Blues Skies Podcast
Season 1, Episode 34

Air Cmde Harish Nayani- Bison Induction

Ganapathy:
The induction of a new aircraft is always an interesting phase in the Air Force. There are pilots that need to be trained, procedures that need to be drawn up, infrastructure that needs to be created. The aircraft has to fit in with the overall air defence or strike environment, depending on where it fits in. So we're going to try in this episode to try and understand what it takes to really induct a new aircraft into the Air Force. And in this case, we're starting with an aircraft that is not particularly new to the Air Force, but so radically different, actually, that it almost can be regarded as new. When you think about the Rafale coming in, you can imagine the same process that's going through as that aircraft is inducted into the service. Onto the show.

01:31
Ganapathy:
Hello, and welcome to the Blue Skies Podcast. I am PR Ganapathy, your host.

01:51
Ganapathy:
It is my great pleasure today to speak to Air Commodore Harish Nayani. Air Commodore Nayani was commissioned into the fighter stream of the Indian Air Force in May 1983. He qualified as a test pilot and commanded No. 3 Squadron at a very critical juncture in the Squadron's journey when it was inducting the new MiG-21 Bison aircraft. And today we are going to have a conversation with him about his career in the Air Force in general, but particularly about the Bison, the induction of the Bison, and to learn how the Air Force absorbs a new aircraft, how it learns to operate and fly a new aircraft. Air Commodore Nayani retired from the Air Force after 28 years of service in 2011 and is currently settled in Bangalore. Thank you very much for joining the program, sir, and welcome.

02:41
Air Cmde Harish Nayani:
Thank you so much, Gana. I consider it a unique honour and a privilege that I'm on the same platform as legendary people such as your father, Air Marshal Ramachandran, Air Marshal Raj Kumar, Gp Capt Agtey, Air Marshal Masand, to name just a few. Thank you so much for inviting me.

02:56
Ganapathy:
Thank you, sir. That's so kind of you to say that. It's really a pleasure to speak to you today. So we start with all our guests by (being) curious about their backgrounds, where they grew up and what motivated them to join the Air Force and what that initial arc of their career was like. So I just love to hear where you grew up and how you joined the Air Force.

03:16
Air Cmde Harish Nayani:
Yes, Gana. So I was born in the garden city of Bangalore, and as an aside, you can't call it that anymore. And thereafter, we moved to Mysore for a very short while, which is where I started my schooling, kindergarten, nursery, etc., and then came back to Bangalore. We were in Bangalore till 1970 when my dad got transferred to Hyderabad. So I think actually it all started there because that was the first time we actually flew in a civil airliner. And we took this amazing Caravelle flight from Bangalore to Hyderabad, and as it turned out, I got a seat right at the rear next to the engine and I was so fascinated. I was all of, I think, eight and a half years old, and I would keep looking at the engine, at the graceful sweepback of those wings. I'm sure you'll agree with me that the Caravelle was probably one of the most beautiful airliners.

04:04
Ganapathy:
Very beautiful. Like a lot of French aircraft.

04:07
Air Cmde Harish Nayani:
Yes. And even at that time, I was wondering what the boundary layer fences were, I was so fascinated to see the flaps and the ailerons deflecting. Anyway, as luck would have it, soon after that, it so happened that my dad got a house slap bang on the approach of Runway 27 at Begumpet and I would spend hours and hours and hours watching aircraft taking off and land from there, starting from Pushpaks to Dakotas to Packets, Avros, Caravelles, Boeing 737s and the odd Air Force aircraft like the Canberra. And once in a while, of course, one odd fighter would come there probably to refuel, but it all started there and I never looked back ever since then.

04:47
Ganapathy:
Fascinating. And then did you join the Air Force through NDA or did you come directly?

04:51
Air Cmde Harish Nayani:
Through the NDA. I joined through the NDA.

04:54
Ganapathy:
Lovely, sir. And which aircraft did you do your basic training on?

04:57
Air Cmde Harish Nayani:
We followed the traditional training pattern, and I consider myself fortunate for that. Mine was the last course to have flown the venerable HT-2.

05:05
Ganapathy
Wow! Okay. Yeah.

05:07
Air Cmde Harish Nayani:
Although at that point in time, because of the less-than-satisfactory safety record of that aircraft, we were never launched solo, but we were launched with an instructor at the point and told to consider that to be a solo flight. Thereafter, we went on to the Kiran at the Air Force Academy, then the Iskra at Hakimpet FTW. And some of us were chosen directly to go to the MiG-21 FL at MOFTU and some of us to the Hunter. So, I was in the first group, although I do regret not having flown that wonderful aircraft called the Hunter.

05:42
Ganapathy:
I know a lot of people have fond memories of it, but what was that step up like from Kiran to MiG-21? That sounds like a massive jump in capability.

05:53
Air Cmde Harish Nayani:
Actually, in my case, it was from the Iskra to the MiG-21. So I recall when I was in class ten or eleven reading an article in the International Defence Review about the competition with the Warsaw Pact. They wanted a trainer which mimicked the handling qualities and the cockpit layout of the MiG-21. So the Iskra and the L-29 were in the running. It so happened that the Warsaw Pact chose the L-29, but Poland continued with the Iskras and that's what we got. And to be very frank, it was so alike, the cockpit of the MiG-21 and the Iskra, and somehow they even managed to mimic the handling qualities of MiG-21. So except for the phenomenal increase in the landing speeds and other operating speeds, the transition was pretty smooth.

06:40
Ganapathy:
And was MOFTU in Tezpur at that time?

06:43
Air Cmde Harish Nayani:
It was in Tezpur and mine was again the first course to follow the MOFTU training pattern. We were the first MOFTU course.

06:50

Ganapathy:
Okay. And before that it was type-training squadrons. Okay. Great. And so just fast forward. So I presume you did several years of squadron service, became fully ops, became an instructor and Test Pilot School happened somewhere along the line?

07:07
Air Cmde Harish Nayani:
Yeah. So after about seven years of Squadron service, initially on the MiG-21 BIS, followed by the MiG-29, I went for the flying instructors course at Tambaram and then did my instructional tenure at Hakimpet where I again got to fly that marvelous aircraft called Iskra and did my A2 as well. And from there, of course, I went for the test pilot selection, did the test pilot course- one year in the Flight Test Squadron in which I did a very interesting project on the An-32 where we re-engined it with the Al-12 engines because we had a lot of those lying surpluses. And after a year or so of actual online testing at Flight Test Squadron, I was sent to the school where I was an instructor and then thereafter the senior test flying instructor for three years.

07:54
Ganapathy:
Fascinating. Wow. Yeah. In fact, Gp Capt Agtey had spoken at length about An-32 re-engining.

08:03
Air Cmde Harish Nayani:
He was also in the process.

08:04
Ganapathy:
Yeah. Wonderful. Then you came back to squadron service after test flying?

08:07
Air Cmde Harish Nayani:
Yes. Thereafter I was posted to 51 Squadron in Srinagar. Probably one of my most exciting tenures because of the terrain and the landscape and the weather there.

08:16
Ganapathy:
Right. Which year was that?

08:18
Air Cmde Harish Nayani:
I went there in ‘95 and I was there for two years.

08:22
Ganapathy:
Okay. And so during Kargil, where were you?

08:25
Air Cmde Harish Nayani:
I'll come to that. So soon after my tenure at Srinagar, I went to Pathankot. That was in 26 Squadron, The Warriors. And just about a year or year and three months after having reported to 26 Squadron, I came to learn by some serendipitous happening that I was shortlisted to go to Russia as a test pilot for the Bison program. And even before that, something even more marvelous happened. Now since I was shortlisted to fly the Bison in Russia, the Israelis had extended an invitation to the Indian Air Force to send one test pilot to fly their MiG-21 2000, their upgraded MiG-21 BIS, on a no-cost, no-commitment basis, whatsoever.

09:07
Ganapathy:
Wow. That's not the LanceR. That's different from the LanceR, is it?

09:11
Air Cmde Harish Nayani:
That's different. The LanceR was with Elbit. This was by IAI. And the LanceR was based on the MF platform. This was on the BIS platform. So that was absolutely amazing. Went there for about ten days, flew solo on their MiG-21 2000 with IAI Kfir chasing me. And I had to render a report. And of course, the Israelis then told me that we know that you've signed the contract with Russia, but we'd like to demonstrate to you what we are capable of. And we are now pitching for the MiG-27 upgrade. And it's going to be a similar standard of preparation, although, of course, the MiG 27 upgrade went the indigenous route. Anyway, so I came back to India, submitted a report on the MiG-21 2000, and then off I went to Russia.

09:56
Ganapathy:
Okay. So sorry, sir. I can't let you go so easily. What was it like flying in Israel with the Israelis? What was that aircraft like?

10:03
Air Cmde Harish Nayani:
Yes, exactly. Believe me, that was absolutely a marvelous experience and eye opener, the way they went about doing it, the way they view security, and at the same time, they were pretty warm and accommodating. So what happened was, as soon as I reached there, along with the flight test engineer who was to come with me to Russia, late Wing Commander Nathan, so, we reported there, and our ex-chief, Air Marshal ‘Charlie’ Browne, was DA over there. I think that was the first DA that the country had in Israel, and he gave us a detailed briefing. And thereafter we reported to Israeli Aircraft Industry at Ben Gurion. They gave me about a five day capsule because the cockpit was entirely different. It was an all-glass cockpit, head-up display. They had made some changes to the cockpit, made some changes to the canopy, and it required a fair deal of groundwork.

10:59
Ganapathy:
And at that time, how many hours did you have on the MiG-21?

11:03
Air Cmde Harish Nayani:
At that time, I had about maybe 1200 to 1300. And it was a MiG-21 BIS. I think it was from the Ethiopian Air Force. And for some reason, the Ethiopian Air Force didn't go ahead with the project, nor did they take back their prototype. And all in all, it was an absolutely amazing experience. They had put the entire 2032 radar on the aircraft, which I think was their icing on the cake because they really showed it off to me with great pride. The synthetic aperture radar mapping mode, unimaginable in an aircraft of the class of the MiG-21, where, in fact, it was near photo quality imagery that I saw.

11:44
Ganapathy:
So a lot of our audience may not understand some of these terms. So if I can trouble you to just explain what that meant and how is that such a significant improvement? What did you have in the BIS and how is this such a big improvement?

11:59
Air Cmde Harish Nayani:
Yes. Okay. So, sorry, I think I was getting too excited about recalling all that. Anyway, so what happens is, in the MiG-21 BIS, we had at best, what you could call a second generation radar, a normal radar which would send out a pulse, listen for the returning echo. You see a radar transmits an electromagnetic pulse. It waits for that pulse to hit the target and come back, and the intervening time period is indicative of the range of that aeroplane. And the angle at which the antenna is pointing is where the aircraft-the target should be.

Now coming to what was there in the MiG-21 2000 was a pulse-Doppler radar. What a pulse-Doppler radar does is, it's immune from ground clutter. So let me take you back to the basic radar of the MiG-21. If the MiG-21 radar is pointing towards the ground, it gets completely cluttered up because all those ground returns come back to the radar receiver and the receiver is not able to discern whether it's a target or what it is. So all you see on your radar scope in the cockpit is a whole lot of green light. That's about it. But thereafter came the advent of the pulse-Doppler radar, wherein the Doppler shift… Once again, I think I need to very quickly explain what the Doppler shift is. All of us have stood by a railway line and listened to a train coming towards us. And those of you of, say, your generation or mine even heard that distinct whistle of a train. Right. So as it comes towards you, the whistle seems to get shriller and shriller and shriller, and as the train goes past you, it becomes of a lesser frequency. So there's the same principle that's used in a pulse Doppler radar. So if the target is moving, the received radar frequencies undergo what is called an apparent frequency shift. So there's a very clever way of making the radar recognize what is a moving target and what is a ground return. All the ground returns are filtered out, and what you get is an absolutely clutter-free display with the target clearly visible.

13:55
Ganapathy:
Is this what they call a look-down shoot-down capability?

13:59
Air Cmde Harish Nayani:
Absolutely. So while you're flying at high altitude, your radar can look down, pick up low flying intruders and give you a launch solution on that intruder.

14:09
Ganapathy:
Okay. And so when you were testing this, they had a sample target for you to focus on.

14:16
Air Cmde Harish Nayani:
Yeah. They had a corporate jet called the Galaxy who kept flying and giving me a target.

14:20
Ganapathy:
Okay. And so you could pick him up despite the ground clutter and things like that?

14:26
Air Cmde Harish Nayani:
Oh, absolutely. Yeah. Of course, I'd flown the MiG-29 earlier, which also has a pulse Doppler radar. So I was fairly conversant with what a pulse Doppler radar is and how it works. But this was, I guess, two generations ahead.

14:40
Ganapathy:
And did it have any data link capability or ability to talk like that?

14:45
Air Cmde Harish Nayani:
They indicated that whatever was required by the Indian Air Force could be integrated. At that point in time, what we had was a telemetred link down to the ground station because the aircraft, after all, was a prototype. So they could see what I was doing and what my scope was showing as well as a host of other flight parameters.

15:03
Ganapathy:
Fascinating. How did you find the Israelis as pilots and their other, like did you do any manoeuvres against them?

15:14
Air Cmde Harish Nayani:

Yeah. So that's again, very interesting. I was under the tutelage of Ronen Shapira, son of the legendary Shapira of the Arab-Israeli war fame. I think many of our readers must have read about him. So Ronen very proudly introduced himself as the legendary Shapira's son, and he himself, I could make out, was an exceptional pilot. The way he explained things to me and made me comfortable with the cockpit and the controls. So on the day of the briefing, I was introduced to my chase pilot, who was flying a Kfir C7. The Kfir, for the benefit of your listeners, is an Israeli version of the Mirage-3 with an American J79 engine. So when I asked them why you were sending me a chase, because I already have a target, which was the Galaxy executive jet. So they told me that because of the restrictions on their airspace, which was like the sliver of land joining the Mediterranean Sea, they wanted to preclude any chances of me straying out of the sector and getting shot up by the friendly neighbours all around. So what was interesting was that the Kfir took off and trailed behind me, the standard 15-second trail. And throughout the flight, I was, I should say, pretty thrilled that he kept asking me to reduce power a little bit just to stay in place. And even I did a downward split S, what in the Indian Air Force, we call it a half roll, wherein while flying level, you invert yourself and then pull through all the way 180-degrees and point the other way around. At the end of this manoeuvre, he actually lost sight of me, and he had to be guided by radar.

16:52
Ganapathy:
Were you just messing with him?

16:55
Air Cmde Harish Nayani:
Kind of. I wanted to compare performance as well, although that wasn't part of the mandate, just to see how things would happen. And of course, that manoeuvre also helped me determine how good the radar was by looking directly at the ground.

17:09
Ganapathy:
Fascinating. How many sorties did you fly in those ten days?

17:12
Air Cmde Harish Nayani:
Just one.

17:28
Ganapathy:
Great. So let's talk about Bison. When was it conceived? When did we consider it? What are the alternatives that we considered? And what were the big quantum jumps that we were looking for when we were evaluating the buyers?

17:46
Air Cmde Harish Nayani:
Yes. So sometime in the mid 80s, I think the Indian Air Force started looking at an upgrade to the MiG-21 BIS. And in the early 90s, this proposal gathered momentum and the

Directorate of Aircraft Upgrade was set up at the Air Headquarters. At that time, the Director was Air Marshal Harish Masand, and he did a great deal of groundwork in terms of formulating what exactly we required on that aircraft. And of course, the main driver of the program was the then assistant Chief of Air Staff, Air Vice Marshal Krishnaswamy who later became the Chief of Air Staff. So then we started looking at the world market, and we knew about the LanceR upgrade that was underway in Romania. So that was also looked at. But all in all, I think the Russians had an upper hand because they were willing to give us the R-77 Beyond Visual Range active guided missile, along with the R-73, and, of course, the Copio radar, which was more or less comparable to the ELTA 2032, with certain limitations and I should say, shortcomings. But all in all, it was a wonderful package, and I dare say that there was some political influence as well. And finally, it so happened that we signed the deal with the Russians with MAPO-MiG at the house.

19:05
Ganapathy:
Okay. And were we the only customer, the launch customer for this Bison?

19:09
Air Cmde Harish Nayani:
Yes, we were the launch customer and the only customer, although the Russians had a prototype of the MiG-21 93, on which our Bison is very broadly based.

19:18
Ganapathy:
Okay. And were they looking, also at some modifications to the engines, or was it only weapon systems and radar and things?

19:26
Air Cmde Harish Nayani:
Yes, the engine modification was not looked at at all, although I very dearly wish that there was one. But I think given the small dimension of the MiG-21, it was difficult to fit in an engine any bigger than the R-25 that came with the original aircraft.

19:42
Ganapathy:
Great. So you were heading to Russia, and was it just you or was there a whole team?

19:46
Air Cmde Harish Nayani:
Yes. So what happened was in the year 1996, a core team consisting of six officers, led by the then Group Captain Anil Chopra, who later retired as Air Marshal Anil Chopra. He was the team leader, and he had five officers under him. One more test pilot, then Wing Commander, later Air Marshal RK Dhir. And there were four engineering officers, very capable people. And this very capable team established themselves in Moscow at the office of the MAPO-MiG. And they drove the program from the word go. Of course, with a lot of assistance from Air Headquarters, the Director (Aircraft Upgrade) by then was Gp Capt

Mathappan, one of the most hardworking people I've ever come across in my entire career. So what the contract envisaged was that once the two Indian prototypes. So two Indian prototypes were stripped and shipped to Russia in an Il-76. And these were the two prototypes that were upgraded. And once they were ready for flight testing, the contract had a line which, quote unquote said, when flight testing of the Indian prototype aircraft commences, one Indian test pilot and one Indian flight test engineer would participate in the flight trials. Period. So based on this, myself and late Wing Commander Nathan reported to Air Headquarters. We were briefed and we were told that we would be there only on temporary duty. It was not a posting for us since it was under such that the flight test program would finish in ten months. So we reported to Group Captain Chopra at Moscow and were immediately told that, okay, guys, off you all go to Nizhny Novgorod. Both of us were completely destroyed because not only hadn't we heard of that city ever before, and we were looking forward to a great time in Moscow with all the hustle and bustle, Moscow nightlife, et cetera. And I must tell you, that was probably the best thing that happened, because this town called Nizhny Novgorod is a rather picturesque town, located on the banks of the River Volga and the Oka, and is home to what the Russians at that time called Factory 21. Factory 21 manufactured every version of the jet-engined MiG, starting from the MiG-9, the MiG-15, the MiGs 17, 19, 21, with the exception of swing wingers. So didn't make the 23 or 27, but made the 25 and the 31. So we reported there, and of course, the flight test program didn't finish in the period that was envisaged in the contract, and it carried on for two years.

22:20
Ganapathy:
What sort of test did you have to do? Broadly in terms of categories?

22:25
Air Cmde Harish Nayani:
So what happened was when we reported to Nizhny Novgorod, the first thing they told me was that you can't fly the aircraft. So I showed them the contract and they said, it says that you will participate. You're more than welcome to participate. Listen to the briefing, listen to the debriefing, look at the data analysis, etc. So I immediately called up Group Captain Chopra and he said, okay, we'll take it up. And these guys are playing dirty. I suspect that they had an ulterior motive, because when a customer representative comes to the site where flight testing is going on, there are bound to be hold-ups and a tighter look at what's being achieved, whether our qualification requirements are being met. So that was, I think, reluctance on their part. So in any case, flight testing got underway. Without my active participation in that, I didn't really fly the aircraft for almost a year to a year and two months. In the meanwhile, Group Captain Chopra, Group Captain Mathappan, and Air Vice Marshal Krishnaswamy, everybody had raised the level and it went up right to the level of the Defence Minister. And at that level, it was decided that, yes, I would fly. And I think they agreed upon, I think, 20 sorties. Yeah, 20 test flying sorties for me. And thereafter they again sprung another surprise, telling me that all your RT has to be in Russian, otherwise you can't fly. And we hadn't done the Russian language course, nor were we given any formal training. So I would spend a lot of time with the engineers and the people on the shop floor learning Russian technical terms and a lot of time with the test pilots as well. Every one of them are

wonderful guys, and very soon I could converse in Russian pretty well, as well as also understand the RT natter. RT for the benefit of listeners, is radio telephone. Natter is nothing but the speech that goes on on the radio telephone. So thereafter, they put up another limitation on me, saying that since I hadn't flown for more than a year, I need some continuation training, con training as we call it in the Air Force. While my professional pride kind of made me kind of disgruntled on this, at the end of it all, I'm so thrilled that it happened because I got to fly the L-29. I got to fly some dual sorties on their MiG-21 UM, got to do spinning on that aircraft, got to do PFL (practice force landing) with a simulated failed engine, which for some reason in the IAF we never do, and also got to see the way they fly and the way they manoeuvre the aircraft whilst carrying out various test manoeuvres. And, of course, also got to fly the Yak-130. One flight on the Yak 130 with the legendary Roman Taskaev, one of their best test pilots. So that's how it all happens.

25:13
Ganapathy:
I'm going to come to the Yak later, because whenever we look at that aircraft we wonder why didn't India acquire this as part of our AJT program? So what was the aircraft like compared to what you had flown in Israel and compared to the BIS that you'd flown before in the test?

25:33
Air Cmde Harish Nayani:
Yes. So after the mandatory duals that I flew on the MiG-21 UM, they made me fly a legacy Type 75, a MiG-21 BIS, two solos, and then launched me on the prototype, the two prototypes that we had. So first impressions, amazing cockpit. Not a fully glass cockpit. We did retain some of the mechanical instruments, but though they were miniaturized. The front view from the cockpit was excellent because they had replaced the traditional three piece windshield with a single piece windshield. The movable part of the canopy, the one that folds down and you lock it, they had made it a bit of a bubble canopy, which meant that you could sit higher and look rearwards much better than you could in the types of 75 or the legacy MiG-21 BIS. And none of the upgrades, other upgrades, I must tell you, neither the LanceR nor any of the other MiG-21 upgrades feature this bubbled canopy. But what I did miss was the amazing periscope that we have on all MiG-21s. Prismatic periscope, which is fitted on top of the canopy, which gives you an amazing view of your rear quarters. So all you have to do is glance up and you can see what's happening behind you at 6 ‘o clock. Now, because of the bubble canopy, that was deleted, although they did install planar rear-view mirror, but nothing compared to what the prismatic periscope could show you.

26:58
Ganapathy:
Fascinating. And three MFDs or what is the layout like inside?

27:03
Air Cmde Harish Nayani:
One MFD. One MFD, one head up display. And we had what is called a multi purpose control and display unit for the French inertial navigation system. And also some displays for the Israeli countermeasures dispensing system. I must tell you, the traditional AGD, the

artificial horizon. So I come to that. That was replaced by a smaller instrument called the AGR 29. Now, coming to the Agada, I realized when I went to Russia that in the Indian Air Force, we had Indianized the Cyrillic Alphabet. So when I asked them, why have you removed the Agada? They looked at me very curiously. So they asked me, what is Agada? So it turns out that actually, in Russian, it is ‘ah-geh-deh’. And similarly, in the Indian Air Force very fondly used to refer to it as the ‘Asapa Pafada’. Again, when I asked them, they stared at me blankly. Turned out that it's actually ‘ah-ehs-peh peh-ehf-deh’.

28:11
Air Cmde Harish Nayani:
So can I talk a little more about the Agada, as we call it, and the problem that I had over there?

28:16
Ganapathy:
Yes, please. Yes, sir.

28:17
Air Cmde Harish Nayani:
So now, Gana, the Agada actually is different from the Western Artificial Horizon in the way it shows you the aircraft bank angle. Are you aware of this?

28:26
Ganapathy:
Yeah. Something about something being fixed and something moving in the reverse in the rush. And this thing. Right.

28:31
Air Cmde Harish Nayani:
I would liken it to if right where you're sitting now on your desk, if I give you a sheet of paper and told you to draw a picture of a motorcycle turning left, you would draw the road parallel to the base of your table and you show the motorcycle tilt to the left by, say, 25 degrees or so. So that is what the Agada indicates. And this is on the outside-in bank indication philosophy. Whereas all Western Artificial Horizons follow what is called the inside-out bank indication philosophy. So which is like, let's say the motorcycle rider had a GoPro camera on his helmet and you were looking at it on a TV screen, the motorbike would appear to be erect. But the road itself would tilt, right? So this is called the inside-out bank indication philosophy. So now, on the Agada, or the Artificial Horizon in the cockpit, the outside-in bank indication philosophy was what the Russians retained. Whereas on the head-up display, it necessarily has to be inside-out. So these two conflicting images were what the Russians and even people at my headquarters in Moscow were worried about. But after a great deal of trials and deliberations, I realized that this was the ideal combination on the lookdown instrument, the outside-in philosophy on the head-up display, the inside-out philosophy. And it worked pretty well, I must tell you, we didn't upgrade the trainer. MiG-21 trainers were not upgraded at all. And they retained the traditional Agada. So that it was even for pilots to train and transition.

30:09
Ganapathy:
Right. And the head-up display in this aircraft is very similar to the head-up display you'd find in, say, a Jaguar. Any other Western aircraft?

30:16
Air Cmde Harish Nayani:
Yes, very similar.

30:19
Ganapathy:
And the MFD display language and things like that, do they do it in English for us?

30:24
Air Cmde Harish Nayani:
In English. Absolutely. Everything in English.

30:27
Ganapathy:
Okay, great. Outside of these things, basic handling characteristics and whatnot of the aircraft, remained unchanged? Right.

30:34
Air Cmde Harish Nayani:
They did change a little bit. There was a slight variation in the centre of gravity, especially while carrying, say, the R-77 missile, because of which they installed a system called the LSA- longitudinal stability augmentor, which fooled the pilot into thinking that the aircraft was stable. There were certain regimes in the flight envelope where the aircraft was slightly unstable, in the sense that the margin between the centre of gravity and the aerodynamic centre was a little less than optimal. So to cater for this, they had installed a longitudinal stability augmentor called the APUs, which was pretty similar to what is there in the MiG-29s.

31:13
Ganapathy:
So during these 20 sorties, what sorts of things did they let you do, so did they let you fire any live weapons, test those missiles they were going to give us? What sorts of sorties did you manage to do?

31:25
Air Cmde Harish Nayani:
Most importantly, they did not allow me to fire any weapons for two reasons. One is, their Ministry had flatly refused to allow me to fire any weapons. Secondly, the weapon firing phase itself was over because it was conducted at a base called Akhtubinsk, the Russian Air Force’s equivalent of Edward's Air Force Base, located close to the Caspian Sea. And even

to go there and monitor the results of the weapon firing was one big task, because they said it's a secret airbase and no foreign pilot or engineer has ever been there. Once again, the matter went up to the Ministry, and I think we established a record of sorts, because myself and Nathan were probably the first foreigners to ever set foot on Akhtubinsk, not only in the town, but into the military base as well. Yes, so we were given a lady who I'm quite sure was from the KGB, which at that time was the FSB, an elderly lady, very sprightly, very cheerful, and we were under her watchful eye from the moment we left our little cottage, which we had rented, till the time she dropped us back after work at about 6:30 in the evening. And we weren't permitted to step out of that office room that they gave us, although we could see a lot of aircraft taking off. In fact, at that point in time, the Russians were waging their war with the Chechnyan rebels and Su-24s laden with bombs would take off from this base. And, of course, a lot of other flight testing by the Sukhoi Bureau, by the Tupolev, our aircraft, their MiG-29 and a lot of other flying was going on. Anyway, so all the firing was completed at Akhtubinsk, and I think their air-to-ground range was located in neighbouring Kazakhstan. But they had an agreement, I think, with the Kazakhstanis that they would use this test range because that's where they had all the instrumentation set up, etc. So firing was out of the question for me. Now, coming back to your question, the 20 sorties that they gave me, I was given the liberty to decide what I'd like to do in those 20 sorties. So I first looked at handling qualities, stability and control, supersonic flying, radar assessment, some dummy dives. We also carry out what are called dummy dives just to see how easy it is to aim at the target. So I could do some dummy dives overhead the aerodrome simulating that I was firing weapons. And that, more or less, I think, was what the 20 sorties comprised of. A major portion, as you would imagine, was dedicated to radar assessment. So they gave me one and even two airborne targets, one L-29 and a MiG-21 trainer, and also the air-to-ground radar modes. Like I told you, the radar has some mapping modes called Doppler beam sharpening and synthetic aperture radar modes.

34:27
Ganapathy:
And so once you were done with that, you kind of signed-off and approved the aircraft for us to acquire.

34:34
Air Cmde Harish Nayani:
So what happened, I must tell you, Gana, is that, firstly, the flight test program got delayed from an envisaged ten months to two years in Russia. But even at the end of two years, there were some glitches, mainly related to software, to the radar especially, and to the air-to-ground weapon delivery work. Secondly, the Russians refused to test any of the electronic warfare equipment on Russian soil. So we had the ELTA electronic countermeasures for, what is called SPJ- self protection jammer. So since the MiG-21 is such a small aircraft, this equipment couldn’t be mounted internally. It was mounted on a pod, which we would carry on the outboard wing station. So flight testing of this equipment was also to be done in India. So actually, although the prototypes were once again dismantled and sent back in an Il-76, they were reassembled at Ozar. HAL, Ozar, where a team of Russian engineers and flight test personnel were also at hand. And I continued with the flight test program for close to almost another year ex-Nasik.

35:40
Ganapathy:
Just walk me through the process. Once the two prototypes have been debugged to use a software language, then we sign a contract, I presume, for converting a certain number of airframes.

35:56
Air Cmde Harish Nayani:
The series production was to be done by HAL. A total of 123 airframes. So while that work got underway at HAL, 3 Squadron was nominated as the first MiG-21 Bison Squadron. And I think very rightfully, then Wing Commander Dhir was the commanding officer nominated to take over 3 Squadron. So once HAL started producing the aircraft, 3 Squadron moved to HAL Ozar, where we called what is called a handling flight. Since the technical infrastructure, the snag rectification expertise was available there at Ozar, the 3 Squadron pilots would come there and train on the prototypes, not on the prototype, on the initial series production aircraft, and then go back to Ambala, the homebase of the Squadron.

36:44
Ganapathy:
Now, the aircraft of the Squadron were being converted by HAL. What's that process? How long did it take, when an old airframe went in for the new one to come out? And how is that process managed in the induction of a new aircraft?

37:01
Air Cmde Harish Nayani:
Yeah. So when the Legacy MiG-21 Type 75, that is the MiG-21 was going for the major ovehaul, they would then undergo a change of avatar that included life extension as well, because the airframes were pretty old. And then a complete remake to emerge as the MiG-21 Bison.

37:23
Ganapathy:
Okay. And so the Squadron would continue to have its strength of aircraft, I presume. Right?

37:29
Air Cmde Harish Nayani:
Yes. The 3 Squadron actually started building up the strength of the aircraft very slowly because the production rate wasn't all that good at the initial stages. And only a handful of pilots initially converted to the Bison. And thereafter, as they started getting their full complement of aircraft, every pilot qualified on the Bison. And like I told you, we didn't have a Bison trainer. So insofar as take off/ landing/ handling characteristics were concerned that they had to still rely on the Legacy MiG-21 Type 69 or the UM. And then the first flight on a

Bison would be like a first solo for, say, a pilot on a Gnat or F-35 or whatever. Because all the systems were so much different.

38:15
Ganapathy:
Now, I'm presuming that for a MiG-21 pilot, at least basic handling and all that, they'd be familiar. They'd have to learn all the, how do you make use of the MFD, the head-up display, the radar. But I'm sure you had to develop a whole body of tactics that exploit this new capability of this new aircraft. What was the process to develop those tactics and then train Squadron pilots on those techniques?

38:46
Air Cmde Harish Nayani:
Yes, that's a very good question, Gana. So I must tell you that I was lucky and once again, very fortunate to have taken over from Wing Commander Dhir. I took over command of 3 Squadron from him. And I must thank him for all the spade-work that he did. Dhir Sir, I don't know if you know him, is a man who can get things done. So as the commanding officer of 3 Squadron, he had set up all the infrastructure, you know, the training facilities, the air-conditioned rooms for the mission planning system, the video recorder, debrief station, everything was set up for me. So when I took over the Squadron, I didn't have to concentrate on those ancillaries. And I immediately set about getting my pilots to very clearly understand the various systems on-board the aircraft. And I was also fortunate that as a test pilot, I had exposure to the Mirage 2000, the Jaguar, and also theMiG-29 experience that I had two years in Squadron service and in my Squadron, I had one or two Mirage qualified guys as well under me. So we had to start writing the rule book from scratch, including the pilot orders, the standard operating procedures, tactics and everything. Of course, the tactics were always vetted by Tag D, which is a nodal agency in the Indian Air Force for formulation of tactics and other techniques of air combat. So that's how it went. And I had a very, should I say, satisfying tenure there.

40:13
Ganapathy:
So give me a flavor for particular engagement between aircraft, one versus one, two versus two, whatever it might be, where you would have done it in a certain way in the previous versions, Type 96 or MiG BIS. But you could do something very differently and have a much better outcome because you were flying the Bison. Just to give us, in the hands of a fighter pilot,how is this such a better tool? What could you do better?

40:44
Air Cmde Harish Nayani:
Yes, very nice question once again. So to begin with, the Russians also gave us the helmet mounted sight.

40:50
Ganapathy:

All right. I was going to ask about that.

40:52
Air Cmde Harish Nayani:
Yes. Very similar to what's there on the MiG-29. So for the benefit of your readers, your listeners, rather, when you do traditional air combat, the aircraft, you treat the aircraft as a weapon which has weapons which are forward firing. So you have guns which fire forward, you have missiles which fire forward. So it stands to reason that you have to manoeuvre your aircraft till you are facing the enemy. So that's what dog-fighting is all about. You have to really manoeuvre your own aircraft, harnessing the aerodynamic capability that it has to be able to turn or pitch or to loop or whatever, with the end result being that you get a shot on your adversary before he gets a shot on you. Now just imagine that instead of pointing your aircraft, you just move your head. You're pointing your helmet mounted sight at the adversary, you obtain a lock-on and your missiles now look where you're looking, and thereafter you can launch. So you can actually make an inferior aircraft fight against a superior enemy in terms of manoeuvring capability just because of the helmet mounted system. To make this a little more clear, let's assume that you're trying to manoeuvre your aircraft to point your nose at him, but you still have a 45 degree deficit. You still have 45 degrees to go, and you're not able to do that because your aircraft is at the point of stall. Now all you have to do is move your head so that your helmet mounted sight is now pointing at the enemy, obtain a lock-on. And your missiles are now looking at where your helmet is looking. And if you're within launch range, you can launch. So that is a quantum enhancement and capability for a platform like MiG-21.

42:30
Ganapathy:
And what are you seeing in your helmet? What sort of displays are you getting there?

42:35
Air Cmde Harish Nayani:
Yes. Once again, what we had wasn't a helmet mounted display, per se. It was a helmet mounted sight. You had a small monocle which would come down in front of your eye, and that monocle had two concentric circles. So the aircraft had an internal mechanism where the exact angle of your helmet was determined and passed on to the weapon control computer and to your weapons as well. So if you moved your head to the right and looked through the monocle, through those two concentric circles, you are now centred on your adversary. You had a lock-on button on the throttle, which you just pressed. And now you would lock-on and your missiles would also lock-on. And it was actually a form of designating the target using your helmet.

43:09
Ganapathy:
And then you get town and then you fire. Now, people say 45 degree off both side, 60 degree off both sides, at those speeds, it just sounds mind boggling that a missile can actually turn that much. So when you're turning your head, is the missile, you're saying the

missile looks where you're looking. Is the hard point actually turning or is this a virtual looking at the..

43:46
Air Cmde Harish Nayani:
The hard point is not turning. The seeker head in the missile- that actually swivels left right, by as much as 70-75 degrees, in today's missiles, beyond 90 degrees as well.

43:57
Ganapathy:
Fascinating. Okay. And so when you fire it, it will fire off at a really odd angle to the aircraft, then, I presume?

44:05
Air Cmde Harish Nayani:
Yes. It initially goes straight and then to its guided phase.

44:09
Ganapathy:
Sorry, did you ever fire at an airborne target off poor sight and get to see the effect of that?

44:14
Air Cmde Harish Nayani:
No, unfortunately, I didn't do that in real life because that was done at Pokharan a couple of times. But by then I had left the Squadron.

44:20
Ganapathy:
You had left the Squadron. Okay.

44:23
Air Cmde Harish Nayani:
You asked me about, can the missile manoeuvre so much off course? So to give you an idea, typical g loads of the missile are in the region of 35. Can you imagine the missile once you launch it, it can manoeuvre with up to 35 G to follow its guidance.

44:39
Ganapathy:
Fascinating. Great. And so your Squadron was the first Squadron. So you were developing all of these tactics and whatnot, training your pilots, I presume. And these pilots were already fully ops on the MiG-21, and then now, were kind of additionally qualified on the Bison?

44:56

Air Cmde Harish Nayani:
Yes, very much the initial lot of pilots were all qualified MiG-21 pilots or Mirage 2000 pilots.

45:01
Ganapathy:
And did they form, then the nucleus of the Bison fleet through the rest of the Air Force? And they went out to the other squadrons and replicated the same?

45:08
Air Cmde Harish Nayani:
For a while that's how it was. And then the next Squadron to convert onto the Bison was 21 Squadron, under the command of yet another test pilot, then Wing Commander Tarun Bannerjee. And they formed the Squadron at Sirsa.

45:23
Ganapathy:
And so your Squadron command was for how many years?

45:26
Air Cmde Harish Nayani:
My Squadron command was for two years, three months and eight days.

45:30
Ganapathy:
Okay. So you had two years of Squadron command, you had two years plus in Russia, and then maybe about a year and a half in Ozar with these things. About five years with this program then.

45:43
Air Cmde Harish Nayani:
Yes. So I actually wasn't posted to Ozar. I was re-posted to ASTE, where I actually wore two hats. I was the senior test flying instructor whilst also doubling up as the Bison project test pilot. And I would shuttle between Bangalore and Ozar whenever a project test campaign had to be underway.

46:01
Ganapathy:
Right. Okay, great. So you really saw the system go from not quite conception, but at least the very initial trials to actual operational Squadron service, must have been a sense of great satisfaction to see that come to fruition.

46:19
Air Cmde Harish Nayani:
Very true.

46:20
Ganapathy:
So take a step back for us and tell us how you, at that time, saw the Bison fitting in with the overall fleet of the Indian Air Force, what it did to the MiG-21, what it did to our capabilities. And when I think about aircraft and aircraft acquisition, the time horizons are so long that it's obvious that no aircraft you acquire is going to, throughout the life of its service, fit every need. So naturally, a mid-course upgrade is going to be required. And I guess the Bison is the example of that quantum upgrade that happened, but just enough for you to reflect on what role that played to our capabilities given your close involvement with it.

47:04
Air Cmde Harish Nayani:
Yes. So that's a very valid point. So I think the world over air forces and ministries of defence have come to realize that the basic platform or the air vehicle, as you would call it, is not really that important anymore, provided it has a basic minimum performance, and upgrades are very cost-effective and very effective in enhancing the capability of an aircraft. That's one thing that I think every single Air Force has learnt. Friendly neighbours from the west have done that with the Mirage 3s. The Romanians have done it with their MiG-21s, and we have done it with our MiG-21. We've done it with our MiG-27 as well as a MiG-29. And of late, the Mirage 2000 as well. And all of them, I dare say, have been extremely successful upgrades.

47:54
Ganapathy:
And of course, the Darin with the Jaguar.

47:56
Air Cmde Harish Nayani:
Yes, very much so. Just imagine an aircraft of the class of a MiG-21 today has the capability, or when the Bison came in to carry a beyond visual range active guided missile, fire simultaneously at two targets beyond visual range, activates its electronic warfare system and if required, closing in for a within visual range combat arena and launch an R-73 type of a missile off both sides. That's absolutely, should I say, eye-watering capability for such an ancient aircraft, right?

48:31
Ganapathy:
Amazing. Yeah. I think we have to be really, a lot of people are critical of why we're flying MiG-21 so late in the day, so many years after it was initially conceived, and don't realize that it's not the same aircraft. It's gone through so many upgrades that it's quite a potent fighting machine. Super. Thank you so much. Is there anything about this program that I haven't asked you that you think the audience should hear?

48:58
Air Cmde Harish Nayani:
I can think of a lot of things, but I think we are short of time.

49:03
Ganapathy:
Great. I want to thank you so much for your service and I want to thank you for your time today. It's just been a wonderful conversation. It's really opened my eyes to what a significant upgrade of a platform involves, and I hope the listening audience have also got a learning from this.

49:20
Air Cmde Harish Nayani:
Thank you so much. I enjoyed every one of your questions.