? What do those trials involve? At Leh, you know which is a difficult airfield to land at by itself, but in absolutely new aircraft, what are the precautions that you took or the experience that you had?

G/C Tyagi 27:10

So Leh, we knew that we have to prove this aircraft for high altitude operations. And can you imagine, the first detachment which we took, was to Leh after we did one detachment in Nagpur. And we had done one at Goa. And then we straightaway took this in 2009. And thereafter I think I've taken LCA there for four or five times more. So it's nearly four or five times I've been to what you call Leh with LCA. And first time we went there, I would say ignorance or enthusiasm, or whatever you call it. We were not sure what kind of problems we were going to encounter. Right, the system designers have not... although they knew what kind of temperatures and other things in cold weather we are going there. But you see, after all, there's a limit to human imagination, in imagining what kind of situations we're going to encounter. If we could exactly predict how things are going to be, we could design a system for every contingency and there's no need to fly test. Right. So the system designers had put certain limitations, they believed in their system that like for example, environment control system, there was a belief that if the environment control system comes up in so and so time the temperature of the cockpit should rise by so much. Right. And when that didn't happen, that system said it has failed. It says that

it's not possible that I'm not able to heat up the cockpit in this much or time. Or the equipment in this much of time, right. So it said I have failed, right and it just stopped.

Same thing with the starting system, the viscosity of the fluids, there are experts who went into it in the first detachment. First time we landed there to take off from there, there was a thought that you know, there was a scare in our heart, that we may have leave the aircraft there. Whether we will be able to get out from here or not. Whether we will be able to start the aircraft or not. And the delta wing in the rarefied air, this and that. And of course, we trained from Kanpur we operated we did overshoots at Leh, and seeing myself, now Air Mshl Tiwari, Cmde Maolankar, he was also there. We made long maps from here to Leh. And so initially we can back with lots and lots of lessons, and a lot of work to do. And our staffing, and whether it's a question of engine loads to increase the... there's a particular RPM where you advance the throttle, so that thing was changed to a higher figure... at this place you do this, for the engine to start better. And that worked, whatever it was. So that that first thing in that cold, in that atmosphere, it was fun, it was interesting and, of course, flying clothing, the 4-5 times we went there we kept on improving the flying clothing.

So, and operating from Leh in that atmosphere, and finally, the last time when I went there... the first time was in 2009 and the last time was in 2016. And that was for, we took the trainer. And it was in the hot and high conditions, rather cold weather had been proven, we were showing that in hot conditions where the density altitude is very high, will be that load whether you can lift off, whatever the specifications of the load are whether you can lift off or not. So that was about in 2016. So that's been an interesting phase of trials, because going there itself was a challenge. Flying down from Bangalore first to Pathankot. With, we used to take a halt at Nagpur. And that was one interesting aspect. The Cold Weather trials, the high altitude trials, I think, has been the one of the most exciting things which we have done. And once we had to leave the aircraft; there was snow and we had to leave the aircraft and all of us came back 10 days, there was no flying and nothing, it was just snow there. And weather playing a part in that. The limitation of weather in the sense after some time when the shadows become more than that you can't take off. You are supposed to land back before that. So planning and executing it was quite challenging, flying in that area with so much of snow around you, you felt that and with hardly any features, in terms of mountains, it was... and executing a circuit there was... it's a difficult thing, you know the straight in approach is very less... flying in the bowl, but like I said this aircraft is really nice, you can operate tight at a slow speed, and do that circuit.

Ganapathy:

Right. And I presume the moving map would have given you good situational awareness of the terrain and things like that, right?

G/C Tyagi: 33:23

Yes, yes, that's true but there everything's visual. You have got to be visual with everything. If there's a clouding below, at that time at least it was not permitted to descend below that and try to do anything funny with your inertial navigation system or ILS, or GPS or anything.

Ganapathy:

Let's move on now... I think you came from the Jaguar background, and you did some of the first air to ground weapons release, so just love to hear what were those trials like, what was your experience like, the use of the laser designator pod, things like that.

G/C Tyagi: Air to Ground has been my bread and butter all my life

Ganapathy : Right !

G/C Tyagi : And, Jaguar also I did a lot of Air to Ground so I think I have reasonable expertise in Air to Ground weapons and you know testing them. It is very interesting that I think that was also in 2009 when everybody else was busy with Aero India quietly. We didn't want to go to an Air force Range in a big way and do the weapon fire. So you know Sriharikota where the ISRO is there there was a Jaguar trial long back there (DARIN 1) so there (in Sriharikota) there was a large island that they had and there was a target in one area so we activated that and we couldn't do it quietly and had to announce that there was you know Air to Ground fire going to happen. That time Mr Jadhav who was the director NAL he was incharge of the weapons and Mrs. Padmavathy who was incharge of the LCA model she was the avionics person who was leading all these things and we had PK Singh (Sqn Ldr ?) in that who was incharge of safety and weapons. The four of us primarily convinced (Air HQ?) that we should go ahead and do this and we had our boss Air Commodore Rohit Verma who believed that 'Let's execute things'

So while the whole focus was on Aero India we quietly activated that range sent the plane and dropped the first (?) bomb on that target which was x x x . Later on when I was retiring Mr. Jadhav presented me a photograph of that first impact of that bomb that they had filmed it was so nice. And from there I think (Sqn. Ldr Sri Krishna??) was posted to ASTE that time and we did the first drop there at Sriharikota. And thereafter every three or four months there was a weapons attachment. I have lost counts of those weapon attachments to Jamnagar AFB, Jaisalmer AFB, Uttarlai AFB and every three four months we used to go with new weapons in between we did some work on symbologies and changed the symbologies with lot of deliberations among ourselves and we wrote the global specifications for the symbology and then the Laser Designator pod came in for the laser ranging and integration and I had done the H1 program in the Jaguar (it is called the H1 Program) from the Israeli side and I think LCA was the H6 program so the LITENING Pod I knew quite well because we had worked on it earlier and then integrating it , getting the sensor harmonization with every sensor looking at one place was a big challenge for us. We also had to try and see that all the ranging sensors which primarily decide when and where to release the weapon whether its altitude or your

laser/radar ranging or radio altimeter ranging getting that harmonized and to have them deliver the weapon where it's supposed to go has been quite an exciting journey and sometimes very very frustrating too, because you go again after 6 months and you drop so many weapons and thereafter you realize Oh ! this thing is still not working and at a human level what happens is that you develop a connect with the design team you know. That has been quite a rewarding part of my test pilot experience, to have a connect with those designers , discussing and sitting with them day in and day out every morning talking with them and having a common goal to achieve so what I'm tryin to say is that one thing of my Test Pilot's career is that connect and human experience with the design team, the joy that you experience when you did something and it worked and the frustration and disappointment you experience with those situations where it doesn't work and not looking into each others eyes

Pr Ganapathy : Yeah.

G/C Tyagi: 00:39:37

Going through those highs and lows I think , I think that's something which you remember. I may not remember actual incidents when it happened but I remember cases where somebody saying/passing blame to each other in those weaker moments of ours so ... so ..that journey has been along with the aircraft coming up we also came up in accepting the limitations of ourselves and the designers

PR Ganapathy : 00:40:13

Right. And these are the sort of experiences you can only have in an indigenous design because in a foriegn bought system the designer is very far removed from you and you do not have any interaction with them.

GC Tyagi : 00:40:27

Yeah True ! That's something which ... because finally it is a weapons platform and integrating weapons is the main reason why you (the A/C) exist and to deliver them to the right place. You can never be satisfied with the accuracy of the drop .

00:40: 56 Music Begins

00:41:08 Music Ends

PR Ganapathy :

So on the that topic IF I can draw your memory back to you know IRON FIST 2013 when you did something quite amazing you know, first time in public the TEJAS was seen firing weapons and you did both the Air to Surface and then you did an Air to Air immediately after that so sir can you describe that sortie for us ? I'm quite sure it's still quite etched in your memory !

GC Tyagi : 00:41:34

Yeah. True. Yeah. This was a ... I'm like I said what the ??? called the 'mud movers' i.e. a Ground attack Pilot.

PR Ganapathy : Laughs.

GC Tyagi :

Laughs, and to get a chance to fire a Air to Air weapon and that too a live one was something you know which was a dream come true. I don't know how dreams come true but that's something which has happened to me again and again in my life. So and the best part in this is that the first live firing (A2A) which I was doing was this, before that I had practiced on a dummy flare, eh.. And that the dummy flare was dropped and the rate of descent of that flare was more, it was faulty

PR Ganapathy : Hmmm, Hmmm

GC Tyagi : 00:42:35

But I didn't know

PR Ganapathy: Ok.

GC Tyagi :

After firing the LGB, you know the plan was to fire an LGB from 10,000 Ft you know eh.. And there is a dais the LGB target if you're on the dais is let's say about 11'o Clock to you and then from there you turn Right in a descending spiral, you tighten the turn, descend to low levels in front of the dais and in front of the dais you're almost parallel to it and you continue turning right and take a lock on the flare with your HMD/S (Helmet Mounted Sight) which is Off boresight and then fire it and fly there is no like, and like you know like xxxx were doing it you know they were coming in straight from behind , the flare was dropped , they were flying wings level and then fire an R-73 , but here you are pulling about 2-3 G picking up a lock-on and then firing

PR Ganapathy : Right

GC Tyagi : 00:43:32

So that was the plan. So first time when I was doing this at eh.. And you are supposed to climb a little bit to get a lock but because the rate of descent of this flare was high I couldn't climb! And in fact when firing instead of climbing I was descending because I was keeping the flare (in view) at a certain place relative to my cockpit.

PR Ganapathy : Ah Haan

Gc Tyagi : 00:43:53

And I could see the ground coming up but I thought OK, I'm coming to a firing position I'll worry (about the ground coming up) later and I fired and as soon as I fired I tightened the turn and thereafter I started climbing and the way that the missile went it almost went like a sea skimming missile parallel to the desert

PR Ganapathy : WoW Hahaha

GC Tyagi :

Laughs. I think the missile hit the flare just 10 ft above the ground which the people couldn't see. That's the ignorant space you know, probably if I was wiser I would have a xx. And that was really an experience for me and everybody to see that and Wng Cdr Raveendran was staying in the hotel that I was staying at. He saw me and he yelled at me and he hugged me.

PR Ganapathy : Laughs

GC Tyagi :

With that R73 going *fatak* in front of my eyes thought of the journey we have traveled and how far we have come (with the A/C)

PR Ganapathy : Haha

GC Tyagi : 00:45:18

So this 2013 IRON FIST was I think, we were the only one having weapons and still turning inside the danger zone you know, and eh... the A/C although we have very strict places where to and of course the telemetry helps in helping you remember where to switch on because we were turning in front of the dais and pointing the nose of the A/C at the dais and you have a live missile on the A/C and everybody is sitting on the dais so you have to be 3000% sure that there is no switch which is left in any position than what it is supposed to be and the telemetry helps in these kinds of things you know. So there's a double check and a triple check so 2013 IRON FIST was really really one of the highlights of my career as a Test Pilot or a pilot. I did the IRON FIST in 2016 as well and not many Air defense pilots would have fired as many R-73's that I have fired that too in a turn in a maneuvering flight at low levels. So in that way IRON FIST is very dear and close to me .

PR Ganapathy : 00:47:00

So Sir, you had a couple of emergencies, I want to draw your attention to that... you had an undercarriage issue in 2010, then in 2013 you were doing some airbrake expansion trials and then you had a situation where the elevons were moving in the opposite direction, so tell us about those emergencies, what did you go through and how did you handle it? What was that experience like?

G/C Tyagi: 00:47:22

See this undercarriage thing, in 2010, like I said, I retired on 31st August 2010, and then from 1st October, 2010, I was a civilian and this flight was the first flight of mine as a civilian. And that time we had still the aircraft in, you know, kilometers and litres. So the screen what you were flying was not in knots, it was in kmph. And 700 in kmph was the climb speed. And, I didn't have my insurance. Because now I had to find my own insurance. But most of the insurances companies didn't want to give insurance because they didn't know what is this all about. So one insurance company finally agreed and they didn't give me a policy also, they had given me a held cover note, that's what they call it in their parlance, "that we agree to this." So with that I told Air Cmde Rohit Verma, "listen, I got insurance, and so I need to get on. Because he had told me that "till the time you don't have insurance I won't allow you to fly." And I said, "it's been 10 days, and I've been sitting on the ground," so I said, "let's go."

So we flew, and I was merrily climbing through I think 10,000 ft. or 3 or 3.5 kms, at that speed and then, all of a sudden all hell broke loose. And I heard some sound, and there was a rapid deceleration, and there was some grinding noise, which is a typical sign of engine seizure, which we have learned. So I looked at the engine parameters and the aircraft started pitching up quite steeply. So first thing was to control the pitch up. And I thought, "if I tell telemetry, what will I tell them?" Because the engine is fine, and the aircraft is pitching up, I said "if they are sitting on their consoles and looking at the parameters then if they know that something is abnormal, let them come up. If I tell them, it may confuse them that what I am going through, there may be panic in telemetry. Then I put on bank, to control the pitch up and then I started, you know the good old thing that please check the configuration, undercarriage, flaps, airbrakes... and I looked at my undercarriage. And I found they were red. There should have been no light there. That means undercarriage has come down. And I think from that incident to this time, maybe about 30-40 seconds must have elapsed, till the time I tried to figure out, and then went back to the controls, and I'm looking also... I remember I was flying in the sector where the Krishnagiri dam is there, and I'm looking, in that turn, with right bank I'm looking where I could possibly eject. And then in the meantime telemetry called and said "it seems like your undercarriage has unlocked." And I said, "yeah, I got these three reds, and this is the thing." Now my fear was that if this doesn't come down, if the gear doesn't lock down, because if there's something you know. [Limitation] speed was 360 kmph, if I remember correctly, we were at 700 kmph. So if there is something, damage to it, or something to it, then it may not come down, that was the next. So we dropped speed, it came down, and then we landed. But yes, the next 45 seconds or so, I could see where is gear. And later on, the cause was found, whatever the cause was, because of I think there was one o-ring, or washer or something which caused this some back pressure, the people went into detail and fortunately we could find the exact cause of it so that it doesn't happen again. But the most important thing of this flight was that I came back and I really thought, "is it worth it?" Because this was my first flight as a civilian.

Ganapathy:

And with that piece of paper as insurance.

G/C Tyagi: 52:31

You know, insurance is fine, insurance okay your wife will get it, but the thing is that now I was a civilian. And I had not drawn my first pension yet. And there's a family pension. In case something happens to you, the wife gets the family pension. Some 40 or 50 or 60%. I don't know. That's the amount, right. Let's say if I was in the Air Force and something happens you know the pension is different, it is a full pension. Now it happens, although I am flying a fighter aircraft, doing an Air Force task, and to have the thought that your first pension is a family pension, is not very encouraging you know. So I was really wondering you know, a couple of days I really wondered. Is it? Should you be doing it or not? But then yes, I said okay, let me... then I had a word with my wife, explained to her, about this and that, and then I said okay, let me continue.

Ganapathy:

How about the airbrake issue where you had the elevons moving in the opposite direction? What are elevons to start, for the audience and then what happened there?

G/C Tyagi: 53:51

You see elevons are which give primarily control to your nose. Up or down. And so we were doing this airbrake envelope expansion in terms of... and then we had to see the... you had to dive to maintain certain higher mach number... and I think this was maybe 0.95 mach. Which was the highest speed for that. And there was a compensation given in the laws for elevons, a compensation given for the airbrake. When you deploy the airbrake, there was a compensation up or down, all these were in the control law. Which compensated. Whether it was over compensated or under compensated, I don't know but, practically what happened was... we were in a screeching dive, to maintain that 0.95 [mach], with that airbrake out. And we were close to the ground it is also a combination of mach number and the speed. So the lower you are the higher you have the speed for the same mach number. That was I think 0.95 mach, the highest speed that you can get, so you're in the dive. When you want to pull out from the dive, instead of the nose coming up, it went down. Right. So your dive angle increases. And so, I think I did it twice, I attempted twice to pull out, and when it didn't... when I found the... whenever I tried to pull out it steepens and [inaudible]. And so, you know, in parade there's a very good command which you have, "Jaise the." Or in Windows you have that "Undo". So "Jaise the" means get back to where you were. So I just selected the airbrakes in, because that aircraft is proven and I pulled out. And in that time, there is no... in that situation the person sitting in telemetry he cannot help you because it is happening so fast. For him to analyze the data is not possible. And for me to transmit that what I am experiencing is not possible.

Ganapathy:

What altitude were you at when you started and what altitude did you experience this reverse control?

G/C Tyagi: 56:13

I think we started at around 15-20,000 ft., in that dive.

Ganapathy:

Not that high.

G/C Tyagi:

.... And came down to about 6,000-5,000 ft. AGL, where we were about 4,000 ft. AGL and pulled out around 2,000 or 3,000 ft. Above ground.

Ganapathy:

Wow, that's not a lot.

G/C Tyagi:

So there is no way to transmit about this situation. You just go through it and come out and thereafter I said something. Maybe I said you know like "I felt funny." That's what I said. While pulling out, I garbled something. While pulling out, I felt this, that, and later on we realized that, we found that this is what is happening. And, the control law team working very closely with them, personal rapport with them, professional rapport with them, has been exceptionally good, for most of us, all of us in fact, all the pilots. And the biggest compliment which I have received ever as a test pilot is from Dr. Girish Deodhare and his team they said that... I don't speak much in the cockpit. They said that "when Tyagi says something in the air, whether he says in a manner or observation or not, but we take it as an observation and we come back and analyze the whole thing. Even sometime it may be just a grunt from my side. You know: "awwww". They said "everything." I seldom say much in the cockpit. They said that "you compensate for most things." Whenever you feel that you are not able to compensate you open your mouth. So they said that there's every kind of pilot who are there. There are some pilots who complain about every small thing - that is also good because you know what is irritating, but you - it has been a good experience for us that we learned that what is wrong. Although you just made a qualitative comment or noise or voice, or whatever. So that was one of the biggest compliments. Still when I meet them they always say this. "Whenever you said something in the cockpit, we knew that we had a job to do.

Ganapathy 58:50

So Sir, changing gears now to the engine, I think you were involved with some of the interesting trials around engine distortion testing, so what is that, how do you do these trials, and also you were doing the relight tests on the engine, that's shutting it down and then starting it again in the air, so just love to hear about this work that you were doing on the engine what are some of the trials, what were these experiences like?

G/C Tyagi: 59:29

You see, engine testing... the engine and airframe are matching. So like I used to call... I used to say that if you get some monkeys and train them to do this engine testing. Because actually like you have the engine, and you call it a test cycle, so you hold the throttle at idle for 5 seconds, then bang it to max reheat and hold it there for 5 seconds, come back to max military or max dry power for 5 seconds, back, forth. So this cycle is about... sometimes for 15 seconds, sometimes for 25 seconds. Sometimes for 50 seconds.

Ganapathy:

You are almost deliberately abusing the system to make sure...

G/C Tyagi: 01:00:12

Yeah, yeah, you are just banging the throttle, you know, against the wall - the back wall and the front wall, right, and somewhere in between. Min reheat, max reheat. And hold it there, count till 5, then bang it again, right? And, in that time, for those sorties, 25 to 50 seconds, you need to hold certain parameters steady. Like let's say if you need to hold the speed or mach number steady then you need to dive the aircraft, and when you are bringing back the throttle, you have less power so you have to... and as you go to reheat, you need to reduce the dive angle, to keep that speed same, so it is a very very dynamic maneuver. And on top of that you have to induce side slip into it, so you have to apply full rudder. And that too opposite side rudder. So you are sitting there, like doing these monkey tricks, in the cockpit, and it was, really really it's like skill, your concentration, remembering that throttle cycle although telemetry tells you but if you don't do it it be late, and going through that engine cycle and then holding those parameters constant, applying that full rudder, your right leg is against the wall, your right hand is you know, into your stomach in that dive angle, trying to spiral down, and reducing and increasing... and banging the throttle up and down. So that was the most, one of the most complex test points which you can have. To start sometimes from 48-49,000 ft. and come down to 20,000 ft. So that went on. And then engine distortion testing, where you see that there's no distortion in the engine, sometimes you get in the entire envelope, so that engine distortion testing was.... I loved doing it, and getting it right was so, so satisfying. Because there's a lot of fuel is used to climb up to that height, and come down, if you have to repeat it is.... So, engine distortion testing was quite interesting and quite exciting and quite satisfying in terms of that.

Ganapathy: 01:02:54

And so now you're giving an engine really to the squadron irrespective of the skill of the pilot, even if they abuse it a little bit you know that it's going to... I remember some of the old jet aircraft you had to handle the engine very carefully otherwise you would have a surge or a compressor stall, something or the other, so you had to be very careful. I presume with this, you don't have to.

G/C Tyagi 01:03:16

Sometimes there were situations where the afterburner wouldn't light up, you get a little bit or warning of a fault or something like that. But nothing serious. There may be spin up, maybe,

little bit delayed or whatever, but there's nothing serious. And the engine I think, this has been one of the biggest blessings of the whole program. This engine, the GE-404, has been a big blessing to this program.

Ganapathy:

And what were the relight tests like, Sir? What altitude do you do these test at, and how do you ensure that if it doesn't relight, you can land back safely or eject? What's the protocol one normally follows?

G/C Tyagi: 01:03:58

I think the thing was, if it doesn't relight, the thing was to eject. There is no landing back. Because you won't have to control systems and everything to go for more than that. Interesting thing when we were to do it, we had this committee where I was a member of, to come to a conclusion how to do relight... we did a lot of RTS [Real Time Simulator] tests, windmilling RPM, this that and now you say hindsight is the only exact science, so we did the relight tests, and then the second set of relight tests when we were do it, we found that there are certain sets of calculations that we did were not as accurate as we thought what they were. So, switching off the engine and then relighting it, that time it seemed that we are doing quite a high risk thing, but we had done it, like we have switched off the engine on the ground, and then taken it back again. Switch off means you just switch off and take it back again. With air flowing it should work. The main thing is that if you let the RPM drop below certain point, where you can't relight, to do a startup, the kind of startup you do on the ground in the air, that's the real hurdle. If, for example, in the air, it doesn't pick up, and this thing, in the aircraft drives typically the control system, the fuel system, and all the environmental control systems, software control and electrical power which is coming from the engine driven things, those disruptions were also major things, if that goes, while on the ground we have tested and seen, so that was the major risk. Otherwise the test point was for a few seconds. Switch off, hold it for 3 or 5 seconds in the switched off position, and before the engine RPM can drop below a certain limit, you just push the throttle back and it goes, as they say, by the book. But the risk in that was that if it doesn't happen, then? I remember at that time the PD NFTC was Air Cmde Muthanna, he sat till late night, we were discussing till midnight, and then finally this thing... This was in October, first week of October when we did this test, in 2013. Then he gave all confidence to us, and that also paved the way for the second stage of relight trials.

Ganapathy 1:06:51

Well Sir, before I let you go, I just wanted to see, what are you doing after having left the program? Are you still involved in aviation in some way?

G/C Tyagi: 01:07:01

You see, like I joined in 2010 as a civilian. In 2017, I thought I'm getting too old for this kind of flying and may not be able to continue for more than 3-4 years. I decided to once again go to civil airline flying and that's when I thought... it was a very difficult decision for me to part ways

with the... where I spent nearly more than a decade. And also lots of people from ADA including Dr. Girish Deodhare, Air Mshl AP Singh, and other people in the Air Force at that time DCAS Air Mshl Bhaduria, they said you know please you should continue now, and see it through to the end. I said "Sir, it may not be possible to fly like this for very long. So it's no point at 55, so I think it's the right time now, and I need to leave." They agreed and then I left. Once again I was going for the civil airline and then in 2017 Aero India I met up with people from a company called Saab. It is a Swedish company, they make this Gripen aircraft, they make everything from fighter aircraft to submarines and things in between. Security and defence and they have missiles, so they make weapons and Carl Gustav is a good weapon which the Indian Army is using for the last 30 years I think. And I happened to meet them at Aero India 2017 where they had they were bidding for LCA Mk. 1A radar and EW [Electronic Warfare] equipment. And they saw me in the overalls and they just halted me and they said listen we are doing this. And I said "I'm leaving in 1 month, so there's no point." Then later on they called me and they said that they want to open an office in Bangalore, would I be interested. And being part in Uniform and I've seen some people who have been in the Air Force or Armed Forces they have joined companies and I never thought that I'll ever join a company like this. And that too a company which is not Indian. I thought about it a lot. Then I said that "listen, these are companies who have made names internationally. They know their stuff. They are making aircraft which is a good aircraft." I have seen it in Aero India and I have seen other things. "They are making such and such defence equipment. They are doing this. In terms of technology they are certain areas which definitely they have an edge over us. Right. And we have been doing things in a certain manner. I have been in this program for 10 years and we have been in R & D since forever. Let me see how these guys do it .

Ganapathy : Especially in a small country. It is so amazing

GC Tyagi : Yes, It's a small country. 10 Million people.

Ganapathy : Laughs

GC Tyagi :

Tnd they have offices in 30 countries right ? And eh... So and I think their turnover is I think good. So I said let me see you know eh... let me take up a challenge in my life once again and see let me change the end of the binoculars ! from tester let me become a vendor right. And see If I can facilitate some technologies, some JV, something which is beneficial for us. Of course they will do it only for business right. But then business can be much more fruitful if I can facilitate that right. That was the thought which motivated me to join SAAB and of course I have learnt a lot in terms of eh.. I couldn't have asked for a better employer, I don't think there exist better employers that these countries in terms of Work Life Balance , in terms of dignity and other things. It has been an amazing experience and the first two three years were really very interesting in the sense that learning how to do business and it was disappointing that sometimes you know when we see our own procedures and things and the way we do things in India. In India we want to ensure honesty by procedure right ! rather than individual accountability which was a learning for me and my utopian dream of getting some technology to

work was frustrating but and yeah let me see how long I last here and if there is some breakthrough which comes in my career and if we can facilitate something between IAF and SAAB, we are working on few things and if that happens I would say that joining here was good, otherwise other than having a good employer and nice work life balance and a good work which pays reasonable well has been what can I say it shouldn't go waste. We should ensure that something like ToT , Make in India happens which we are working on a couple of things. If that happens yes I would say that it has been worthwhile yeah. So that's what I do presently now.

Ganapathy : 01:12:27

Very nice , and I'm sure the learnings have been great anyway but hopefully something materializes at the end of it. Superb.

Sir, I have taken more than an hour of your time and want to thank you for your service and also for all the time you have taken to speak to me today, but I have one last question before I let you go.

So you know it's a fighting platform (LCA Tejas) and it has entered service and you are a fighter pilot so you know if you were to go to battle with the platform that has been developed what would be your assessment of its ability to hold its own, to deliver Air to Surface weapons or in an Air to Air mode given the threat environment we face in the Indian subcontinent.

GC Tyagi : 01:13:10

You see the thing is , in terms of Air to ground weapons I have done most of the testing I can say and in terms of delivering it can deliver all the ordnance. I think there is no question about the fact that it can deliver. Air to air , the long range in fact you know in my career I don't think anyone has flown more LCA than me even in the new sqn also. I have flown almost 650 sorties on this A/C and in terms of weapons platform you can say that it's a lean mean fighting machine you know the whole integrated package and the Mk 1A is having an improvement with the EW (electronic warfare) which is an important aspect. I think that EW capability makes it a complete king in terms of going into battle. The in Mk 1a the EW capability is little bit lacking and it has just needs development in the next this thing. With that capability I think it can hold its own anywhere / anytime that's no question. And the fusion of all things combined , I left in 2017 and it's been 4 years and people who have been there i.e. some of my colleagues ex colleagues are working there now the way they are working I think they are improving it day by day and thats the thing today the essence of the thing is that you have to you know gone are the days when you did life cycle upgrades on the aircraft you know in 5 or 10 years. Today it is like I would like to say it's like and Iphone (with frequent upgrades) . And this being your own aircraft I think you can do it so that's the biggest advantage you know.

PR Ganapathy : 01:15:48

Lovely! Thank you sir.

So on that note I'm going to thank you for your time today and wish you the very best.

JAI HIND sir.

GC Tyagi : Thank You Thank you so much. JAI HIND.

01:16:00 : Music Begins

01:16:12 : Music Ends

Ganapathy : Well folks that's all we have time for this week. Join us again next week. In the meantime sign up for updates at <https://blueskiespodcast.com/>.

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