

**DESIGN, DEVELOPMENT, MANUFACTURE AND
INDUCTION OF LIGHT COMBAT AIRCRAFT (LCA)**

MINISTRY OF DEFENCE

**PUBLIC ACCOUNTS COMMITTEE
(2018-19)**

ONE HUNDRED AND FOURTEENTH REPORT

SIXTEENTH LOK SABHA



**LOK SABHA SECRETARIAT
NEW DELHI**

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Presented to Lok Sabha on: 14.12.2018

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**LOK SABHA SECRETARIAT
NEW DELHI**

DECEMBER, 2018 /AGRAHAYANA, 1940 (Saka)

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* to be appended at the time of printing

COMPOSITION OF THE PUBLIC ACCOUNTS COMMITTEE
(2018-19)

Shri Mallikarjun Kharge - Chairperson

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1. Shri A.K. Singh - Additional Secretary
2. Shri T. Jayakumar - Director
3. Smt. Bharti S. Tuteja - Deputy Secretary
4. Shri Deepankar Kamble - Committee Officer

INTRODUCTION

I, the Chairperson, Public Accounts Committee, having been authorised by the Committee, do present this One Hundred and Fourteenth Report (Sixteenth Lok Sabha) on "**Design, Development, Manufacture and Induction of Light Combat Aircraft (LCA)**" based on the C&AG's Report No. 17 of 2015 relating to Ministry of Defence.

2. The above-mentioned Report of the Comptroller and Auditor General of India was laid on the Table of the House on 8th May, 2015.

3. The Public Accounts Committee (2018-19) took up the subject for detailed examination and report. The Committee took evidence of the representatives of the Ministry of Defence (MoD), Defence Research and Development Organization (DRDO), Aeronautical Development Agency (ADA), Hindustan Aeronautics Limited (HAL), Bharat Electronics Limited (BEL) and Indian Air Force (IAF) on the subject at their sitting held on 17th November, 2017. Accordingly, a draft Report was prepared and placed before the Committee for their consideration. The Committee considered and adopted this draft Report at their sitting held on 5th December, 2018. The minutes of the Sittings are appended to the Report.

4. For facility of reference and convenience, the Observations and Recommendations of the Committee have been printed in thick type and form Part- II of the Report.

5. The Committee would also like to express their thanks to the representatives of the Ministry of Defence (MoD), Defence Research and Development Organization (DRDO), Aeronautical Development Agency (ADA), Hindustan Aeronautics Limited (HAL), Bharat Electronics Limited (BEL) and Indian Air Force (IAF) for tendering evidence before them and furnishing the requisite information to the Committee in connection with the examination of the subject.

7. The Committee place on record their appreciation of the assistance rendered to them in the matter by the Office of the Comptroller and Auditor General of India and the Committee Secretariat in preparation of the Report.

NEW DELHI;
12 December, 2018
21 Agrahayana, 1940 (Saka)

MALLIKARJUN KHARGE
Chairperson,
Public Accounts Committee.

REPORT PART-I

CHAPTER - I INTRODUCTORY

1. Government of India (GoI) sanctioned in August 1983, design, development and manufacture of Light Combat Aircraft (LCA) over 8 to 10 years from 1983 at an estimated development cost of ₹ 560 crore including six flying prototypes.
2. In June 1984, GoI constituted Aeronautical Development Agency (ADA) as a dedicated institution for the management of LCA project. MoD, besides sanctioning funds for LCA project, is involved in the decision making process through the General Body and Governing Body of ADA. The General Body of ADA presided over by Raksha Mantri annually review the progress of LCA project, while the Governing Body chaired by the Secretary, Department of R&D manages all affairs and funds of the society. Hindustan Aeronautics Limited (HAL), a Defence Public Sector Undertaking is the principal contractor for the LCA project.
3. Subsequently after the completion of the feasibility study and project definition, the Cabinet Committee on Political Affairs (CCPA) in February, 1991, approved to execute the project in two phases of Full Scale Engineering Development (FSED). The FSED Phase-II was taken up in February 2000 even before the closure of Phase-I and the FSED Phase-I was retrospectively closed with effect from 31 March 2004 within the sanctioned cost of ₹ 2,188 crore by carrying forward the pending activities to FSED Phase-II. The project was assessed to be completed by 2004.
4. Government of India, in November 2009, sanctioned FSED Phase-III at a cost of ₹ 2431.55 crore (FE ₹ 818.60 crore) for design and development of two prototypes of LCA Mk-II with an imported alternate engine with a delivery schedule of 31 December 2018. Thus, LCA development can be termed as completed only when the LCA Mk-II is developed under FSED Phase-III, productionised and inducted into IAF squadrons thereafter, as LCA Mk-II is expected to meet the ASR.

5. A total amount of ₹ 10397.11 crore (FE ₹ 3800.01crore) was sanctioned for the three FSED phases of LCA programme, against which, ADA had incurred a cumulative expenditure of ₹ 8294.39 crore (FE ₹ 2768.18 crore) in October 2014. This sanction and expenditure are exclusive of cost of Kaveri engine (₹ 2,839 crore) and Electronic Warfare Suite (EWS) (Mayavi) (₹ 154.74 crore) developed for LCA as development of Engine and EWS were sanctioned in 1989 and 2005 as separate projects by DRDO.

CHAPTER - II

AUDIT REVIEW

6. The execution of the LCA programme was examined to assess the extent of:
- (a) Achievement of Air Staff Requirement (ASR) and Weaponisation of LCA;
 - (b) Indigenous capability developed through LCA programme;
 - (c) Development and manufacturing of LCA (AF) including setting up of manufacturing facilities at HAL; and
 - (d) The preparedness of IAF to induct LCA into Service and consequent operational impact.

The records of ADA, Air HQ, HAL and DRDO Headquarters and its laboratories affiliated to design and development of LCA were seen for conducting the review.

7. Delays in execution of LCA project with respect to project definition, deficiencies in planning and financial management were commented upon in Para 50 of Report No. 3 of 1989 of the C&AG of India, Union Government Defence Services (AF&Navy) for the year ended 31 March 1988. Delay in execution of Phase-I of LCA project which included development of Multi Mode Radar, Flight control system, Digital Electronic Engine Control, integration of Kaveri engine on LCA, etc and consequent up-gradation of MiG-Bis aircraft, import of Su-30 MKI aircraft to cover the shortfall in fighter aircraft, were highlighted in para 28 of the Report No. 8 of 1999 of the C&AG of India, Union Government, Defence Services (Air Force & Navy) for the year ended 31 March 1998.

8. The PAC (2017-18) selected the subject as reported in the C&AG's Report No. 17 of 2015 which covered issues relating to design, development, manufacture and induction of Light Combat Aircraft (Airforce) for detailed examination and report. Subsequently, the Committee obtained requisite information and some other clarifications from the Ministry of Defence (MoD). The Committee, as a part of their on the spot Study Visit programme to Chennai, Hyderabad and Bengaluru from 30.10.2017 to 02.11.2017, had discussed the subject at Hyderabad on 01.11.2017 to gain in-depth knowledge and also took oral evidence of the representatives of MoD, Defence Research and Development Organization (DRDO), Hindustan Aeronautics Limited (HAL), Bharat Electronics Limited (BEL), Aeronautical Developmental Agency (ADA) and the IAF on 17.11.2017 in New Delhi to obtain further information on the subject. Based on the information gathered, the Committee proceeded with examination of the relevant issues in detail as outlined in the succeeding paragraphs.

CHAPTER - III

PROJECT PROGRESS

9. Cabinet Committee on Political Affairs, in February 1991, approved in principle, execution of the LCA project in two Full Scale Engineering Development (FSED) phases as detailed below:

- (i) FSED Phase-I: Building and limited flight testing of two LCA Technology Demonstrator (TD1 and TD2) aircraft to demonstrate confidence levels in critical technologies through 210 hours of test flying and parallel development of other technologies and proving them on ground rigs/flying test beds.
- (ii) FSED Phase-II: Building further five prototypes and integration of other technologies developed in parallel in Phase I, Integration of Kaveri engine, Flight- testing and weapon integration to achieve IOC and FOC.

FSED Phase-I

10. It was, however, seen that from the approval in November 1995 of the General Body, ADA, during the course of FSED Phase-I, ADA had, on the ground of

accelerating the development process of LCA, advanced the manufacture of two prototypes (PV1 and PV2) from FSED Phase-II to FSED Phase-I so as to utilise the savings in FSED Phase-I occurred due to shifting of certain systems from import list to indigenous development list. ADA's decision was in contravention of the Cabinet approval for Phased development, wherein the building of PVs was to be taken up in FSED Phase-II only after TDs had been built and flight tested for 210 hours to demonstrate confidence levels in critical technologies.

11. As a result of ADA's decision, the two PVs viz. PV1 and PV2, building of which was taken up even before the first flight of TDs and development of other technologies, could not be integrated with systems such as Multi-Mode Radar (MMR), Internal Self Protection Jammer (SPJ)/Radar Warning Receiver (RWR) which had not been developed till 1995 to 2006. These systems were required to be developed and proved on ground rigs/flying test beds in FSED Phase-I and integrated on the PVs in FSED Phase-II as per the phased development sanctioned in June 1993. Subsequently, as per the sanction in November 2001 for FSED Phase-II, remaining three PVs and eight Limited Series Production (LSP) aircraft were to be manufactured and the LSPs were required to be delivered between May 2006 and May 2008 to IAF. Besides, the PVs were also required to be integrated with the MMR, SPJ, RWR technologies.

12. In response to the above, the Ministry submitted as under:

"The decision to advance prototype vehicles PV1 & PV2 in FSED Phase-I has given technology edge for proving critical systems like Weapon integration (R73 E), Drop Tank Integration, Avionics Architecture Upgrades, Extensive use of Carbon-Carbon composites, Aircraft Performance and Envelope Expansion flight testing, open system architecture (PV2). The critical on board systems like MMR, RWR etc. were initially planned to be integrated on PV-1 & PV-2 based on schedules provided by the work centres. However, timelines could not be met by the work-centres due to the technological complexities. The delays are primarily due to the technology challenges, US sanctions in 1998 and change in scope by IAF."

13. However, Audit observed that decision of ADA to advance the development of PV1 and PV2 had a cascading effect on the remaining PVs viz. PV3, PV4 (converted as PV6 and PV5), which were also rendered deficient of these systems (MMR, SPJ, RWR). As a consequence of this, ADA had to resort to utilisation of even the LSP aircraft, which were to be handed over to IAF, towards flight testing/evaluation. The decision to advance building of two PVs was got ratified by ADA from Gol in January 1998. The development of other technologies (MMR, SPJ, RWR) and development of Kaveri engine was also delayed. Various milestones under FSED Phase-I and their actual achievements are indicated below:

Sl.No.	Milestone	Scheduled date of completion	Actual date of completion
1.	Roll out of first aircraft (TD1)	June 1995	November 1995
2.	First flight of first aircraft (TD1)	December 1996	January 2001
3.	First flight of second aircraft (TD2)	September 1997	June 2002
4.	First flight of PV1	December 1999	November 2003
5.	First flight of PV2	June 2000	Shifted to FSED Phase II
6.	Completion of 210 hours of flying (TD1 and TD2)	June 1998	124 hours completed by 31 March 2004 and balance shifted to FSED Phase II

14. Department of Defence R&D, MoD, in April 2005, had requested approval of Cabinet Committee on Security for post-facto closure of FSED Phase-I with effect from 31 March 2004 and within the sanctioned cost of ₹ 2,188 crore while the remaining flight testing of TDs, flight testing of PV2 and completion of development of Multi-Mode Radar (MMR) would be carried out as part of LCA FSED Phase-II. Based on CCS approval, Gol accorded post-facto sanction in July 2005 for the closure of FSED Phase-I with effect from 31 March 2004. In August 2005, ADA also carried forward balance work of

42 ongoing work packages valuing ₹ 65.16 crore as on 31 March 2004 to FSED Phase-II. These 42 work packages pertained to development of MMR, Flight control System actuators, Digital Flight Control Computer, Jet Fuel Starter, Drop Tanks, etc.

15. The Ministry stated that as per FSED Phase-I objectives, TD-1 and TD-2 had completed 124 hours of flying by March 2004 and by then all critical systems were proven with additional prototype models, PB-1 and PB-2. Critical Technologies which were required for prototype and subsequent production of LCA Mk-I were successfully developed indigenously and demonstrated. All the major objectives of FSED Phase-I were achieved.

16. As per Audit, in spite of the fact that FSED Phase-I was delayed by six years and treated as completed in March 2004 as against the scheduled completion of June 1998, the intended objectives of the phased development were not met completely. ADA's decision in 1995 to advance two PVs from FSED Phase-II to FSED Phase-I in order to accelerate the LCA programme failed to yield the desired results, as other technologies (MMR, SPJ, RWR) to be integrated on PVs were yet to be developed and proved.

17. The Ministry replying to the Committee's concern regarding the operational vehicles with requisite sensors and weapons not being included in Phase-I considerable delay, replied as under:

"the programme of indigenous development of Light Combat Aircraft (LCA) was initiated in 1983 when there was no Technology base in the country. The feasibility studies and Project Definition Phase (PDP) studies were completed in 1988. Based on the report of a Specialist Committee consisting of Chief of Air Staff (CAS) & Secretary, Dept. of Defence (R&D) which examined the complexities of the project, it was decided by CCPA at its meeting held on 27-02-1991, that LCA development programme would be executed in two phases - in the first phase to build Two Technology Demonstrators (TDs) along with development of critical technologies including Multi Mode Radar (MMR) and in the second phase to build five Prototype Vehicles (PVs), integrate Weapons, Sensors and flight test the aircraft leading to Initial Operational clearance (IOC) and Final Operational Clearance (FOC). there was a risk mitigation considering

the lack of availability of various technologies in the country. The LCA FSED Phase-I was sanctioned in June 1993 to develop Technologies in view of technology complexities & their demonstration. Build of Prototype Vehicles with the requisite Sensors and Weapons was sanctioned in LCA FSED Phase-II, after flight of the Technology Demonstrator in 2001 which proved the above critical technologies."

FSED Phase-II

18. Various milestones under FSED Phase-II and their actual achievements are indicated in Table II below:

Sl. No.	Milestone	Original date of completion (November 2001)	Revised date of completion (November 2009)	Actually achieved date
1.	PV2- first flight (Carried forward from Phase-I)	December 2002	-	December 2005
2.	PV3-first flight	July 2003	-	December 2006
3.	PV4-first flight	December 2003	Jan-Feb 2010	November 2014
4.	PV5-first flight (Trainer)	October 2004	August 2009	November 2009
5.	Achievement of IOC	December 2005	December 2010	December 2013
6.	Creation of facilities for achieving LSP of 8 aircraft per annum at HAL	May 2006	May 2006	Facilities created at HAL only for manufacture of four aircraft
7.	Manufacture of eight LSP standard LCA by HAL and delivery to IAF	May 2006 - May 2008	May 2006 - May 2008	HAL manufactured seven LSP aircraft during April 2007 to March 2013
8.	Achievement of FOC	December 2008	December 2012	Not achieved

Audit observed that delays pertaining to achievement of milestones of FSED Phase-II were mainly on account of continued design modifications on LCA and low availability of aircraft.

19. The Ministry explained the delays as under:

- i. Change in Avionics architecture demanded by customer;
- ii. Addition of new systems (HMDS) and Weapon Suite by customer;
- iii. Delayed decisions by customer in finalizing of GUN, Air to Air Refuelling & BVR missiles;
- iv. LCA programme has taken abinitio development & LSP is blessing in disguise;
- v. Delay in flight testing due to the grounding of Aircraft for Escape System & pipe-line butting Mods;
- vi. This development and flight testing has been planned in concurrently on various LSP aircraft to achieve IOC & FOC goals quickly;
- vii. During the course of development, the changes in the critical system like communication system, Radar & Helmet Mounted Display System has forced SOP change staggered on different LSPs; and
- viii. Awaiting maturity of all the systems on PV series aircraft and completing IOC task involving around 2500 sorties with three numbers of PV series aircraft would have resulted in further delays.

20. As per the MoU entered into between HAL and ADA in June 2002, HAL was to manufacture and supply eight LSP aircraft between 2006 and 2008. Against this, HAL supplied seven LSP aircraft during April 2007-March 2013 with a delay ranging from 4 to 51 months, mainly due to design changes by ADA, which resulted in equipping each of the LSPs with different configuration. Audit also observed that ADA had utilised these LSP aircraft towards flight testing/evaluation for achieving IOC/FOC, instead of handing over these aircraft to IAF, in contravention to the commitment given in October 2001 while obtaining GoI sanction for building these LSPs under FSED Phase-II.

21. The Ministry stated that advancement of 2 prototypes had given technology edge for proving critical technologies which required extensive flight testing for maturity, and

awaiting maturity of these technologies with only two TDs would have resulted in further delays in the programme.

22. When reasons for using the LSPs for flight testing/evaluation instead of handing them over to IAF were enquired in July 2014, ADA stated in October 2014 that due to shortcomings on TD/PV aircraft, LSP aircraft were built in a phased manner with specific capabilities. As such the transfer of technology to the production agency (HAL) was executed in batches by identifying the LSP-1 to LSP-8 to resolve design issues and conduct the flight test towards finalization of standard of preparation (SOP) for production.

23. Audit observed that building of PVs before development of other technologies resulted in these aircraft having shortcomings, compelling ADA to utilise even the LSPs towards flight testing of LCA. Thus, the purpose of manufacturing of LSPs for the usage by IAF has not been met till January 2015 and these aircraft have been used by ADA as additional prototypes for evaluation purposes, in contravention to the commitment given in October 2001 while obtaining sanction for building these LSPs.

24. In November 2009, GoI extended the milestones of LCA project up to end of December 2012 (IOC-December 2010 and FOC-December 2012) and additional amount of ₹ 2475.78 crore (FE ₹ 581.92 crore) was sanctioned to cover extended programme cost, expenditure towards Programme Management, maintenance and operational cost of 15 aircraft (2 TDs, 5 PVs and 8 LSPs), foreign flight test consultancy for optimizing the flight testing, spares for LSP aircraft, etc. Out of this, the major portion of the cost towards maintenance of 15 aircraft (₹ 187.78 crore) during this extended period was due to ADA utilising the LSP aircraft along with TDs/PVs towards flight testing/evaluation. However, even these extended timelines could not be adhered to by ADA as LCA achieved IOC only in December 2013 and FOC is yet to be achieved.

25. When the Committee sought reasons for the above, the Ministry furnished that objectives beyond FSED Phase I like incorporation of Composite Structure, Drop Tanks capability, Open Architecture based avionics and weapon system were developed and integrated in advance on PV1 and PV2 aircraft which otherwise would have led to more delay in the programme. Moreover, additional two prototypes contributed to the flight

testing which enabled the capabilities for achieving in time, LSP aircraft were also used for integration of newer and modern weapons and Air to Air Refuelling Probe during the development of Tejas.

26. The Vice Chief, IAF, while furnishing details regarding FSED Phase II, submitted during oral evidence as under:

"Sir, an aircraft first undergoes for trail and then it is upgraded. So, the first stage is Initial Operational Configuration (IOC) in which some weapons are cleared. Like, Chairman, HAL has brought out, clearing a weapon in an aircraft is a flight safety issue and it is a very complex process. In this process, currently we are happy to report that as IOC goes, Tejas is quite well-equipped. Yes, Sir. It is combat ready in Initial Operational Configuration (IOC). That means, it can fire dummy missiles; it can fire the laser guided bombs; it can fire the dumb bombs and rockets. Sir, for final operational clearance, these capabilities will have to be enhanced. It will be carrying the missiles that are now being developed by DRDO and other new weapons we are buying from outside. They will be integrated with it. It will have a jammer; it will have the new radar on it that DRDO is making and its Fatigue Life will be extended. This is the Final Operational Configuration. Even the Mirage 2000 upgrade that we are using, it comes as Initial Operational Configuration. Even the Rafale and all other aircrafts always come with Initial Operational Configuration and then are upgraded into Final Operational Configuration. "

27. Regarding the delay, the CMD-HAL, during oral evidence, submitted as under:

"Sir, with regard to the road map for LCA, yes, we took time to develop the state-of-the-aircraft, 4 ½ generations straight away. Very few countries are there in the world who could claim this and we are proud to create such a product of 4 ½ generation fighter light weight aircraft. Sir, yes, there were delays. But today, the production agency, Hindustan Aeronautics Limited has spent money to create 32,000 sq. m. of controlled environment area, all the jigs and fixes are calibrated to 50 to 80 microns and these are the state-of-the-art facilities. We are ready now to produce 8 aircraft per year and we are enhancing the rate of production to 16 by spending ₹ 1,331 crore, 50 per cent by HAL, 25 per cent by IAF and 25 per cent by Navy. By 2019-20, the country will have the capacity of producing 16 aircraft deliverable per year. In addition, as a model, we are encouraging the eco-system in the country, whoever the private vendor who could not make it, the major modules like wing, front fuselage, centre fuselage, rear fuselage, four pieces of an aircraft have already been contracted to four major vendors in India and if they start supplying us in the next eight to nine months, the capacity could be enhanced further more. By the end of 2020 or 2021, depending upon the requirement of the user and the improvements which need to be put on to it, we would be able to deliver about 16 to 24 aircraft. All the facilities are in place except the developmental work and the modifications which is required to be complied which is stage-wise. So, initially, you would appreciate, when the

engineers of HAL and DRDO started making the aircraft, first the belief was not there. This is the second phase. So, that is how the programme might look to be a little longer, but the kind of an achievement where we are releasing beyond visual range missiles from this aircraft is the proof that Indian scientists and the engineers could demonstrate these capabilities. Today, we have a very clear road map. Depending on the requirement of our customer and depending on the performance achievements, the industry is ready to make; not only HAL, but in total India there are 200 agencies who have contributed in the development of LCA."

28. The Ministry further submitted that delays were evident due to various uncertainties encountered during the phase of development such as:

- i. Change of Scope or Change of Requirements from User
- ii. Need for Continual Design Improvements
- iii. Sanctions and Policies
- iv. Grounding of specific LSP aircraft for detailed analysis of snags experienced, modifications and improvements.
- v. Delay in availability of LRUs in time in addition to Obsolescence, Failure of LRUs, PI checks and reliability issues
- vi. Air effort spent on flying other than developmental flight trials
- vii. Delays in short periods related to period specific testing (cold weather, cross wind, hot weather, air to ground range, etc.)

INADEQUATE EXPERTISE IN FLIGHT TESTING AND CONSEQUENT FLIGHT TEST CONSULTANCY WITH A FOREIGN FIRM

29. An Empowered Committee (EC) was constituted in November 2006 with Chief of Air Staff as its chairman to monitor the flight development activity and all issues for smooth induction of LCA on a quarterly basis. Audit observed from the minutes of the very first meeting of the EC in December 2006 that there was inadequate expertise in flight testing within the Indian design community; and therefore EC felt that consultancy with reputed design centres in advance nations would be needed for flight testing to meet the IOC and FOC schedules. Accordingly, ADA concluded in March 2009 a consultancy contract with M/s EADS, Germany at a cost of 18.5 Million Euros (₹ 127.65 crore) which comprised two Phases:

- (i) Phase I of the consultancy contract was to be completed by July 2011 along with the achievement of IOC of LCA; and
- (ii) Phase II of the consultancy contract was to be completed by January 2013 along with the achievement of FOC.

30. ADA could not implement all the recommendations of the consultancy contract pertaining to both Phase-I and II during its currency by January 2013 as detailed below:

- i. Pertaining to IOC Release Sequence of carrier Bomb, Light Stores;
- ii. Pertaining to FOC
 - a. System test philosophy, test process, rig test environment,
 - b. BVR Missile and usage of Air-to-Air Identification of Friend or Foe,
 - c. ADA Rig improvements using the Test Support System

31. During oral evidence, Secretary, DRDO, while justifying the consultancy contract with a foreign firm furnished as under:

".....As you know, the aircraft design is new which happened for the first time in the country. The certification aspect is also new. So, when that aircraft started flying from 2001 onwards, there were series of trials to be conducted, series of test points to be covered and there to economise and to safely do it, we need to have some consultant. That is the reason Air Bus Industries were employed to support and help as a consultant and they will be telling the test points and what to do, what not to do, how to do safely, and how they have done in their case. So, there is a first phase of contract which was employed to do certain types of trials for Phase I or IOC configuration. Once it is completed, we have never continued them though the contract had a provision for extension. So, the contract once it is completed, trials for the IOC configuration was over, FoC configuration was still not completed. That means, when we try out certain angle of attack, certain steep climbing has to be done. IOC asked for some climb and the FOC asked for still further climb. So the topic, the heading is the same, the angle of attack or the flight trails. Due to that, after a delay of one year, they were re-employed to do the same topic. But if you look at the report – we can submit – it is an entirely different angle. Probably the Vice Chief of Air Force can tell about it. So, when the heading is the same, it was done for an entirely different aspect. We have not continuously employed them because there were some developments which we were doing. We have sent them home and we brought

them back after more than a year. So, to that extent, we effectively reduced the cost, we have not wasted the money. That is what we would like to submit."

32. Supplementing the above, the Vice Chief of Indian Air Force during oral evidence submitted as under:

".....But from the pilot's perspective, sometimes in case of the recommendations that are made, there is a trade off whether the technology has to be implemented and at what cost. So, that is best understood by the scientists but we have seen many times that a recommendation made by a company after it is discussed further, it is not necessary that recommendation is to be implemented every time, and exactly in the manner that the company has said. It is just like the example you gave about research. That is how the recommendations are there because he might take a little more risk in recommending something whereas we might demur from taking that risk. Alternatively, we may want to take more risk and we may ignore his recommendation."

33. In March 2013, ADA signed the Closure Report of the consultancy contract treating the contract closed with retrospective effect from January 2013, as PDC of consultancy contract had since expired in January 2013. Responding to an audit observation, in October 2014, seeking the reasons for not implementing the recommendations of the consultant and acceptance of the closure of the contract, ADA clarified in October 2014 that it could not implement the consultant recommendations during the period of the contract as IOC schedules were shifted because of major safety related snags, ejection related issues, etc. ADA further stated in January 2015 that task wise recommendations of consultant were since implemented for achieving IOC and in respect of Phase II of the contract (FOC), it was stated that these were understood and work was in progress.

34. The Ministry submitted that this task was being attempted for the first time in the country, and estimate of the flight test effort required for achieving IOC/FOC was completely understood only after the consultancy. Delay was due to US Govt. restrictions.

35. Audit further observed in October 2014 that ADA concluded, in August 2014, another contract with the same firm viz. EADS, Germany for consultancy in flight testing

for achieving FOC and Post-FOC activity for a period of 16 months with consultation charges of 3.7 Million Euros (₹ 30.34 crore). The scope of work included consultancy for:

- (i) Flight test envelope expansion and carefree maneuvering;
- (ii) separation of weapons and stores from LCA; and
- (iii) design improvement of the Crew Escape System.

Out of the three tasks, two tasks at (i) and (ii) were already included as part of the scope of the first consultancy contract in March 2009. In October 2014, Audit enquired reasons for conclusion of another contract in August 2014 with the same firm for two tasks which should have been completed under the first contract. ADA while admitting the fact of re-inclusion of the two tasks in the scope of work, clarified in October 2014 that the Phase III included not only FOC related tasks, which would be completed within six months, but also post-FOC activity related to design improvements of Crew Escape System.

36. The Ministry furnished that extension of consultancy was to seek help of some high risk activities and the currency consultancy was primarily a risk mitigation plan for support during flight tests and accelerating the same. Grounding of aircraft further delayed schedules. They further furnished that in the earlier contract, all the recommendations of the consultant had been received and the implementation of same was in progress. During final stages of FOC, some of the more high risk and technically complex activities were being attempted for the first time and towards end of IOC-2 some new critical issues involving disciplines not included in the original consultancy came up. These new activities were identified in phase III as new consultancy areas.

37. The Ministry further furnished that all recommendations of EADS consultancy from the earlier contract were already implemented prior to achieving IOC. Subsequently, next phase of consultancy contract was signed for new critical tasks for issues related to crew escape, lightning protection, Air to Air (A to A) refuelling which were not covered in earlier contract. In addition, limited support during flight testing for FOC High AoA expansion was also sought as it was a very high risk activity. This was because ADA had adopted a unique and efficient approach for this task as suggested

by EADS which saved cost and time involved for building a separate additional aircraft for high A to A tests.

38. When asked about the reasons for not signing a consultancy contract earlier so that IOC/FOC could have been achieved much earlier, the Ministry stated that though the flight testing was commenced by the design team, this task was being attempted for the first time in the country, some bottlenecks were encountered during the flight testing and the overall effort appeared to be very large. Hence Consultancy was sought for Flight Test optimization towards achieving IOC/FOC at this stage in Flight Testing.

SHORTFALL IN ACCOMPLISHMENT OF AIR STAFF REQUIREMENT (ASR)

39. Air Staff Requirement (1985) prescribes the physical parameters of LCA such as aircraft weight, fuel capacity, load carrying capacity of weapons, missiles, survivability, navigation, etc and features like single point defueling, pilot protection system, all weather operations, fuel system protection etc. to make the aircraft capable of performing its role of multi mission fighter aircraft and have increased survivability against battle damage. The ASR also envisages timeline for induction of LCA, quantity of LCA fighter and trainer required. There were no revisions to the ASR by IAF, except in respect of weapon requirements.

40. The Project Definition Phase (PDP) document of LCA prepared by ADA in December 1988 had been reviewed by Air HQ in March 1989 who found it deficient in the crucial parameters of aerodynamic configuration, volume and weight as set in ASR, particularly with reference to significant increase in weight of LCA, which could adversely affect performance. To resolve the deadlock, it was decided in March 1990 that the development may be executed as FSED in a phased manner. However, LCA which had achieved IOC in December 2013 did not meet the ASR in terms of increased weight, reduced internal fuel capacity, non-compliance of all-weather operations, non-achievement of single point defueling, fuel system protection, pilot protection, etc., for which, ADA obtained from Air HQ altogether 53 temporary concessions/permanent waivers in December 2013.

41. Audit observed during the course of audit that LCA which had achieved IOC in December 2013 did not meet the ASR in terms of increased weight, reduced internal

fuel capacity, non-compliance of all-weather operations, non-achievement of single point defueling, fuel system protection, pilot protection, etc., for which, ADA obtained from Air HQ in December 2013 altogether 53 temporary concessions/permanent waivers. IAF replying to Audit's observation stated that the concessions/permanent waivers would adversely impact the operational performance.

42. The Ministry stated that at the time of IOC, 53 concessions were accorded by Air HQ/IAF. 20 out of 53 were permanent waivers provided by Air HQ/IAF which were technologically unachievable and 33 remaining ones were not safety critical and had insignificant impact on the combat performance of the Aircraft towards service use out of these 33, 8 had been closed. MK-I has successfully demonstrated combat potential.

43. The 20 permanent waivers granted for ASR parameters which the current configuration of LCA Mk-I with GE-F-404-IN20 engine could not achieve. The performance shortfalls applicable to 20 IOC aircraft under production at HAL will also be applicable 20 FOC aircraft as these waivers were granted for LCA Mk-I in its current configuration. The 33 temporary time bound concessions were granted for ASR parameters which were still under design/development and testing and would adversely affect LCA's combat potential.

44. The views expressed by Air HQ as early as in March 1989 that the aircraft planned to be developed by ADA would be deficient in crucial parameters of aerodynamic configuration, volume and weight adversely affecting its performance have not been overcome in LCA Mk-I developed by ADA as it does not meet the requirements of IAF fully in terms of combat potential and survivability. It was precisely with this forethought that the Empowered Committee headed by Chief of Air Staff had recommended in October 2007 for the building of LCA Mk II under FSED Phase-III in order to meet the ASR parameters. Consequently, till the LCA Mk-II is developed, manufactured and inducted into squadrons, the IAF would be constrained to use the 40 aircrafts of LCA Mk-I with reduced operational capabilities.

45. The Ministry stated that at the time of IOC, 53 concessions were accorded by Air HQ/IAF. 20 out of 53 were permanent waivers provided by Air HQ/IAF were

technologically unachievable and 33 remaining ones were not safety critical and had insignificant impact on the combat performance of the Aircraft towards service use. Out of the 33 concessions, 8 had been closed as they were applicable to IOC and out of the 8, 6 were closed. The remaining two concessions are linked with weapon accuracies above tactical Mach nos. which has no impact on combat potential of the aircraft as LCA MK-I had successfully demonstrated combat potential. 20 Permanent waivers are technologically unachievable because of the need of having a small light combat aircraft. Notwithstanding this, operational capability of LCA is comparable to any other contemporary aircraft of this class.

DELAY IN DEVELOPMENT AND SUPPLY OF TRAINER AIRCRAFT AND SIMULATOR

46. The ASR envisaged a total requirement of 200 fighters and 20 trainer aircraft of LCA. The trainer variant of the LCA was to retain all attributes of the fighter variant except for the changes necessary to accommodate a second seat for imparting training to IAF pilots and was to enter IAF service by 1994.

47. Out of the five prototypes to be built under FSED Phase-II, PV5 was to be the trainer prototype. However, based on the requirement projected in December 2005 by IAF for an additional trainer prototype, ADA decided in March 2006 to convert PV4, a fighter variant prototype, to a trainer variant as PV6. These trainer prototypes PV5 and PV6 were also to be built and flight tested along with the fighter prototypes PV1, PV2 and PV3 towards achieving IOC/FOC and consequent production of trainer aircraft against 20 IOC and 20 FOC contracts of 2006 and 2010 at HAL, with each of these contracts included 4 trainers along with 16 fighters. However, first test flight of PV5 was achieved only in November 2009 and PV6 achieved its first flight only in November 2014. Consequently, trainer LCA was yet to achieve IOC/FOC till January 2015. Air HQ had expressed in Empowered Committee meeting held in April 2013 that availability of operational trainer aircraft was essential for pilot training.

48. Replying to the Committee's concern on the adverse impact on pilot training in absence of training aircrafts, the Ministry submitted that the present trend in fighter aircraft development is to use high fidelity simulators to train pilots. Towards induction

and acceptance of Series Production (SP1) aircraft, IAF pilots are also being trained on high fidelity simulator. Also, IAF is funding for development of another Full Mission Simulator for LCA in 20 Aircraft IOC contract. Trainer PV6 aircraft has been built equivalent to Production standard Trainer and is being utilised for Squadron Pilot's training besides being used for FOC tasks. Also state of the art, full-fledged high fidelity mission simulator has been built for the Squadron for Pilot training. It may be noted that the proposal of handing over of Trainer aircraft - PV6 has been accepted by IAF and change in scope has been approved in 55th Governing Body and subsequent General Body.

49. The Ministry also stated that towards induction and acceptance of series production aircraft, IAF pilots were trained on high fidelity simulator. Hence, the non-availability of trainer was not a serious concern towards induction. So far in LCA programme fifteen pilots had been trained on high fidelity simulator developed by ADA. Proposal of handing over PV-6 had been accepted by IAF and change in scope approved.

50. Audit pointed out in May 2014 delays in attaining IOC/FOC of trainer prototypes and their consequent non-availability to IAF, Air HQ stated in December 2014 that non-availability of trainer aircraft would have adverse impact on pilot training. In response to an audit query in December 2014 regarding non availability of trainer LCA, ADA stated in January 2015 that PV-6 would be handed over to IAF for pilot training. ADA's reply was not tenable as a prototype trainer is not a substitute for a production standard trainer which had undergone flight testing/certification towards meeting the operational standards.

51. The Ministry stated that the trainer aircraft was a spinoff of the fighter variant. The critical system like avionics, flight control, sensors, propulsion system, etc were the same as the fighter aircraft. Hence, delays attributed in realising fighter aircraft had direct implication in achieving FOC of Trainer.

52. The Ministry also submitted that the trainer PV6 aircraft had been built equivalent to production standard trainer as it was being utilised for Squadron Pilot's training, besides

being used for FOC tasks. Also, state-of-the-art, full-fledged high-fidelity mission simulator had been built for the squadron for pilot training.

53. Audit pointed out that HAL would not be able to produce production standard trainer aircraft against IOC/FOC contracts for IAF till the achievement of IOC/FOC of trainer aircraft and its finalization of Standard of Preparation (SOP). Thus, trainer variant as specified in ASR was yet to be handed over to IAF till January 2015, and resultantly, IAF would be constrained to induct fighter LCA without availability of trainer aircraft which would have adverse impact on pilot training.

54. ASR specifies that a full mission flight simulator of the LCA single seater variant was to be developed and delivered in advance of production aircraft as part of training requirement in 1994. However, Audit pointed out that HAL forwarded in November 2006, a proposal for manufacture and supply of Full Mission Simulator (FMS) in respect of LCA to Air HQ. While the proposal was pending for clearance by MoD, ADA sanctioned in July 2010, a project to Aeronautical Development Establishment (ADE), Bangalore to upgrade the existing Real Time Simulator (RTS) at their end to the standard of FMS at a cost of ₹ 4.50 crore in order to meet the training requirements of the IAF pilots.

55. ADE in October 2014, in response to an audit observation regarding the status of FMS, stated that the existing RTS had been upgraded to FMS and was being used by NFTC/HAL test pilots for evaluation and training. However, Air HQ stated that though technical evaluation of HAL's proposal had been accepted by MoD, a case for procurement of FMS from ADE was being processed as per the decision taken in July 2014 in the Empowered Committee. IAF would be using the RTS upgraded as FMS at ADE, till a full fledged FMS was manufactured by HAL and supplied for the usage at LCA operating base.

56. The Ministry replied that towards induction and acceptance of series production aircraft IAF pilots are trained on high fidelity simulator and hence, the non-availability of trainer is not a serious concern towards induction. So far in the LCA programme, fifteen pilots had been trained on high fidelity simulator developed by ADA. Proposal of

handing over PV-6 had been accepted by IAF and change in scope was approved. The Ministry further stated that the trainer aircraft was spin-off of the fighter variant and the critical systems like avionics, flight control, sensors, propulsion system, etc were same as in the fighter aircraft. Hence, delays attributed in realising fighter aircraft has direct implication in achieving FOC of Trainer. Trainer PV-6 aircraft had been built equivalent to production standard trainer for utilizing it for Squadron Pilot's training, besides being used for FOC tasks.

MEETING OF WEAPON REQUIREMENT ON LCA AS PER ASR

57. When the delays caused due to changes in the weapons by IAF was pointed out in September 2014 by Audit, Air HQ stated in December 2014 that the extended schedule of design and development of LCA had resulted in several weapons and systems becoming obsolete/out of stock/operationally irrelevant and to retain operational edge, newer weapons had to be included. It was also stated that ADA being the programme manager could have inducted additional resources to realize the integration of the changed weapons in time. Due to design and development of LCA programme getting extended from time to time, IAF had to opt for newer weapons to retain operational edge of LCA. This consequently had a further impact on the timelines of the LCA programme.

58. The Ministry further submitted that Air HQ had specified changes in weapon suite for more than 10 occasions which indicated lack of clarity towards finalisation of weapon suite. New weapon integration is a continuous process occurring during life cycle of the aircraft. The continuous process of integration of newer and modern weapons has happened during the development of Tejas. As a result, LCA is one of the few aircraft in Indian inventory to have capability of firing the most modern BVR missiles. This process would have taken much longer for an aircraft already in service.

STATUS OF INTEGRATION OF WEAPONS ON LCA

59. Delayed development of LCA by ADA, coupled with delayed identification/go-ahead of specific BVR missile by IAF had impacted the FOC schedule of LCA, which was expected to be achieved by December 2015.

60. The Ministry furnished that the funding towards Derby integration was not available in the original sanction and re-appropriation of funds and sanctions thereof had further caused delay.

61. During oral evidence, the Vice Chief, IAF, submitted as under:

".....One of the reasons why LCA got delayed—I will be very candid to admit—is that the weapons have changed. The LCA started with R-60 MCOM air to air missile that I have flown as a pilot officer. Then, thereafter in 2005--of course, the project was delayed when this missile became obsolete--we asked them to induct R-73 missile. I am happy to report that unlike most of the aircraft that are in initial operational configuration, this particular aircraft can drop all 1000 pound of bombs. That can drop 250 kilogram bomb. That can drop LGB. That can fire an Astra, and it can fire a derby missile too. So, combination of missile and combination of radar, which is very important for this long range missile, has been done."

62. Supplementing the above, the CMD-HAL furnished as under:

"..... When we start developing an aeroplane, we have to take into account all the configurations. When an aeroplane has to fly, while flying it needs to be filled with 5000 kg of fuel, or we need to fit a bomb on it, we have to take everything into consideration. And, when the pilot goes, we have to ensure absolute safety, not even one machine should be failing. First, we design with all its configurations. Then, we do drop a dummy bomb. So, the trial itself is time consuming. Any failure may take us again at the beginning and re-invention."

63. Further, the Vice Chief, IAF, submitted as under:

".....Like, Chairman, HAL has brought out, clearing a weapon in an aircraft is a flight safety issue and it is a very complex process."

64. The Ministry further submitted that due to changes in design and delay in establishment of manufacturing facilities, HAL could not adhere to the committed delivery schedule. As a result, 725 litre drop tank was not integrated on LCA, an IOC requirement, and ADA had to obtain concession towards this while achieving IOC in December 2013.

65. The Ministry stated that as per AHQ letter Air HQ/S/96056/6/11/ASR dated 10th Jan 2012, 725 litre Drop Tank integration was not a mandatory requirement to achieve IOC-2. Hence ADA has not sought any concession on this regard.

66. The Ministry further submitted that IOC certification includes R73,1000 lb bombs, laser guided bombs, Drop Tanks and practice bombs. The SoP of the IOC series production aircraft will include the above weapon as agreed between AHQ and ADA. Further delay in realisation of Pylon and Drop Tank is due to the delays in procurement of Raw material. Vendor identification and establishment of manufacturing setup and Test environment by HAL. All IOC weapons and stores have been integrated and flight-tested.

ELECTRONIC WARFARE CAPABILITIES FOR LCA

67. Combat aircraft are equipped with Electronic Warfare (EW) capabilities to degrade the effectiveness of enemy radar and radio systems. ASR specified that LCA should be capable of carrying an Electronic Counter Measures (ECM) Pod. In addition, provision was to be made for an internally mounted Self Protection Jammer (SPJ) in the LCA with provision for future updates. In March 1997, Air HQ revised the EW capability on LCA to include SPJ, Radar Warning Receiver (RWR) and Counter Measures Dispensing System (CMDS).

68. Development of SPJ by DARE was not successful, and as a result, the LCA Mk-I will be deficient of this system. As regards the other two EW components - RWR and CMDS - till the performance issues are resolved, these two systems will also have performance shortfalls. Consequently, LCA Mk-I remains deficient in full EW capabilities as specified in the ASR.

69. The Ministry/IAF stated that internal SPJ was not part of FOC and shall be integrated on LCA AF MK II. Presently, Tejas is equipped with RWR and flares (CMDS). All the performance issues have been overcome and it is certified to use on SP Aircraft. EW suite draws more power and requires lot of real estate in fighter aircraft.

70. During oral evidence, the Secretary, DRDO, submitted as under:

"As far as the avionics is concerned, the main thing is radar..... we failed to complete at that point of time. Even there, the present radar also, though the rest of the thing, that is the transmitter and the receiver and the sensor person is from ELTA whereas the radar and the front end is within India. We are still producing those antennae. That antennae portion is within the country itself. Even in the

existing one. As far as the radar is concerned, today we have got the next version not mechanical scanning, electronically scanning radar which is already established in the LCA which is also accepted by the services. The same type in a higher frequency band is already made and it is fitted on to the aircraft. The ground trials are going and it will be taken up for flight trials subsequently. We are also simultaneously trying to put another aircraft modified for this purpose so that we will get a much more flight trial type. So, to that extent, we are ready with that. The other main constituent is jammer. As you are telling about jammer, jammer comes under weapon category, not on the main system."

71. Supplementing the above, the Vice Chief, IAF submitted as under:

"..... there is a radar that is being manufactured. That will have AESA technology, Active Electronically Scanned Array System. That will substantially improve its performance. In regard to both radar and jammer, first you have to develop the radar because both radar and jammer do not work together. Jammer can work only when the radar does not operate. Aircraft cannot do without radar. Radar has to be there.....I said that radar has a mode. The aircraft's radar, which is currently in 45 squadron, is working fine. There is absolutely no problem with those radars. If you want to improve the performance of the radar that is in 45 squadron further, we want to change the radome of the aircraft. That is also being done. So, from currently where I can pick up a Su-30 at 60 kilometres, I will pick up at close to 70 kilometres.....Sir, the current radar is an Elta radar but our own radar is also being developed.As far as the jammer is concerned, first the radar has to be developed and then the jammer can be integrated with the radar. There are many jammers- radar available. Towed jammers and Towed Decoy jammers are available. They can be carried on the wing stores and that does not inhibit the aircraft's performance in any way. Once we are getting a jammer with Rafale type, we could always see how it performs."

72. The Ministry submitted that MK-I is equipped with RWR and Passive jammer. The podded active jammer was planned in MK-IA to meet the EW capabilities as agreed with AHQ.

73. The Committee highlighted the fact that as per ASR, Electronic Counter Measure (ECM) suite should have self protection jammer (SPJ) as role equipment though LCA is not integrated with SPJ. They wanted to know why the development agency was deviating from the ASR which specified the need for SPJ and sought the merit behind such a move? The Ministry replied that Integration of SPJ pod as a role equipment would essentially mean reduced weapon carrying capability, due to the SPJ pod occupying one store location. Internal EW system demanded more real estate and therefore was not feasible in Tejas Mk1 class of aircraft. Therefore, integration of EW

system on light aircrafts of Tejas class would have an adverse impact on other aspect of the aircraft performance and capability.

74. The Ministry further submitted that as per ASR para 4.13, ECM (Electronic counter Measure) suite should have self protection jammer as role equipment. IAF vide their letter no AHQ/S96056/6/7/ASR dated 19th March 1997 defined the EW capability on LCA as Self Protection Jammer, preferably internal or podded, RWR and CMDS. IAF had issued further letter dated 24th Dec 2009 stating that internal SPJ was not part of FOC and shall be integrated on LCA AF MK2. At present Tejas is equipped with RWR and passive jamming with chaff and flares (CMDS), only Jammers deferred and all the performance issues have been overcome and it is certified to use on SP Aircraft. However, the external podded Jammer was planned to be integrated on LCA Mk1A variant and the same could be retro-fitted on LCA Mk1 if required. In addition to this MMR and communication system has built-in features of advanced features of ECCM to avoid jamming though LCA Tejas is not integrated with active self protection Jammers. It can be noted that major fighters of Air Force fleet like MIG 21BIS, MIG 29, Su 30 etc are not equipped with any EW systems. Russian combat doctrine has jammers escorting fighters.

75. As per the Ministry, the test results of Defence Avionics Research Establishment (DARE) EW suite which completed its first flight on Tejas PV1 LCA in early 2015 by furnishing as under:

"UEWS integration on LCA PV1 was successful and performance of the system was satisfactory against single and limited emitter environment (five emitters). It is to be noted that PV1 was specially modified to incorporate the EW suite by removing some LRUs. Moreover, the performance of the aircraft was highly compromised by the EW suite. Since this system was not feasible to integrate on production versions of LCA, due to space constraint, further upgrade and detailed evaluation of the upgraded system was carried out by DARE on other aircraft platforms of IAF".

76. The Committee sought the Ministry's opinion on electronic protection and attack capabilities of the LCA squadron as fighter aircraft with EW capabilities would be far

more effective than a single-mission, dedicated electronic attack support aircraft. The Ministry furnished as under:

"any fighter aircraft will always have a power, payload carrying/real estate constraint. Optimisation of power payload/real estate, between attack capability in terms of weapons/sensors/datalink etc. and self-protection Jammer would be a design choice. Therefore the effectiveness of either strategy depends on the attack doctrine followed by the forces".

WORK PACKAGES FOR LCA PROGRAMME

77. As per the Memorandum of Association (1984), ADA was to execute the LCA development by utilising the capabilities of national agencies/institutions, referred as work centers, working in Aerospace technology. There were/are 152 work centres in all, viz. DRDO labs (38), Public Sector Undertakings (PSUs) (22), Government organizations (36), educational institutes (14) and other private agencies (42).

78. ADA had awarded 503 WPs amounting to ₹ 1,112.39 crore for FSED Phase-II. Out of 503 WPs, ADA had identified 110 WPs valuing ₹ 630.21 crore as critical based on the basic functionality requirement for the safe flight of the aircraft. ADA entrusted all the work packages from 2002 to 2013 to 152 work centres and out of which, only 27 per cent of the WPs were completed within the schedule and remaining 73 per cent of the WPs were delayed. Among the critical WPs, only 13 per cent were completed within schedule. Even the on-going 62 WPs related to FOC activities were also behind schedule with delays ranging from 2 months to 11 years. Audit on a sample review of execution of 194 WPs (51 critical, 143 non-critical) valuing ₹ 632.23 crore (₹ 338.37 crore - critical, ₹ 293.86 crore - non-critical) noticed instances of delayed completion of work packages.

79. Upon enquiry by Audit in September 2014 about delays in completing the WPs by the entrusted work centres and basis for selection of work centres, ADA stated that it had no authority/control on the working of work centres. ADA also admitted in October 2014 that the delay in development of WPs had affected the LCA programme schedule. ADA also stated in January 2015 that work packages/project sanctions were continuously reviewed and monitored by ADA through participation in Project Review

Committee (PRC) meetings. However, the priority accorded by these work centres was depending upon the production targets set by their management on which ADA had no authority. As regards the basis for selection of work centres, ADA stated in October 2014 that during 1990s selection of vendor for development of strategic aviation equipment was very limited in the country, hence it had no choice but to go with the vendors who had past experience in the related field.

80. As non-maintenance of data on work packages was a serious issue, the Committee sought to know whether complete details/data of work packages sanctioned in LCA FSED Phase-I was available. The Ministry replying to the Committee's concern replied as under:

"ADA had sanctioned around 600 work packages to various work centres under LCA FSED Phase-I programme. A centralised computerised accounting system was put in place in ADA in 2007. Since FSED Phase-I programme was started way back in 1993 and closed in 2004; details on remaining work packages were not readily available. Subsequently, they have been traced from various archives".

81. Further, they observed abnormal delay in completion of work packages sanctioned in FSED Phase-II programme, leading to delay in LCA programme and sought reasons and actions taken for completing work packages in time. The Ministry replied that:

- (i) large number of Government work centres are involved in development of LCA;
- (ii) ADA believes that delay in project is partly attributed to the lack of direct control of ADA on the working priorities of the work centres in the early stages;
- (iii) to achieve project timelines and accord priority to LCA work, ADA feels that effective control at higher management of PSUs and Government organizations would have definitely helped in accelerating the programme; and

- (iv) notwithstanding, regular reviews at higher level management of the work centres are held and performance is satisfactory.

82. When asked about the reasons for not providing for direct control on the working priorities of the work centres thought of at the earliest by the Ministry which very well knew that a large number of Government labs/agencies were involved, the Ministry submitted as under:

"ADA expected that the work packages sanctioned to various work centres would be given the same high priority by the work centres that ADA gives to development of LCA. But over the period of time it was noticed that there were delays in completion of the work packages. Hence ADA felt that direct control on the working priorities of the work centres would have yielded better results for some of the work packages. However, the delays in many of the work packages were due to technological complexities of developing ab-initio technologies".

83. Further, when the Committee sought to know what suitable measures had been taken to rectify the above mentioned, the Ministry furnished that regular reviews at higher level management of the work centres are held and performance is satisfactory. Towards realization of future projects, the work packages are planned in a modular manner instead of sub-system approach followed for Mk-1. Further, periodicity of higher level reviews has been increased to accelerate execution of work packages.

LACK OF USER INVOLVEMENT

84. Audit observed that in September 2014, that the LCA PDP Review Committee, which examined the work done at Project Definition Phase, had strongly recommended early establishment of a standing Liaison Group between Air HQ and ADA to ensure closer interaction between the design team and the user for better appreciation of mutual perception, including appropriate trade-offs in performance, weight, time frame, cost, technological complexity and operational considerations of LCA.

85. However, no such liaison group was formed. As a result, IAF played limited role as a member in Governing Body and General Body meetings. The active user participation in the LCA Programme was started only after the formation of an Empowered Committee, LCA Review Committee consisting of ADA, HAL and IAF and

LCA Project Management Team (LCA-PMT) at ADA. The Empowered Committee chaired by Chief of Air Staff and co-chaired by Secretary (DP) and SA to RM/DG ADA met Quarterly to review the complete programme with the sole objective to monitor the flight development activities. The LCA Review Committee headed by Deputy Chief of Air Staff met every month to review all the issues concerning the programme. LCA Project Management Team (LCA-PMT) headed by Air Vice Marshal to function as a single point interface between the IAF and ADA/NFTC/HAL for co-ordination of flight test activities, positioning of weapons stores for LCA, etc.

86. Audit sought in September 2014 the reasons for non-formation of standing Liaison Group between Air HQ and ADA to ensure closer interaction between the design team and the user as recommended by the LCA PDP Review Committee. In reply, Air HQ stated (Dec 2014) that expertise of IAF personnel was not in the area of design of aircraft, but in capability to guide the programme in terms of user requirement of operations and maintainability. Hence formation of standing Liaison Group earlier than 2007 may not have been fruitful. It was also stated that IAF test pilots and test engineers were involved in the project as part of National Flight Test Centre (NFTC), Bangalore since 2001.

87. Thus, non-formation of a standing Liaison Group between Air HQ and ADA to ensure closer interaction between the design team and the user for better appreciation of mutual perception, including appropriate trade-offs in performance, weight, time frame, cost, technological complexity and operational considerations of LCA also impacted the LCA development timelines.

88. The Ministry, in reply, furnished that due to the above reasons, maintenance related issues were not pointed out during early stages of the design & development programme by the test crew as well as test engineers. The CSDO RFAs has been raised only after involvement of IAF-PMT from year 2007. This has impacted design modes/timeline.

89. The Ministry further submitted that IAF involvement to Tejas D&D programme was through quarterly reviews from beginning of Tejas programme. However, to accelerate induction activities, PMT team of IAF was formed in 2007 by IAF. IAF pilots

were directly involved in the flight test programme for technology development during FSED phase-1 from the beginning for flight test related activities. Subsequently, to address operational and maintenance issues, IAF PMT was formed in addition in the year 2007 at ADA.

90. During oral evidence, the Vice Chief of IAF submitted as under:

".....the question on Air Force's association with LCA and establishment of project management group as the first question, I would like to assure the Chairman that Air Force has been intimately involved with LCA's development right from writing its QRs. In fact, where LCA is today would not have been possible without intimate association of Air Force people into the LCA project. I have a living example here. The second person to fly LCA was our Air Force officer who is now our Deputy Chief of Air Staff. We have established NFTC in the late eighties with a view to ensuring that the LCA project moves at a quicker pace.....We established NFTC. Subsequently when series production was beginning and that is where rest of the people from the Air Force not the test pilots and flight test engineers of AST and on deputation to HAL and to ADA but when the aircraft was inducted into the Air Force, for pre-induction we also put our project management group that would look at issues related to line maintenance and induction of the aircraft."

91. On being asked about the reasons for not involving the end user viz. IAF fully for maintenance/operational issues impacting design modifications thereby directly affecting the project timeline; the Ministry replied as under:

"IAF pilots were directly involved in the Flight test programme for Technology Development during FSED Phase 1 from the beginning for flight test related activities. In addition PMT team consisting of IAF Personal was formed in 2007 by IAF at ADA. Air HQ felt that formation of Standing Liaison Group earlier than 2007 would not have yielded fruitful results since expertise of IAF personnel was not in the area of design of aircraft. However, Air HQ personnel were participating in major Program reviews".

ABSENCE OF INDIGENISATION PLAN

92. The Gol sanction of LCA project in August 1983 envisaged use of as many sub-systems as were readily available in the world market. However, Gol sanction in June 1993 for FSED Phase-I required to shift the focus on maximising the indigenous

development, even if it meant increase in cost and time, partly because of severe foreign exchange crunch faced by the country in early 1990s and partly for attaining self-reliance in critical areas. Accordingly, ADA had proposed in June 1993 to undertake indigenous development of items such as Jet Fuel Starter, Gear Box, avionics software development and mechanical systems of LCA. In addition, import content was planned to be reduced in design and development of Carbon Fibre Composite (CFC) Wing, Multi-Mode Radar, General systems, import of components instead of systems, apart from increase of import content in infrastructure and aircraft manufacturing activities.

93. In response to Audit observation in July 2014 regarding indigenisation plan for LCA, ADA stated in August 2014 and January 2015 that no indigenization plan/roadmap for LCA was made because the scope of the Project was to develop advanced technologies/components along with LCA development. ADA, however, further stated in January 2015 that sufficient emphasis had been given towards indigenous design and development of various critical systems right from the beginning of the programme.

94. In response to an Audit query in July 2014 regarding the extent of indigenisation in LCA, ADA claimed in August 2014 that indigenous capability developed worked out to 70 per cent of the LCA content in terms of value.

95. The Ministry justified that it was not practical to indigenise the all-electronic components in India due to the lack of infrastructure of manufacturing and such huge investments are not part of LCA Programme. No country aimed at 100% indigenous contents. Indigenous contents of all strategic equipment was enhanced.

96. In response to audit query in August 2014 on the extent of indigenous content, ADA clarified in October 2014 that the LRUs were built in-house using imported components with indigenous design qualifications and certification efforts and hence indigenous content had been worked out at LRU level. ADA, however, further stated that the indigenous content of LCA worked out to about 35 per cent considering the use of imported components and accessories in LRUs. ADA also confirmed in October 2014 the continued dependency on imported electronic components, accessories etc. for LCA.

97. The Ministry submitted that with regard to the figure of 35 percent, ADA had stated that approximately 35% of the parts had indigenous source of raw material and remaining 65% parts were made from imported raw material (Metallic and composite raw material). The Ministry also stated that the figure of 35% was cited by ADA only in the context of raw material of LCA airframe and not for the entire LCA development.

98. As per Audit, in the absence of a roadmap for indigenous development, the efficiency and effectiveness of the indigenous development achieved in the LCA programme could not be assessed. Audit also observed in December 2014 that ADA had further initiated in February 2014 a proposal for indigenous development of 109 LRUs at an estimated cost of ₹ 479 crore.

DEVELOPMENT OF ENGINE FOR LCA

99. Even after incurring a development expenditure of ₹ 2020 crore by GTRE till January 2015, indigenous development capability for LCA propulsion was not successful and ADA would continue to depend on GE imported engine for LCA. However, the Ministry did not comment on the issue raised by Audit in their Report.

100. Inordinate delay in fructification of Kaveri engine and cost overrun of the programme was also commented upon in Paragraph 5.1 of the Report No 16 of 2010-11 of the C&AG of India, Union Government, Defence Services (Air Force and Navy) for the year ended March 2009.

101. The Ministry replied that Kaveri engine development is an indigenous effort for mastering one of the most complex technologies. Kaveri Engine Development Project was sanctioned in March 1989 with project cost of ₹ 382.81 crores at 1987 price level and PDC of December 1996. The project PDC and cost was revised from time to time up to December 2009 and Rs 2839 crore respectively, with ₹ 2105 crore (FE element of ₹ 1227 crore), earmarked for interim flight trials with LCA 'Tejas' and balance ₹ 734 crore for development of final flight standard engine. The Kaveri engine progress so far:

- 9 full prototype engines and 4 core engines have been built so far.
- A total of 2882 hours of engine testing have been completed.

- Kaveri engine has been tested for 73 hours of Altitude testing at CIAM, Russia and 57 hours of flight testing in IL76 aircraft at GFRI, Russia. This is the first time that an indigenously developed military gas turbine engine was flight tested.
- The engine has attained a technical maturity as concluded from recent Kaveri engine technical audit by M/s Safran Aircraft Engine Ltd. The certification tests are under progress at GTRE test bed.
- 12 Materials (Titanium, Steel and super alloys) have been indigenously developed and type certified.
- Adequate manufacturing bases have been established at GTRE, HAL and other private/public sector undertakings for fabrication of various engine components.
- Testing infrastructure has been built at GTRE for gas turbine engine and components.
- The engine will be used for an Unmanned Aircraft.

102. Responding to the query whether the important components of Kaveri Engine were being imported and how many were being imported and what was the expenditure, the Ministry replied as under:

"a few of the accessories like lubrication, pump, integrated nozzle actuation system, variable guide vane actuation system etc. are being imported. The expenditure on imports is to the tune of ₹ 500 crores (approximate) which is 25% of the total sanctioned project cost (₹ 2105 crore). However, the import content will be further reduced once the Kaveri engine is under production".

DEVELOPMENT OF RADOME

103. ADA had to depend on imported source for meeting the requirement of Radome as the one developed indigenously by ASL, Hyderabad and manufactured by HAL was not found suitable for LCA. This had impacted testing of MMR with cascading effect on accomplishment of FOC.

104. Seeking information on the development of Radome by ADA/HAL with Kevlar material selected in first instance by the Committee, the Ministry submitted as under:

"DoAC, ASL (DRDO), Hyderabad were the designers of LCA indigenous Radome. Glass fiber and Kevlar fibre were considered during the design phase. Kevlar was the best available radome material at the time of finalising the radome development. Kevlar fibre with Low Loss Polyester (LLP) resin gives good electromagnetic properties that are comparable to glass fiber composites.

Further, Kevlar has lower density resulting in lower weight for the Radome. Hence, Kevlar with LLP resin was selected for LCA Radome. Kevlar fibre (Generic name – Aramid fibre) was available from import sources. Also, the facility & technology for preparing socks from Kevlar fibre was available within country. Socks of various dimensions were used to make the LCA Radome".

105. When enquired about all the six Radomes were supplied by M/s Cobham, England by January 2015, the Ministry submitted that first two Radomes were supplied by August 2015 for performance evaluation. Last Radome was supplied by December 2016.

106. Regarding the present status of testing of Radome supplied by Cobham along with MMR on LCA, the Ministry replied that flight testing of Cobham Radome has been completed with MMR on LCA and Radar performance meets Air Staff Requirements. Quartz Radome procured from Cobham UK, has been successfully integrated on LCA AF MK1 and various aspects have been tested on ground and in flight. The Radome has now been certified for and being used on series production fighters.

107. When asked whether the Radome developed by HAL was usable on any other aircrafts, the Ministry submitted that Radome developed by HAL for LCA is specific to LCA airframe. So the same Radome cannot be used in other aircraft platforms/aircrafts. However, the basic technology can be adapted for another platform.

108. On being asked whether ADA/HAL would continue to depend on M/s Cobham, England for further supply of Radome in order to meet the requirement of LCA or was there any plan for indigenisation of the same, the Ministry replied that ADA/HAL will depend on Quartz Radome developed by M/s. Cobham for Mk1 series production aircrafts. DRDO has initiated LCA quartz radome development with ASL Hyderabad and R&D Engineers Pune. These radomes will be integrated in LCA Mk1A when ready. CEMILAC has approved the fitment of M/s Cobham Radome from 11th Series Production Aircraft onwards, as Line Compliance, and as Retro-fit on SP1– SP10. HAL

has already placed the order on M/s Cobham for supply of 20 sets of Radomes. Further orders for FOC requirement will also be placed.

109. The Ministry also stated that Quartz radome integrated and flight tested. The performance achieved ASR targets.

DEVELOPMENT OF MULTI-MODE RADAR (MMR)

110. Indigenous development of MMR for LCA could not be accomplished even after 22 years. Further, pending testing of MMR with the newly developed Radome, the performance testing and integration of MMR would remain incomplete, which would impact the combat employability of LCA.

111. The delay in development of MMR despite consultancy from Ericsson and consequent import of three antenna was also commented in Paragraph No 28 of C&AG's Report No. 8 of 1999 for the year ended March 1998.

112. ADA decided to continue co-development with M/s ELTA with the indigenously developed Antenna Platform and antenna, sub-systems as a part of MMR integrated on LCA.

113. The CMD, HAL, during oral evidence, submitted that:

"Coming to the one specific issue on MMR, as the hon. Member has said, always R & D may not result in success. This is one of such MMR development which was assigned by ADA to HAL. HAL has developed three rotables, LRD has two rotables including antenna. When it was flight tested for about 75 sorties, the performance was not as per the required norms. So, to meet the requirement of IOC, FOC, the decision was taken by the then Scientific Advisor to Raksha Mantri that we would go ahead in a 'go development' mode with M/s ELTA of Israel and they said, 'If HAL is interested, you continue with indigenous development'. But as our product will not find a market after development, we could not develop it and we stopped. So, that is an unsuccessful story of antenna development."

114. When asked about the structural requirement of front fuselage and design of MMR could not be planned in tandem so as to avoid structural changes of LCA front fuselage later, the Ministry furnished that the front fuselage was designed to

accommodate indigenous radar LRUs (being developed by HAL, Hyderabad and LRDE, Bangalore). Subsequently, it was modified to accommodate imported radar (ELTA) LRUs which were selected later. The airframe was modified to suit the system LRUs as identified by programme.

115. As regard the present status of performance testing of MMR with imported Radome and on LCA, the Ministry submitted that the MMR performance test with respect to imported Radome has been completed. MMR performance as a sensor in various modes of operation for FOC is in the final stages of completion and performance of the Radar is found to be excellent.

MULTI-FUNCTIONAL DISPLAY SYSTEM (MFDS)

116. HAL was unable to manufacture MFDS either in-house or through the JV Company formed for the specific purpose of developing MFDs and had to resort to procurement from foreign source.

117. The Ministry, while furnishing information on MFDS, stated that plan for realisation of indigenisation of major items/schedule of activities were under financial scrutiny.

118. The Ministry further stated that HAL had already procured 20 sets of multi function display system (MFDS) for 20 IOC series production aircraft. Study conducted by HAL (Korwa Division) for indigenisation, indicated that it is not economically feasible. However, indigenous development of different MFDS called Smart MFDS had been initiated by ADA for further requirements.

JET FUEL STARTER (JFS)

119. Development of JFS as required by IAF with three consecutive starts was still pending as of January 2015 and even after the induction of LCA into IAF, the aircraft would continue to operate under concessions in respect of the JFS until it was retrofitted with modified JFS.

120. On being asked whether the modified Jet Fuel Starter (JFS) developed by HAL was flight tested and whether JFS achieved three consecutive starts as required by IAF, the Ministry replied in positive by stating that JFS, developed by HAL, was flight tested with three consecutive starts had been successfully demonstrated.

121. The Ministry also stated that JFS GTSU-110M1 had been successfully tested at Leh and three consecutive starts had also been demonstrated successfully and certified.

122. Further when enquired about the modification kits being retrofitted with JFS during March/April 2015 and its subsequent result, the Ministry submitted that as per sanction, units were retrofitted and tested during 2015. The oil consumption limits were established. Single start oil consumption limit is 75 ml and for three consecutive start max limit is 250±50ml. These units share lube oil with AMAGB. JFS GTSU 110 and 110 M1-1 have been flight tested and certified so far. GTSU 110 M2 with self lubrication system is planned for integration and flight test on LCA AF MK1 during August 2018.

123. The Ministry explained that SP-1& SP-2 were retro-modifiable with GTSU 110M1. Further improved JFS GTSU 110M2 with integral lubrication had been developed and integrated on aircraft.

FLIGHT CONTROL SYSTEM ACTUATORS

124. The indigenously developed flight worthy actuators were delivered to HAL by DALIA, LCA would depend on imported source for these items.

125. When asked about whether HAL completed the supply of actuators and if the indigenous actuators had since been tested on LCA, the Ministry submitted as under:

"ADA has enabled the productionisation of the indigenous Primary Actuators i.e Elevon & Rudder through a consortium approach of Private industries i.e M/s Godrej & Boyce Mfg co. Ltd and M/s Mumbai MTAR, Hyderabad. HAL, Lucknow which is a nodal agency has placed a purchase order for 13 ship sets actuators. Upon completion of ToT by ADA, currently 2 ½ ship set actuators have been

assembled, tested & delivered to ADA. The 2nd batch of 2 ½ ship set actuators is getting assembled at Godrej Works, Mumbai and PDC is scheduled for June 2018. The balance 8 sets shall be assembled & delivered by HAL and PDC is scheduled for December 2018. Integration of indigenous actuators involves modifications to the aircraft. Since aircrafts were involved in FOC activities, these modifications were not feasible to be done earlier. On completion of FOC activities on LSP2, by May 2018, this aircraft will be modified for indigenous actuator fitment and the actuators will be type certified".

126. The Ministry stated that Indigenous Actuators were realised and qualified. Flight testing was planned from August 2016 onwards. Indigenous actuators along with modified DFCC integrated on LSP2 and Flight test planned.

CHAPTER IV MANUFACTURE AND INDUCTION OF LCA

LOW AVAILABILITY OF LCA FOR FLIGHT TESTING TOWARDS ACHIEVING IOC/FOC

127. HAL was to provide TDs and PVs for flight testing to achieve IOC and FOC as per the MoU of December 2006. However, due to deficiencies in the PVs, LSPs were included for flight testing activities by an amendment in November 2010.

128. Delays in execution of Phase-I activities of LCA programme was also highlighted in Para 28 of the Report No. 8 of 1999 of the C&AG of India, Union Government, Defence Services (Air Force & Navy) for the year ended 31 March 1998.

129. The Ministry stated that low serviceability was linked to concurrent development activities which resulted in increased downtime between sorties as per the requirement of the programme coordinator ADA. Further, each of the LSP aircraft were built to different standards and only specific aircraft could be used for specific test points. The activity of data debriefs and snag analysis for increasing the sortie rate was delayed due to issues in FOC Build Standard document and production drawings planned to be released by October 2017. Build of FOC standard aircraft would begin in FY 2018-19.

DELAY IN PROCUREMENT OF PLANT AND MACHINERY

130. On account of delayed creation of manufacturing facilities, and that too limited to four aircraft per annum as against required eight aircraft per annum the production of 20 IOC LCA has been delayed although IOC was achieved in December 2013.

131. When ascertained about the reasons for such delay, the Ministry furnished status and stated that delay in IOC contract are attributed to continuous changes in design, change of SOP, rejection of parts manufactured to lower issues drawings and launching manufacturing parts to new issues drawing frequently, new requirements warranting changes in jigs and fixtures which were already established, non-establishment of programme developed vendors to manufacture 52 indigenised non-DPSU LRUs to series production standard, delay in supply of CFC parts by NAL etc. LCA Tejas division is geared up for production of 8 aircraft per annum. This can be achieved only after clearance of all D&D issues. Ministry/HAL stated that programme coordinator is yet to release the finalised build standard document for FOC till date for production group to manufacture the aircraft. Delivery will commence on release of build standard document by ADA. HAL has handed over the first IOC SP aircraft to IAF in January 2015. FOC Build Standard document planned to be released for production by Oct 2017.

132. On being asked to provide the present status of procurement of plant and machinery and the position regarding supply of aircrafts to Air Force by HAL, the Ministry submitted that HAL had completed the establishment of plant and machinery as per FSED Phase-II. HAL has already delivered nine Series Production Fighter aircraft to Air Force.

133. The Air Staff Requirement (ASR) (October 1985) envisaged that LCA was required to be inducted in IAF squadrons by 1994 as a replacement of Mig-21. The requirement projected by Air HQ was for 200 fighters and 20 trainers, with a view to form 11 squadrons of LCA in order to overcome depletion of squadrons due to phasing out of ageing fleet. However, inordinate delay in development of LCA (as discussed in Chapter II) has delayed the induction of LCA into service and impacted formation of the squadron.

134. During the oral evidence, the CMD-HAL, submitted as under:

"Sir, the progress has not been that good till last year and we just gave them five fighters in the last two years. This depends on how the standard of preparation gets cleared. I can only make an aircraft which would be acceptable to the Indian Air Force. Today, I have an order for IOC configuration of 20 aeroplanes. Out of it, by this year end, I will complete 11 and next year four, and four more trainers. For trainers, we are still defining the final standard in which we have to prepare them. The next thing is that I can cut the material only when we reach the FOC, which is sooner. So, it goes stage-wise, but notwithstanding the order book. Normally, it is an industry which takes order and then invests the money. Today, HAL has invested the money. I am prepared for any eventuality of supplying minimum 16. Today, I do not have an order."

IAF HAD TO RESORT TO ALTERNATE MEASURES TO MAINTAIN THE FORCE LEVEL

135. Audit enquired (June 2014) regarding steps taken by Air HQ to overcome the depletion of squadron level in view of delay in induction of LCA. In reply, Air HQ stated (February 2015) that the following measures had been taken by them, apart from revising the phasing out of MiG-21 squadrons:

- a. Up-gradation (November 1995) of 125 MiG BIS aircraft at a cost of 626 million USD (equivalent to ₹ 2135 crore)
- b. Up-gradation (March 2008) of 62 MiG-29 aircraft into multi role MiG-29UPG standard aircraft at a cost of 964 million USD (₹ 3841.87 crore). Upgradation was in progress (February 2015)
- c. Up-gradation (December 2009) of 61 Jaguar Aircraft at a cost of ₹ 3113.02 crore. Upgradation was in progress (February 2015)
- d. Up-gradation (2011) of Mirage 2000 aircraft through OEM and HAL at a total cost of ₹ 10947 crore. Upgradation was in progress (February 2015)

Due to delay in development and induction of LCA, IAF had to up-grade other aircraft at a cost of ₹ 20,037 crore. Besides, phasing out of MiG-21 was also revised (January 2013) to utilise the ageing fleet for extended period.

136. The Ministry furnished that due to the technological complexity and associated hurdles, which had to be overcome, there was a delay in development and induction of

LCA into IAF. Investments made in LCA Programme have led to the establishment of indigenous capability for contemporary 4.5 generation aircraft development programme which is essential for future aeronautical development programmes in the country.

137. When the Committee wanted detail on the action plan to overcome operational issues of the Indian Air Force arising due to the delayed induction of LCA, the Ministry replied that IAF has carried out major design upgrades to MIG, Jaguar and Mirage fleets to address operational needs during past 15 to 20 years.

138. As there had been an invariable delay in the formation of LCA squadron, the Ministry apprised the Committee about the steps taken/proposed to fast track the same by furnishing the following:

- (i) Phased development approach for LCA development was changed to Concurrent Development approach.
- (ii) Following reviews are held continuously to avoid further delay:
 - a. Daily reviews at LCA Assy. hanger,
 - b. Weekly Review in ADA,
 - c. Special Review Committees have been set up by Honourable
 - d. Raksha Mantri to review the Progress of the programme;
 - e. Every month by Deputy Chief of Air Staff.
 - f. Half yearly review by Governing Body chaired by Secy, Dept. Defence R&D.
 - g. Quarterly review by Empowered Committee, Chaired by Chief of Air Staff.
 - h. Annual Review by General Body chaired by Honourable Raksha Mantri.
- (iii) Formation of Project Monitoring Team (PMT) with Air Force officers at ADA.
- (iv) Formation of Quick Reaction Teams (QRT) to resolve design/production issues.
- (v) The programme is rescheduled to suit the Induction Programme of Indian Air Force.

- (vi) Private partners, modular assembly, etc.

DELAY IN FORMATION OF LCA SQUADRON

139. Air HQ had planned to have two squadrons of LCA and placed two contracts (March 2006, December 2010) with HAL for supply of 40 aircraft (20 IOC and 20 FOC aircraft). However, forming of LCA squadrons could not materialize (January 2015) due to delay in LCA programme (as discussed in Chapter II) as delivery of aircraft was pending.

140. During oral evidence, the Vice chief of IAF, replying to the specific query of the Committee as to how many years will it take for the IAF to replenish all the fighter aircrafts in its fleet, submitted as under:

"Sir, we had placed an order for 123 aircraft. While there could be, more or less, six or nine in the squadron, the other things are already under air-test. Compared to what we have seen in the first six aircraft, the time that it takes in the air-test has reduced considerably. If we get 20 aircraft, within five to six years, we will have all aircraft.....Sir, I agree with you."

PART-II

OBSERVATIONS/ RECOMMENDATIONS OF THE COMMITTEE

The Committee note that Light Combat Aircraft (LCA) programme was initially sanctioned in 1983 with a development schedule of eight to ten years against Indian Air Force (IAF's) requirement of induction by 1994. However, the project schedules slipped, mainly on account of design changes necessitated due to change in weapon requirements, non-availability of Kaveri engine, delay in completion of work packages by the work centres, etc. The Committee observe that LCA achieved Initial Operational Clearance (IOC), as late as, in December 2013 with 53 concessions/permanent waivers that reduced its operational employability considerably. Notably, the project is still in progress. The Performance Audit (PA) No. 17 of 2015 covered issues relating to Design, Development, Manufacture and Induction of Light Combat Aircraft (Air Force) since the last Review, i.e., Para 28 of the Report No. 8 of 1999 of the C&AG of India, Union Government, Defence Services (Air Force & Navy) for the year ended 31 March 1998. The Committee find that delays in execution of LCA project with respect to project definition, deficiencies in planning and financial management were commented upon by the Audit in Para 50 of Report No. 3 of 1989. Further, delay in execution of Phase-I of LCA project which included development of Multi Mode Radar, Flight control system, Digital Electronic Engine Control, integration of Kaveri engine on LCA, etc and consequent up-gradation of MiG-Bis aircraft, import of Su-30 MKI aircraft to cover the shortfall in fighter aircraft, were highlighted in Para 28 of the Report No. 8 of 1999. The Committee also note that the inordinate delay in fructification of Kaveri engine and cost overrun of the programme was pointed out by the Audit in Paragraph 5.1 of the Report No 16 of 2010-11 of the C&AG of India, Union Government, Defence Services (Air Force and Navy) for the year ended March 2009. The Committee's examination of the subject revealed that inspite of being pointed out by the Audit in 1999 and again in 2010-11, several shortcomings persist and accordingly they made observations/recommendations on the issues relating to the Ministry of

Defence/Aeronautical Development Agency (ADA) as detailed in the succeeding paragraphs.

2. The Committee note that the ADA advanced building of two prototypes (PVs) from Full Scale Engineering Development (FSED) Phase-II to FSED Phase-I on the ground of accelerating the development process of LCA, however, the decision failed to yield the desired results. The FSED Phase-I was closed in March 2004 after a delay of six years and without completing all the activities which were carried forward to FSED Phase-II. Further, building of PVs was completed three to eleven years beyond scheduled date delaying IOC from December 2005 to December 2013. The Committee find that all the major objectives of FSED Phase-I i.e. 42 work packages pertaining to development of Multi-Mode Radar, Flight Control System, Actuators, Digital Flight Control Computer, Jet Fuel Starter, Drop Tanks, etc. were not achieved and were carried forward to FSED Phase -II and resultantly, prototypes were rendered deficient of critical onboard systems {Multi-Mode Radar (MMR), Self-protection Jammer (SPJ), Radar Warning Receiver (RWR)} which eventually led to using the Limited Series Production (LSP) aircraft (meant for IAF use) towards flight testing/evaluation of the critical on board systems, in contravention of the commitment given to the GoI while obtaining sanction (November 2001) for building of these aircraft. The Committee note from the reply of the Ministry that the timelines in respect of critical on-board systems like MMR, RWR etc. initially planned to be integrated on Prototype Version (PV)-1 & Prototype Version (PV)-2, based on schedules provided by the work centres, could not be met by the work centres due to technological complexities. The Committee reproach the ADA for taking decisions that lacked scientific basis by advancing building of prototypes overlooking the fact that neither the critical technologies were developed by then nor the Technology Demonstrators flight tested for specified 210 hours. The Committee while noting that the decision resulted in deficient prototypes further leading to diversion of LSP towards flight testing, desire to be apprised of the details of the expenditure incurred on deficient aircraft.

3. The Committee observe that the ADA could not complete flight testing activities for FOC during the currency of the consultancy contract (March 2009 to January 2013) with M/S European Aeronautic Defence and Space (EADS) comprising of two phases to be done along with the achievement of IOC and Final Operational Clearance (FOC) respectively, at a cost of ₹ 127.65 crore and had to go in for a second consultancy contract costing ₹ 30.34 crore (August 2014) for completing the activities. The Committee note with serious concern from the reply of the ADA that recommendations of the consultant could not be implemented during the period of contract as IOC schedules were shifted because of major snags, ejection related issues etc. and another contract was concluded with same firm for two tasks which should have been completed under the first contract itself. The Committee opine that the money spent on first consultancy was rendered wasteful as the ADA could not complete flight testing activities and subsequent induction of aircraft and had to close the contract without implementing the recommendations. The Committee admonish the ADA for not doing proper homework before engagement of consultants resulting in non-implementation of the task-wise recommendations of the consultant during the currency of the first contract, huge delays in meeting the IOC/FOC schedules and wasteful expenditure incurred on the first consultancy contract.

4. The Committee note that the addition of new weapons by Air HQ for giving an operational edge to the LCA (March 1997, December 2009) necessitated design changes on the aircraft, coupled with specification of integrating R-73E missile (December 2009) with Multi-Mode Radar/Helmet Mounted Display and Sight and identification (December 2009) of Beyond Visual Range Missiles delayed the achievement of IOC/FOC. The Committee note from the reply of the Air HQs that inclusion of newer weapons was necessitated due to systems/weapons becoming obsolete/irrelevant in the backdrop of extended schedule of design and development of LCA. The Committee take serious note of the delays at each stage of the project that rendered the original specifications obsolete and new requirements and their integration delayed the programme, further. The Committee note that while LCA programme is being monitored by multiple

agencies/bodies like General Body, Governing Body, involving the representation of MoD, Ministry of Finance at the highest level, various committees at ADA/Hindustan Aeronautics Limited (HAL) and Empowered Committee chaired by Chief of Air Staff. The delays in completion of work packages seriously affected the LCA programme schedules which could not be contained due to lack of coordination at various levels and ineffective monitoring of the programme by all the agencies involved. The Committee are of the view that casual approach of the monitoring agencies in enforcing the timelines led to inexplicable delays of more than 30 years on an ambitious Defence project. The Committee exhort the Ministry to fix realistic timelines, taking into account technological complexities, for completion of remaining works urgently and apprise the Committee thereof. The Committee also desire to be apprised of details of the recommendations made by various review committees and action taken thereon within six months of presentation of this report. Further, the Committee while opining that the committees at the highest level cannot decipher routine ground level difficulties due to preoccupations and other constraints desire that a core team, fully responsible for day-to-day decision making, be constituted with dual responsibility of achieving goals within timelines and ensuring that the end product complies with the standards specified by the user group . The function of this core team may be separated from monitoring and guidance given by other committees by making it responsible for tracking the day to day progress, resolving cross functional issues and making decisions about course corrections in case of delays, excess expenditure or major alterations in specifications.

5. The Committee observe that LCA Mark (MK)-I, which achieved Initial Operational Configuration (December 2013) had significant shortfalls (53 permanent waivers/concessions) in meeting the Air Staff Requirement (ASR) resulting in reduced operational capabilities and survivability, limiting its operational employability. The Committee note from the reply of the ADA that 20 out of 53 concessions that were accorded by Air (Headquarter) HQ/IAF at the time of IOC were permanent waivers being technologically unachievable and remaining 33 were not safety critical and had insignificant impact on the combat

performance of the Aircraft. However, as per the reply of IAF, the concessions/permanent waivers would adversely impact the operational preparedness and the 33 temporary concessions would affect LCA's combat potential. Resultantly, the IAF would be constrained to use the LCA MK-I with reduced operational capabilities. The Committee note the apprehensions expressed by Air HQ, as early as in 1989 that aircraft planned to be developed by ADA would be deficient in crucial parameters, volume and weight adversely affecting its performance and find that the same have not been overcome in LCA MKI developed by ADA.

The Committee further note that LCA Mk-I is deficient in Electronic Warfare (EW) capabilities as specified by IAF, as the Self Protection Jammer could not be fitted on the aircraft due to space constraints and the Radar Warning Receiver/Counter Measure Dispensing System (CMDSD) fitted on the aircraft are having performance issues, which are yet to be overcome. The Committee observe from the reply of the IAF that EW suite draws more power and requires lot of real estate in fighter aircraft and an internal SPJ shall be integrated on LCA Air Force(AF) MK-II. Further, a podded active jammer is planned in MK-IA to meet the EW capabilities.

The Committee are disappointed to note that even after almost three decades, the ADA has not been able to develop the indigenous aircraft as per requirements of IAF in terms of combat potential and serviceability and opine that non fulfilling of requirements of the users has rendered investment of both time and money in the project, so far, infructuous. The Committee desire to be apprised of the total costs incurred on the project till date and the estimated costs until the FOC is achieved. The Committee expect that development of LCA Mk-II being done by ADA will overcome the shortcomings in LCA MK I and desire that the same may be done within fixed timelines to restore confidence in the LCA project.

6. As per the Audit Report, the Air Staff Requirement (ASR) envisaged a total requirement of 200 fighters and 20 trainer aircraft of LCA. The trainer variant of the LCA was to retain all attributes of the fighter variant except for the changes

necessary to accommodate a second seat for imparting training to IAF pilots. The ASR had envisaged that the fighter and trainer aircraft should enter the IAF service by 1994. Further, a full mission flight simulator of the LCA single seater variant was to be developed and delivered in advance of production aircraft (1994) as part of training requirement. However, production of trainer aircraft at HAL was delayed as the trainer LCA had not achieved IOC/FOC. As regards flight training simulator, IAF was using an upgraded Full Mission Simulator (FMS) at Aeronautical Development Establishment (ADE) for pilot training, pending supply of a FMS by HAL at LCA operating base. The Committee note from the reply of the Ministry that towards induction and acceptance of series production aircraft, IAF pilots are trained on high fidelity simulator, and, therefore, the non-availability of trainer is not a serious concern towards induction. However, AIR HQ had expressed in Empowered Committee (EC) meeting that availability of operational trainer aircraft was essential for pilot training. The Committee are appalled at the casual reply of the Ministry that non-availability of trainer is not a serious concern towards induction as the reply undermines the usefulness of trainer aircraft. Further, as per reply of the Ministry, the Trainer PV-6 aircraft had been built equivalent to production standard trainer being utilised for Squadron Pilot's (SP) training, besides being used for FOC tasks. However, Audit has stated that since build-standard document was planned to be released only by March 2018, the Ministry's contention that Trainer PV6 aircraft had been built equivalent to production standard didn't hold true. The Committee while reproofing the Ministry for such baseless replies desire to be apprised of the correct and updated details regarding development of trainer aircraft. Further, the Committee desire that trainer variant of LCA be productionized in a time bound manner, preferably along with the combat variant, so that the pilots get the requisite exposure and training for flying the LCA.

7. The Committee note that the LCA Project Definition Phase (PDP) Review Committee, which examined the work done at Project Definition Phase, had strongly recommended (September 1989) early establishment of a standing Liaison Group between Air HQ and ADA to ensure closer interaction between the

design team and the user for better appreciation of mutual perception, including appropriate trade-offs in performance, weight, time frame, cost, technological complexity and operational considerations of LCA. However, no such liaison group was formed and active user (Air HQ) participation in the LCA Programme started only after a long delay of 17 years in November 2006. The Committee note from the Action Taken Notes that due to non formation of liaison group, maintenance related issues were not pointed out during early stages of the design and development programme by the test crew as well as test engineers impacting design modes and timelines. The Committee are of the view that sound project management involves preparation of a detailed requirement specification document which is complete description of the system to be developed containing all interactions users will have with the system as well as non-functional requirements at the planning stage itself i.e. well before execution of the project. The Committee while noting with dismay the belated involvement of users in the project which eventually delayed achievement of IOC/FOC and wastage of tax payers money and resources opine that user involvement right from inception would have gone a long way in effective and efficient completion of the project. The Committee desire that the requirements as specified by the IAF for LCA MK-IA and LCA MK-II be understood and incorporated urgently to avoid further delays in achieving the timelines.

Further, the Committee observe from the reply of the Ministry that AIR HQ felt that formation of Standing Liaison Group earlier than 2007 would not have yielded fruitful results since expertise of IAF personnel was not in the area of design of aircraft. Since provisions for induction of weapon systems, RWRs, Pods etc have to be made in the design stage of the aircraft itself the Committee are not convinced with the plea of the Ministry that formation of Standing Liaison Group comprising IAF personnel earlier than 2007 would not have yielded fruitful results. The Committee while observing that change in scope and user specifications led to huge delays are shocked at the reluctance of IAF in actively involving itself during the design stage. The Committee, therefore, desire the Ministry to fix responsibility upon officers who failed to ensure involvement of

IAF personnel in the initial years of design of the aircraft and see that such instances are not repeated in projects involving thousands of crores of rupees and country's security.

8. The Committee find that Government of India had emphasized (June 1993) increasing the indigenous content of LCA while sanctioning Full Scale Engineering Development (FSED) in phased manner, but ADA did not make any roadmap for indigenization during LCA development. As a result, indigenous content of LCA estimated by ADA as 70 per cent actually worked out to about 35 per cent only (January 2015). The Committee note from the reply of the Ministry that indigenisation of the all-electronic components in India was not practical due to the lack of infrastructure of manufacturing and such huge investments are not part of LCA programme and the total indigenisation content of 70% in LCA as claimed by ADA is valid. Further, the Ministry stated that no country aims at 100% indigenous content and only indigenous contents of all strategic equipment is enhanced. The Committee observe that the prototype version of LCA was to be developed with a proven imported engine, while the production version of LCA was to use indigenous engine. However, the Committee find that Gas Turbine Research Establishment (GTRE), could not develop Kaveri engine as per the LCA schedule and specifications. The Committee are constrained to note that even after incurring an expenditure of more than ₹ 2000 crore on this project, indigenous development capability for LCA propulsion had not been successful and resultantly, LCA has been made perennially dependant on GE imported aero engines throughout its service life. The Committee while opining that GTRE has failed miserably in its attempt to develop an indigenous engine desire that since GTRE has been entrusted with development of strategic equipment it may be upgraded from merely a lab under DRDO to a fully autonomous organisation empowered to take decisions on its own capable of attracting and recruiting best talents in the field. Similarly, a review of the functioning and achievements of DRDO and HAL may also be carried out to suggest ways to improve their working.

The Committee also note that the LCA programme suffered major setbacks in the indigenous development of Multi-Mode Radar, Self-Protection Jammer, etc.; development of Jet Fuel Starter, though achieved indigenously, had unresolved performance issues and the proposal for indigenous development of 109 LRUs has been pending for approval since February 2014. The Committee are dismayed to note that even after more than twenty five years after the Government of India shifted the focus on maximising the indigenous development, only a few fully indigenised components/systems could be developed. The Committee are of the view that with the IAF placing such bulk orders involving thousands of crores of rupees for supply of aircraft, 100% indigenisation of the components/systems has to be encouraged. The Committee are of the considered opinion that a clear roadmap be developed to ensure that indigenous components/systems are maximized before productionization of LCA MK-IA and LCA MK-II. Further, setting targets against which the performance can be evaluated, positively impacts the efficiency and efficacy. Given that India has abundant brain power and is a shining star in the field of space with indigenously developed technology, the Committee desire that adequate financial support and encouragement from the Government of India be provided so that indigenisation of components/engine/systems be earnestly developed with the help of committed research and development.

9. The Committee note that due to huge delays in development and induction of LCA, forming of two LCA squadrons could not materialize, IAF had to up-grade MiG-BIS, MiG-29, Mirage-2000 and Jaguar aircraft at a cost of ₹ 20,037 crore, phasing out of MiG-21 had to be revised and IAF is operating with 35 squadrons as against 42 squadrons sanctioned out of which squadrons for MiG-21 aircraft and MiG-27 aircraft would retire over the next ten years. The Committee are disappointed to note that the failure of HAL/ADA and Ministry of Defence (MoD) to provide the required number of aircraft has adversely affected the combat potential of the IAF resulting in security threat to the country. The Committee note with serious concern that due to lack of R&D in the aviation sector the country has to shell out thousands of crores of rupees for procurement of both

combat as well as civil aircraft from foreign countries. It is needless to mention that at times of war it would be difficult for the nation to procure combat aircraft from unfriendly countries. The HAL, ADA and its work stations are miserably failing in its R&D to have the much needed technology in the aviation sector. The Committee while noting the temporary measures taken by the IAF to maintain the operational preparedness and to overcome the drawdown of squadron strength exhort the Ministry to take urgent steps to expedite development of LCA to cater to the needs of the IAF so as to restrict imports of fighter aircraft of this class and ensure self-reliance of the country in the long run. The Committee desire to be apprised of the schedule for induction of aircraft for overcoming depleting squadron strength of IAF.

10. The Committee observe that the LCA project was sanctioned in 1983 to provide replacement aircraft for MiG-21 series which were to complete their technical life and were to be phased out in 1990s. As specified in ASR (Air Staff Requirement) specified in 1985, the LCA was to be inducted into IAF by 1994. The Committee note that the Departmentally related Standing Committee on Defence in their Seventh report, thirteenth Lok Sabha had desired the Ministry of Defence to come out with a fixed and irrevocable date of induction of LCA. The Committee had hoped that all possible steps would be taken to put the LCA on the production line at the earliest possible after reviewing at the prototype stage so that it can be inducted into IAF during the 10th Plan period i.e. by 2007. The Committee note that despite repeated observations of the Audit and the Parliamentary Committee on Defence on the delays in the project, the situation has not been improved much. The Committee are aghast to note that, as on 31 July, 2018, IAF has only got 9 out of the 200 fighter and 20 trainer aircraft envisaged in ASR. These 6 aircraft have been productionised after only an Initial Operational Clearance (IOC) and are not combat ready, as yet. The Committee are perturbed to note that the Final Operational Clearance (FOC) has still not been achieved by the LCA even after more than 5 years of IOC. The ADA/HAL have also not been able to provide IAF with even a single production standard trainer aircraft till date. Further, since HAL could not augment its capacity in line with the

demand of the IAF, the IAF will have to depend on imported aircraft for a longer time, given its dwindling squadron strength. The Committee are disappointed at the progress of the project as even after three and a half decades, the country has not been able to get its first combat ready indigenous fighter aircraft. The Committee opine that these delays have, besides increasing the costs, limited the combat potential of the IAF. The Committee exhort the Ministry to actively monitor the project to ensure that FOC is achieved within its timeline, capacity is increased as soon as possible, much needed trainer aircraft are supplied to IAF, better coordination is ensured and costs are optimised.

11. The Committee note that air operations by any Air Force involve employment of air assets by themselves or in concert with other assets which are a part of the overall strategy in case of a war. They observe that development of LCA was to arrest the falling number of fighter aircraft due to the ageing and obsolete MiG-21 and MiG-27 fleet and to maintain minimum squadron strength of the Indian Air Force. However, the project was plagued with various technical issues resulting in timelines being extended due to which the Government had issued Request for Information (RFI) under the framework of the Defence Procurement Procedure (DPP), 2016 to global vendors for the procurement of other combat aircrafts such as the American F-16 Block 70 and Globemaster C-17, Russian Sukhoi Su-30 and Su-35, European Eurofighter Typhoon, Swedish Gripen-E, French Rafale etc. The Committee while noting that Light Combat Aircraft (LCA) are effective for combat missions requiring light strikes and other interdiction roles opine that a multi role combat aircraft is still required to effectively counter any aerial threats during war or peace time to maintain overall security of the nation as evident from the inventories of the air forces of the developed nations like USA and Russia. The Committee are of the view that it is high time that indigenous development and production of other combat aircraft such as aerial refuelling, bombers, transport, unmanned aerial vehicles (UAVs) electronic warfare, airborne early warning and control system may be initiated so that the bouquet of air assets in the Indian Air Force's inventory may be complete and dependence on combat aircraft of foreign origin may lessen and eventually

brought down to nil. While signing contracts with foreign vendors, it should be ensured that transfer of technology permeates within the Indian production and manufacturing sector thereby giving a boost to indigenous production.

Further, the Committee recommend that more emphasis should be laid on the indigenous research and development (R&D) of complex military technologies by involving premier institutions like IITs, IISc, etc., and private sector, creating dedicated agencies, supported by a think-tank, for development of critical components and providing adequate funds so that these institutions may develop cutting edge technologies which is eventually passed on to defence production sector to make the country self sufficient and reliant.

Also, the Committee recommend that while developing and producing next Generation Fighter Aircraft, the negotiations be made for full-scale transfer of technology (ToT), including the fighter's source codes, full system and software control and the establishment of a production assembly line in the country, so that the country's own engineers get a hands-on experience of learning the art of constructing and designing a plane by paving way for future indigenous manufacture and production.

13. The Committee are constrained to observe that the Ministry have failed to ensure proper coordination among its own different wings, like ADA, HAL and IAF, to develop our indigenous combat worthy LCA aircraft which ultimately resulted in half hearted approach on country's security and incurring huge expenditure for procurement of fighter aircraft from foreign countries. The Committee, therefore, exhort the Ministry to imbibe the success stories of our own committed space scientists who are working steadfastly to achieve their targets.

NEW DELHI;
12 December, 2018
21 Agrahayana, 1940 (*Saka*)

MALLIKARJUN KHARGE
Chairperson,
Public Accounts Committee.