CHAPTER-III DEFENCE RESEARCH AND DEVELOPMENT ORGANISATION (AIR FORCE)

3.1 Execution of Mission Mode Projects and delivery of systems by DRDO

Audit examination of 14 Mission Mode projects carried out by DRDO Laboratories revealed that all the projects failed to achieve their timelines and their probable date of completion (PDC) were extended many times. In five projects there were cost overruns as well. Further, although Operational Requirements / Qualitative Requirements / Broad Technical Requirements of IAF existed in all projects, the requirements of IAF were met to their satisfaction only in one completed project *viz.*, project 'Rohini'. In the same project the technology was also transferred leading to its productionisation by BEL and final induction into IAF. The systems developed in other closed projects were yet to be accepted by IAF.
The delays can be attributed to inadequate monitoring by different committees as well as to change of requirements by IAF (three projects). Lack of harmonisation (where multiple agencies were involved) was also noticed in two projects. The projects were therefore not carried out in spirit of Mission Mode which adversely affected Air Defence plans of IAF.

3.1.1 Introduction

Defence Research Development Organization (DRDO) was established (1958) with a view to achieve technological self-reliance in weapon systems and platforms in accordance with the expressed needs of the armed forces *i.e.* three services.

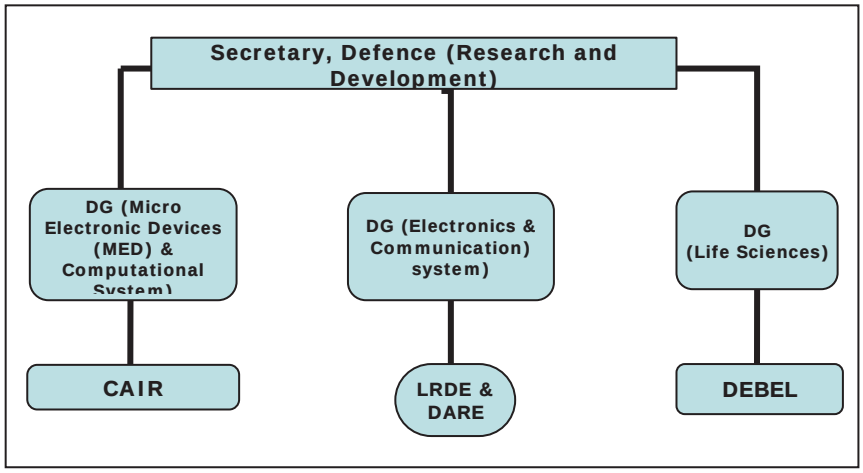
Mission Mode (MM) projects are taken up by DRDO as high priority projects as they are based on specific requirements of Services. MM Projects are those where the technology is already available and which can normally be completed in short duration of less than five years.

Out of 52 DRDO laboratories, nine[1] laboratories normally provide services to Indian Air Force (IAF). Considering importance of these projects to IAF, audit of these projects was taken up. Based on Audit criteria, MM projects undertaken by four[2] (out of nine) laboratories have been selected for the present review.

3.1.2 Organisational set up

DRDO functions under administrative control of Secretary, Department of Defence, Research and Development within the Ministry of Defence (the Ministry). DRDO is divided into seven clusters[3] each headed by a Director General (DG) to whom the Directors of laboratories under the respective clusters report to. The reporting structure of four selected laboratories is as given below:

Figure 3.1: Reporting structure of selected DRDO laboratories



[1] Electronics and Radar Development Establishment (LRDE), Bengaluru, Defence Avionics Research Establishment (DARE), Bengaluru, Aeronautical Development Establishment (ADE), Bengaluru, Gas Turbine Research Establishment (GTRE) Bengaluru, Centre for Airborne Systems (CABS), Bengaluru, Centre for Artificial Intelligence and Robotics (CAIR), Bengaluru, Microwave Tube Research and Development Centre (MTRDC), Bengaluru, Defence Electro-medical and Bioengineering laboratory (DEBEL) Bengaluru, Defence Food Research Laboratory (DFRL), Mysore.

[2] LRDE, DARE, CAIR & DEBEL, all located at Bengaluru

[3] Electronics & Communication Systems, Aeronautical Systems, Micro Electro Devices (MED) & Computational Systems, Life Sciences, Naval systems & Materials, Armament & Combat Engineering Systems and Missile & Strategic Systems.

3.1.3 Scope of Audit and Audit Sampling

For purpose of the present audit, all MM projects having sanctioned cost more than ₹ one crore and either completed or under execution beyond the original probable date of completion (PDC) as on 31st March 2014, were selected. Accordingly, out of 27 MM projects **(Annexure-VI)** executed by the nine laboratories during the period covered in audit *i.e.* 2007-08 to 2013-14 to meet the requirement of IAF, 17 projects[4](seven closed and ten on-going) met the audit criterion. This audit therefore examined 14 projects (six closed and eight on-going) valuing ₹1017.31crore as detailed in **Annexure-VII (A)**.

3.1.4 Audit Objectives

Audit was conducted with a view to evaluate whether projects were executed efficiently, effectively and in a time bound manner as Mission Mode projects.

The audit objectives were to evaluate:

i. Compliance to policies or guidelines for the execution of the MM projects.

ii. Operational Requirements (ORs)/Qualitative Requirements (QRs) were met as per IAF satisfaction and whether projects were delivered / executed within defined timelines.

iii. Project planning and monitoring.

iv. Transfer of technology for production and induction in IAF.

3.1.5 Audit Methodology

An Entry Conference was held on 4th August 2014 at Defence Avionics Research Establishment (DARE), Bengaluru with the DRDO HQ and

[4] Two projects *viz.*, Development of Kaveri engine for LCA by GTRE, and Development of Electronic Warfare (EW) Suite for MiG 27 aircraft by DARE had already been commented vide Para 5.1 of C&AG' Report No. 16 for the year 2010-11 and Para 2.1 of C&AG Report No. 4 for the year 2014 respectively. The project for Airborne Early Warning & Control (AEW&C) system of CABS is planned for a performance audit separately due to its materiality.

representatives of concerned laboratories wherein audit objectives and scope were discussed. Audit of the selected 14 projects was conducted at the concerned laboratories, DRDO HQ and concerned Directorates of Air Headquarters (Air HQ) from August 2014 to October 2014. During audit, audit memos and queries were issued for obtaining requisite information, for eliciting replies, gathering evidence, obtaining clarifications and giving audit observations. Exit conference was held on 19th December 2014 at DARE with the representatives of DRDO HQ and the concerned laboratories, wherein results of audit were discussed. The draft report was issued (April 2015 and August 2015) to the Ministry. The replies (June 2015) of DRDO have suitably been incorporated in this report. Reply of the Ministry was awaited (September 2015).

3.1.6 Sources of Audit Criteria

Audit criteria were derived from:

- Procedures for Project Formulation and Management (PPFM) in DRDO published in January 2006 and May 2014
- Defence Procurement Procedure (DPP) of 2008 and 2011
- IAF requirements- Operational Requirements (ORs), Qualitative Requirements (QRs)
- Project proposals, sanctions, execution, system trials, user evaluation, project closure reports (Technical and Administrative)
- Annual Reports of concerned Laboratories

3.1.7 Acknowledgement

Audit acknowledges the co-operation extended by the Ministry, DRDO HQ, concerned Laboratories and Air HQ for smooth conduct of audit and timely response to observations. DARE deserves a special mention for arranging Entry and Exit Conferences.

3.1.8 Audit Findings

Audit findings are broadly organised as under:

a) Macro perspective relating to policies, requirements of IAF and achievement, project planning and time and cost over runs (*Paragraphs 3.1.8.1 to 3.1.8.4*).

b) Closed projects *i.e.*, projects which were closed by March 2014 (*Paragraphs 3.1.8.5 to 3.1.8.9*).

c) Ongoing projects as of March 2014 (*Paragraphs 3.1.8.10 to 3.1.8.15*).

d) Conclusion and Recommendations (*Paragraphs 3.1.9 and 3.1.10*).

3.1.8.1 Standardised process for MM Projects

DRDO had formulated Procedures for Project Formulation and Management (PPFM) in January 2006 which included procedure and guidelines for execution of projects. PPFM was further modified in May 2014. PPFM included procedure for feasibility study, formulation of project proposal, sanction, execution of projects, monitoring and review, PDC extension, projects closure, *etc.* It was seen that the Laboratories had broadly followed these guidelines in execution of the projects as per PPFM, except for following.

As per PPFM, 'a key stage in concluding a project is to confirm that the project has met expectations of the user'. The PPFM further prescribes that after completion of project related tasks, the project has to be evaluated and measuring customer satisfaction is part of this process.

However it was seen that Electronics and Radar Development Establishment (LRDE), Bengaluru had carried out user trials and acceptance of projects 'Rohini' (*Paragraph 3.1.8.5)* and 'Aslesha' radars *(Paragraph 3.1.8.6)* as separate projects.

Further LRDE's project 'Aslesha' (*Paragraph 3.1.8.6*) and DEBEL's 'Common Helmet and Mask' and 'Nuclear, Biological and Chemical-Individual Protective Equipment (*Paragraphs 3.1.8.8 and 3.1.8.7*) were closed without meeting user specification. PDC of CAIR's project 'Meghdoot' had expired in December 2013 and IAF had not accepted the security solution developed by the laboratory so far (July 2015) (*Paragraph 3.1.8.9*).

3.1.8.2 Requirements of the IAF *vis-à-vis* achievement

All 14 MM projects had defined Operational Requirements. Out of six closed projects, only 'Rohini' radar developed by LRDE was productionised and inducted into IAF (*Paragraph 3.1.8.5)* and remaining four[5] projects were yet (July 2015) to be accepted by IAF. Shortfalls *vis-à-vis* user requirements as noticed in audit in these projects are discussed in *Paragraphs from 3.1.8.6 to 3.1.8.9.*

It was also noticed that in three projects ('Ashlesha', Common Helmet-Mask and D 29) IAF either did not indicate its complete requirement [*e.g.* power supply systems, sensor head, commander's display unit (*paragraph 3.1.8.6)*, requirement of Helmet Mounted Sighting Display (HMSD) for certain types of aircraft (*Paragraph 3.1.8.8*)] *ab-initio* in the ORs or changed its requirements for the systems relating to weight, testing, *etc.*, *(Paragraph 3.1.8.6, 3.1.8.14)* subsequently, leading to further delays in these projects.

3.1.8.3 Deficiencies in project planning and monitoring

The sanctions issued by the Ministry contained mechanisms for monitoring of projects by certain committees along with frequency of their meetings. Shortfalls in monitoring by these committees (*Paragraphs from 3.1.8.9 to 3.1.8.11*) were noticed impacting the project execution.

There were deficiencies in project planning in respect of three projects *viz.* development of Common Helmet-mask for all types of aircraft and helicopters of IAF by DEBEL, Bengaluru (*Paragraph 3.1.8.8)*, development of Medium

[5] The development of the Rohini radar and its user trials/acceptance was carried out separately under two projects.

Power Radar (MPR) by LRDE *(Paragraph 3.1.8.10*), and development of Electronic Warfare Suite (D-29 system) for MiG-29 aircraft by DARE *(Paragraph 3.1.8.14).*

3.1.8.4 Time and Cost overruns

Audit examination of selected 14 MM projects revealed that there were time overrun of 25 to 210 *per cent (Paragraphs 3.1.8.5 to 3.1.8.15)* in all the projects. Further out of 14 projects, there was cost overrun in five projects ranging from of 0.57 to 158.94 *per cent,* four projects were completed in less than initially sanctioned cost resulting into savings ranging from 7.44 to 25.07 *per cent.* In the remaining five projects (all on-going) there was no cost overrun as of 31st March 2015. The details are in **Annexure-VII (B)**.

Further as against the normal requirement of completing the Mission Mode projects in less than five years, only two projects (NBC IPE and Common Helmet-Mask) were completed in less than five years, however these were yet to be accepted by IAF (June 2015).

DRDO stated (June 2015) that in three projects, time overrun was due to technical reasons and in the remaining 11 projects, it was due to erroneous estimate of PDC by the laboratories as time required for user trials was not taken into consideration while projecting PDC, non-availability of platform for fitment for user trial and change in specification by the user. DRDO also stated that the cost escalation was due to additional modifications and change in specifications which cannot be attributed only to DRDO as other agencies were also involved.

Significant time overruns in all selected Mission Mode projects is a cause of concern.

3.1.8.5 S-band Surveillance Radar system 'Rohini'

3D (Dimensional) Surveillance radar system is a S-band[6] medium range radar capable of scanning and tracking airborne targets up to 150 km for 2 square meter (sq m).

[6] S-Band denotes frequency range 2 to 4 GHz.

Based on IAF's Operational Requirements (ORs) (August 2003) for the radar to perform as a base radar[7] and LRDE proposal therefor, MoD sanctioned (November 2003) a Mission Mode project 'Rohini' to LRDE at a cost of ₹34.05 crore with a PDC of 36 months (*i.e.* by November 2006). However, the project sanction did not include the post development activities such as user trials and its acceptance by IAF.

LRDE developed (August 2007) the radar within the extended PDC (August 2007) with an expenditure of ₹28.02 crore and closed (August 2007) the project. Subsequently, LRDE submitted (September 2007) a new proposal for evaluation and user trials of 'Rohini' radar along with 'Revathi' radar, also developed by LRDE for Indian Navy. MoD sanctioned (December 2007) the project under MM category at a cost of ₹8.00 crore, with a PDC of 15 months (March 2009). IAF carried out the trials of 'Rohini' radar between February 2008 and March 2008 and recommended its induction into Service. The project was completed (December 2010) with an expenditure of ₹7.27 crore.

Audit noticed (October 2014) that during the course of development and trials of 'Rohini' radar itself, Air HQ had placed two supply orders (March 2006 and July 2009 respectively) on M/s BEL, the production agency, for manufacture and supply of 37 'Rohini' radars.

In response to Audit observation (December 2014) on non-inclusion of user trials of 'Rohini' radar in the initial sanction and status of supplies under the BEL order, LRDE stated (January 2015) that as the radar required extensive trials to prove the capabilities in various environmental conditions, a separate project was initiated. Non-availability of the users, site and aircraft, *etc.*, was also cited as reasons for splitting up the project activities. As of December 2014, 36 'Rohini' radars had been delivered.

The fact remains that splitting up of the activities of a MM project was in violation of provisions laid down in the PPFM. Hence, two sanctions issued separately by the Ministry for development and user trials were not in order.

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[7] Medium range 3 dimensional surveillance radar, to work in stand-alone mode mounted on TATRA vehicles.

3.1.8.6 Low Level Light Weight Radar 'Aslesha'

Low Level Light Weight Radars (LLLWR) are mobile radars having a range of 50 Km that can be transported by animal carts/ trucks/ helicopters for deployment in difficult terrains.

Based on IAF's requirement (August 2004) for 36 LLLWRs and Defence Acquisition Council (DAC)'s 'in-principle' approval (September 2004) for procurement of 15 LLLWRs through 'Buy' option and balance 21 through indigenous development by DRDO, MoD sanctioned (December 2004) development of LLLWR ('Aslesha') to LRDE under Mission Mode at a cost of ₹21.94 crore with a PDC of 30 months (June 2007). However, in deviation from PPFM, the project sanction did not include the need for conducting trials and user acceptance.

As per the sanction, LRDE developed one laboratory prototype and one fully engineered prototype[8] of LLLWR within the revised PDC of June 2008. To facilitate user trials and post development activities of 'Aslesha' radar, LRDE submitted a new proposal (September 2008) at a cost of ₹1.98 crore. However, DRDO HQ sanctioned (November 2008) the project at a cost of ₹50 lakh with a PDC of 15 months.

After user trials (December 2009-February 2010), IAF trial team recommended (February 2010) improvements in power supply system, sensor head and Commander's Display Unit, *etc.*, of LLLWR. LRDE agreed to carryout changes in production model and closed (September 2011) the project as successful with an expenditure of ₹20.77 crore. Subsequently, MoD concluded (March 2012) a production contract with BEL for supply of 21 Aslesha radars at a cost of ₹205.13 crore with delivery commencing from June 2013 onwards.

However, implementation of IAF suggested improvements on LLLWR by BEL under the production contract (March 2012) resulted in increase in weight of 'Aslesha' radar from the specified 190 Kg to 205 Kg. Though, the

[8] Laboratory prototype is retained by concerned laboratory for future modification / up gradation. Fully engineered prototype is meant of production purpose.

increase in weight of LLLWR was acceptable to IAF, the delivery of the radars was withheld pending amendment to the contractual specifications[9] with regard to increased weight.

Audit observed (December 2014) that as per PPFM, a key stage in concluding a MM project was to confirm that the project has, in fact, met the specifications of the user. However, in the instant case, before closing the project as successful, LRDE did not ensure to carryout suggested changes as recommended by IAF in the prototype model instead of the production model (after conclusion of the contract). This made the acceptance of LLLWR with increased weight by IAF a fait accompli.

In response, LRDE stated (January 2015) that modifications/improvisations were incorporated in production model as suggested by the user. The DRDO HQ, in its reply (June 2015) to the draft report (April 2015) agreed that modifications/improvisations suggested by the users should have been addressed in the prototype model before conclusion of the production contract and as a remedial measure, DRDO HQ had contemplated to form a Change Control Board (CCB) to oversee any modifications post development of projects.

Thus, the requirement to amend the contract by MoD has delayed the delivery of LLLWR by 23 months (June 2015) thereby affecting the Air Defence capability of IAF.

3.1.8.7 NBC Individual Protective Equipment (IPE) for crew of Transport Aircraft and Helicopter

Nuclear Biological Chemical (NBC) Individual Protective Equipment (IPE) protects crew of transport aircraft and helicopter fleet from NBC hazards. Based on Joint Services Qualitative Requirements (JSQR) (July 2007), DRDO HQ sanctioned (August 2008) a Mission Mode project to DEBEL for development of NBC IPE including its sub-systems[10] at a cost of ₹1.35 crore with a PDC of 30 months (February 2011). However, the sanction did not

[9] DGAQA will clear production of LLLWRs only as per contract specifications.

[10] Sub-systems, *viz.* Protective Respiratory mask, Canister for filtering air, blower system and battery for blower and flexible hose from blower system to respirator.

specify the requirement of user trials. DEBEL developed (February 2012) IPE (Respiratory protective mask) with an expenditure of ₹1 crore.

Audit observed that in contravention to PPFM guidelines for MM projects, DEBEL closed (July 2013) the project without completing the field trials on the plea that it was a long drawn affair involving considerable amount of time.

DEBEL stated (October 2014) that respiratory protective mask developed by them could only be tested along with other IPEs[11] which were expected to be developed by other DRDO labs[12] by June 2015. DEBEL justified its decision (July 2013) to close the project pending user trials on the ground that its aim was only to design and develop the respiratory protective system.

In reply to Draft Report (April 2015), the DRDO HQ stated (June 2015) that the requirement of other NBC IPE was beyond the scope of the subject project which led to non-completion of user trial and time over run.

DRDO HQ reply is not acceptable as NBC-IPEs, though executed by different DRDO laboratories under a project, cannot lose sight of the project objective, which was the successful development of NBC-IPE in the instant case. Moreover, DRDO HQ did not indicate in their MM sanction (August 2008) the need to conduct user's trials along with other NBC-IPEs being developed by other laboratories. Further, on account of the delay in development of NBC-IPE by other DRDO laboratories, as confirmed (June 2015) by DEBEL, a proposal for import of 40,000 sets of NBC IPE items by Tri-Services was under progress (May 2015).

The fact thus remains that DEBEL closed the MM project without user trials and acceptance of the developed NBC-IPEs by IAF. Further, DRDO did not ensure effective synchronisation *vis-à-vis* the development of remaining NBC-IPE undertaken by other laboratories. Thus, the delay in indigenisation of the NBC-IPE had forced the defence forces to resort to import to meet their requirements.

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[11] NBC Glove, NBC Over boot and NBC suit.

[12] DRDE, DMSRDE, INMAS, VRDE, R&D (E) Est, DFRL, SSPL and LASTEC.

3.1.8.8 Design and Development of Common Aircrew Helmet-Mask

Indian Air Force (IAF) operates different types of aircraft with unique helmets and oxygen masks for aircrew. A common helmet mask not only alleviates the problems of procurement and logistics but also make the inventory holding manageable.

Hence, based on Air HQ QRs (February 2009), DEBEL proposed (May 2009) to develop a common aircrew helmet-mask for Russian[13] and European series[14] aircraft at a cost of ₹48.5 lakh. DRDO HQ sanctioned (July 2009**)** the MM project to DEBEL at a cost of ₹47.5 lakh with a PDC of three years (July 2012). However, the sanction did not include the requirement of user trials.

The prototypes of helmet-mask assemblies developed (November 2011) by DEBEL were subjected for 600 knots of wind blast test at National Aeronautical Laboratory (NAL) Bengaluru. However, at the instance of IAF, further testing at 600 Knots in open jet wind blasts (OJWB) at M/s CEAT, France was carried out by DEBEL to meet Military specification. During OJWB minor failures occurred on helmet-mask and to resolve these failures, the design of the helmet-mask was changed by DEBEL from acrylic visor to poly carbonate visor and also to manufacture of additional prototypes. This led to change in scope of project and specifications of the MM project resulting in enhancement of project cost twice[15] aggregating to ₹1.34 crore[16] and extension of PDC up to July 2013. DEBEL developed the modified prototype helmet-mask and closed (July 2013) the project at a total expenditure of ₹1.23 crore.

Audit observed (October 2014) that the prototype developed was not fit for use in three aircraft *viz*., Su-30 MKI, MiG-29 and MiG- Bis as the helmet of these aircraft needed Helmet Mounted Sighting Display (HMSD) [17]. Neither did IAF specify in their initial ORs (February 2009) about the requirement of

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13 MiG-21, MiG-Bison, MiG-23, MiG-27, MiG-29, Su-30 MKI aircraft and Cheetah / Chetak Helicopters.
14 HPT-32, Kiran, Hawk, Jaguar and Mirage-2000.
15 February and May 2012.
16 ₹47.5 lakh (original) + ₹44.50 lakh (enhanced) + ₹42 lakh (enhanced).
17 HMSD projects information on visor of the aircrew helmet.

HMSD on these helmets for three aircraft nor DEBEL brought out this fact in their project proposal. As a result, IAF had issued (November 2013) separate QRs for these three aircraft. This was against the provisions of a Mission Mode project in which before sanction of a project, the laboratories are required to carry out a detailed feasibility study wherein *inter-alia* the goals of the project are defined after taking inputs from all stakeholders. Audit also observed (October 2014) that in contravention to the spirit of MM project, DEBEL closed the project without user trials and acceptance of the helmet-mask by IAF and that the project saw a time and cost overrun of 33 *per cent* and 158.84 *per cent* respectively.

In response to audit observation, DEBEL stated (October 2014) that user's insistence (November 2011) for testing the prototypes at France resulted in escalation in cost and time of the MM project which could not be anticipated. DEBEL further added that design of common helmet-mask developed by them was not catered for HMSD mounting and hence was not suitable for Su-30 MKI, MiG 29 and MiG Bis aircraft and RCMA (Aircraft) had provisionally cleared (October 2014) helmets only for MiG-21 variants. DEBEL, further stated (January 2015) that since conducting flight trials was pending with Aircraft Systems and Testing Establishment (ASTE), IAF, the project was closed without seeking further PDC extension.

In reply to Draft Report (April 2015), the DRDO HQ stated (June 2015) that design restrictions were observed by users at a later stage of the development which forced users to consider a new design of helmet for three aircraft.

Reply may be viewed in light of DEBEL admission that design of common helmet-mask developed by them was not catered for mounting of HMSD which was contrary to their project proposal which included the above three aircraft. Further, Air HQ changed the requirement for testing only after development of the prototype, which resulted in consequent design changes/cost over-run /delays and issue of fresh ORs for three aircraft. Thus, the objective of the Mission Mode project was yet to be achieved (August

2015) as neither DEBEL properly appraised the work involved nor IAF projected their initial requirements correctly.

3.1.8.9 Secure video, voice and fax communication between Air borne platform and Ground station 'Meghdoot'

Encryption is the process of encoding messages or information in such a way that only authorized parties can read it, and is thus, effective way to achieve data security.

IAF had planned[18] to procure three Boeing Business Jet (BBJ) VVIP aircraft from USA which had inbuilt Video Tele Conferencing (VTC) system which was unencrypted and therefore unsecure. Hence, in pursuance of IAF requirement (October 2006) for an indigenous security solution for information flowing between the VVIP travelling on aircraft and ground locations and CAIR proposal (August 2007), Ministry sanctioned (December 2007) the project 'Meghdoot' to CAIR under MM at cost of ₹9.76 crore with a PDC of 24 months (December 2009). The sanction provided for project monitoring once in six months by a Steering Committee and once in three months by the Project Monitoring and Review Committee (PMRC).

CAIR completed (March 2009) design and development of the security solution on COTS[19] equipment and placed (March 2009) a supply order on M/s BEL, Ghaziabad for hardware platforms for VTC security solution at a cost of ₹6.61 crore with a PDC by December 2009.

However, after assessing the vulnerability of COTS, the Scientific Analysis Group (SAG)[20] of DRDO changed (December 2009) norms for Cipher Policy Committee (CPC)[21] evaluation of security solution. Hence, CAIR redesigned

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18 Ordered in October 2005 from M/s Boeing, USA and aircraft received between August 2008 and January 2009.

19 Commercially off the shelf

20 SAG evaluates communication equipment to be introduced in Services

21 CPC is the evaluation arm of SAG and will evaluate and grade the encryption security solution.

the security solution by providing an add-on card with an additional cost of ₹1.33 crore.

In order to install CAIR redesigned security solution on the BBJ aircraft, Air HQ concluded (January 2010) a contract with the OEM (M/s Boeing) for modification of all three aircraft with a staggered delivery (December 2011 and January 2013). Meanwhile, CEMILAC[22] cleared (December 2012) the redesigned security solution for fitment on the aircraft followed by security grading by the CPC in May 2013.

After installation of the security solution on the modified BBJ aircraft, IAF carried (May 2013) out the user trials wherein rise in temperature of on-board security solution up to 56 degree centigrade as against CEMILAC stipulated limit of 35 degree centigrade was observed. In order to resolve the issue, the project PDC was extended upto December 2013.

Audit observed (October 2014) though the overheating of the security solution persisted (October 2014), CAIR neither got the PDC extended (from December 2013) nor submitted a formal closure report, which was against the norms of a Mission Mode project. Audit also observed that as against required 27 Project Monitoring and Review Committee (PMRC) meetings, only eight were held (October 2014) thereby indicating inadequate project monitoring.

In response CAIR stated (December 2014) that deficiency was not in design of security solution but in inadequacy of cooling arrangement by aircraft OEM, hence PDC extension was not obtained. The laboratory accepted that PMRCs could not be carried out at the specified intervals.

CAIR subsequently informed (June 2015) to audit that problem of inadequate cooling was resolved by OEM, security solution required for deployment and spares along with the necessary key management equipment was handed over to IAF although the secured communication system developed by CAIR was yet (June 2015) to be accepted by IAF. Moreover, the security solution

[22] Centre for Military Airworthiness and Certification.

developed by CAIR was yet (June 2015) to be cleared by CEMILAC for regular service use.

Thus, requirement of the on-board secured communication system was yet to materialise (August 2015) since its projection (October 2006) thereby forcing the three VVIP aircraft inducted in IAF between August 2008 and January 2009 to fly[23] without the essential prerequisite.

3.1.8.10 Medium Power Radar 'Arudhra'

Medium Power Radar (MPR) is capable of automatic detection and tracking air intrusions at an altitude of about 100 meters up to a range of 30 km.

IAF projected (November 2002) a requirement of 23 MPRs with active phased array[24] radar technology for replacement [between X (2002-07) and XII (2012-17) Five Year Plan] of existing radars (PSM-33 radars, P-40 and TRS-2215 radars), which had completed their service life of 20 years.

Based on Air HQ ORs (November 2004) and due to non-availability of technology, MoD approved (April 2006) import of 15 MPRs by IAF and indigenous development of eight MPRs by LRDE with a delivery schedule of 60 months (April 2011). LRDE submitted (November 2006) a proposal to Air HQ for development of MPR using imported antenna[25] at a cost of ₹97.84 crore to meet IAF time frame of 36 months. However, Air HQ insisted (June 2007) LRDE to develop a fully indigenous MPR including its antenna using latest technology.

Accordingly, LRDE submitted (September 2007) revised proposal to develop active phased array technology based MPR with Digital Beam Forming (DBF)[26] feature, the Ministry sanctioned (November 2008) the project MPR 'Arudhra' under MM at a cost of ₹134.14 crore with a time frame of 54

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23 During 2014-15, all the three BBJ aircraft had under taken 239 sorties involving 442.03 Flying hours.

24 In active phased array each antenna has transmit / receive (T/R) modules to boost up output power of the transmitted signals required for maximum detection range.

25 Through direct import of MAP antenna from M/s Thales, France.

26 Digital Beam Forming is employed to synthesize multiple signals received in the form of a beam.

months (May 2013). The sanction provided for monitoring of the project by an Empowered Steering Committee (ESC) on need basis and by a Technical Coordination Authority (TCA)[27] on quarterly basis.

LRDE finalized (May 2009) radar architecture and Preliminary Design Review (PDR) for the development of radar through 13 developmental partners catering for 16 sub-systems of the radar **(Annexure-VIII)**.

Audit observed (September 2014) that:

a) Though, Developmental partners were identified during Empowered Steering Committee meetings held in January and June 2009, the supply orders were actually placed (between March 2010 and February 2013) by LRDE after delays ranging from nine months to 44 months (since June 2009) due to time taken in designing system hardware, technical evaluation, *etc.*

b) Only five out of 16 sub-systems ordered were received, tested and accepted within original PDC (May 2013) of the project and remaining 11 sub-systems were received with delays due to time taken in design finalization by LRDE, conducting Electro Magnetic Interference (EMI) / Electro Magnetic Compatibility (EMC) evaluation tests and Factory Acceptance Tests (FAT), *etc.*

c) As per minutes of sixth Empowered Steering Committee (April 2013), antenna cabin was sub-contracted (April 2010) to M/s Larsen & Toubro (L&T) Mumbai and same was received (April 2014) by LRDE after a delay of more than two years due to diversion of man power by L&T to another project 'Ashwini' of LRDE.

d) Against 16 TCA (as of June 2014) meetings as per sanction, only six were held despite instructions (August 2011) of DRDO HQ on strict adherence to project review meetings.

[27] Both the Committees *i.e.* ESC and TCA consist of representatives of DRDO, IAF, Production Agency namely BEL and between the two, ESC comprises of senior officials.

The PDC of LRDE project was extended latest in October 2014 (up to December 2014) to complete pending work such as main radar integration, testing and user trials.

In response to audit observation, LRDE stated (October 2014/ January 2015) that DBF and many of sub-systems were being developed for the first time, hence major unexpected problems were noticed which delayed the project schedule. In regard to monitoring meetings, it was stated that as progress of project was less in the initial stages, the frequency of TCA meetings was also less.

The fact remains that given the IAF requirement (November 2002), ORs (November 2004), Ministry's qualified (i.e catering for import of 15 MPRs to meet out the urgent requirement) approval (April 2006) for time bound indigenous development, the follow up and implementation of the indigenous project has not been in the spirit of a Mission Mode project and the MPR prototype was yet to be tested / trial evaluated by IAF (August 2015) by when ₹130.06 crore had been incurred on the project. The delays have affected the Air Defence (AD) plan.

3.1.8.11 Low Level Transporable Radar 'Ashwini'

Low Level Transportable Radars (LLTR) are intended to provide surveillance against low level intrusion of airspace up to a height of 30 meters in a range of 150 kms.

Air HQ projected (1997) a requirement of LLTR based on active aperture array technology and obtained (January 1998) 'in-principle' approval of MoD for acquisition of 37 LLTR. Air HQ efforts to import LLTR on four occasions (between March 1998 and February 2002) did not fructify due to DRDO HQ objection on extent of transfer of technology (ToT) from foreign vendor.

To meet immediate requirements of IAF, Defence Acquisition Council (DAC) accorded (October 2005) acceptance of necessity to import 19 LLTR under 'Buy & Make'[28] category with ToT and balance 18 LLTR under 'Make'[29]

[28] 'Buy and Make' means buying a portion of demand, obtaining ToT and production in India for remaining demand.

[29] 'Make'-developed by DRDO laboratories through indigenous efforts and manufactured by an Indian production agency.

category by LRDE.

In backdrop of Air HQ ORs (February 2006), DRDO HQ emphasized (September 2008) to MoD not to seek ToT from foreign vendors as technologies for LLTR were already available indigenously or under development and also confirmed that LLTR developed would be a Transmit/Receive (T/R)[30] module based active aperture phased array radar.

Based on LRDE's proposal (January 2009), the Ministry sanctioned (June 2009) the project ('Ashwini') at a cost of ₹73.95 crore with a PDC of 42 months (December 2012). The project was to be monitored by a two tier committee *viz.*, Empowered Steering Committee (ESC) on need basis and the Project Monitoring & Review Committee (PMRC) after every four months. As per LRDE, parallel indigenous development of LLTR was taken up to reduce dependency on imported LLTRs for future requirements.

The Ministry also concluded (July 2009) a contract with M/s Thales, France for procurement of 19 LLTR (six fully furnished, two semi-knocked down, two completely knocked down and nine indigenous manufacture based on ToT) at a cost of ₹1272 crore along with ToT at a cost of ₹575.20 crore with delivery schedule from October 2011 to March 2014.

LRDE engaged 13 partners **(Annexure-IX)** for development of LLTR. Out of 13 supply orders placed for various sub-systems, supplies were delayed in respect of four sub-systems (*i.e.* Mobile platform, antenna, Operational shelter & power supply systems) due to delays by LRDE in finalisation of critical design parameters / import of critical sub-systems and also in despatching IFF[31] antenna to the firm for integration with 'Ashwini' antenna array and delays by development partners contributing to overall delay in the project as described in **Annexure IX**.

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30 It transmits and receives signals.

31 Identification of Friend or Foe (IFF) is a secondary radar. Antenna was realised by M/s AMPL Hyderabad and Input Device from M/s Thales, France.

Audit observed (September 2014) that despite LRDE claim about availability of requisite technology, the development of LLTR could not be completed within original PDC (December 2012). Further, against required 11 PMRC meetings as per sanction, six meetings were held (up to August 2014).

In response to audit observations, LRDE stated (October 2014 / January 2015) that development of LLTR with DBF feature was taken up for the first time indigenously. Further, delay in development had been due to unexpected problems at different stages of project and erroneous estimation of completion date. Also shortfall in project monitoring was due to less incremental progress achieved at the beginning of the project.

Audit noticed (May 2015) from the Brief for Executive Board (EB) meeting on Project 'Ashwini' of May 2015 that the assembly engineering and integration of the main antenna cabin had not progressed and complete calibration / evaluation of the main antenna array / user trials was yet to be completed. Though most of the sub-systems were realised by LRDE, these sub-systems were yet to be tested in an integrated environment. An amount of ₹63.72 crore had been incurred (March 2015) on the project 'Ashwini' and its PDC extended (October 2014) up to April 2015. No further extension for the project had been accorded so far (May 2015).

In response to draft report (April 2015), the DRDO HQ stated (June 2015) that realising an integrated active array with T/R module and DBF was attempted by LRDE for the first time, which took considerable time to understand, simulate and analyse the concepts, algorithms and finalise the architecture.

The fact remains that in spite of confidence of DRDO to produce LLTRs indigenously, the first field worthy indigenous LLTR was yet (August 2015) to fructify as DBF and many sub-systems were developed by LRDE for the first time although the project was sanctioned as Mission Mode. Also, prolonged consideration of DRDO reservations on ToT through import delayed the placement of import order (July 2009) *vis-à-vis* the IAF projected requirement (1997). Consequently, only two (out of 19) imported LLTRs had been received (March 2015) from M/s Thales, France by IAF. Thus the delay

in development of indigenous LLTR has adversely affected[32] the IAF plans for Air Defence (AD).

3.1.8.12 Primary Radar for AEW&C system

An airborne early warning and control (AEW&C) system[33] is an airborne radar system designed to detect aircraft, ships and vehicles at long ranges and perform command and control of the battlespace. When used at altitude, the radar on the aircraft allows the operators to detect and track targets much farther away than a similar ground based radar.

Development of AEW&C system was sanctioned (October 2004) to CABS under MM category. Primary Radar (PR) is one of the major sub systems of AEW&C which was entrusted (December 2004) by CABS to LRDE, at a cost of ₹550 crore, with a time frame up to April 2011 (*i.e.*, in line with overall PDC of AEW&C System).

Primary Radar consists of three major sub-systems *viz.* Active Aperture Array Unit (AAAU), Central Unit (CU) and Radar Processing Unit (RPU). Since, LRDE planned to use the AAAU developed under L-STAR[34] (a TD project) which was found not suitable because of its excess weight for elevation scan as required for the AEW&C System. Hence, Expert Committee recommended (October 2007) the usage of slotted array antenna developed by CABS for AEW&C system. Hence, the project cost sanctioned to LRDE was revised by CABS (June 2009) to ₹97 crore (for CU and RPU).

Three primary radars [jointly developed (December 2013) by CABS and LRDE] were integrated in System Testing and Integration Rig (STIR) at CABS and performance validated for fighter and commercial aircraft (February 2014). The mounting of Primary radar on Embraer aircraft[35] was also completed.

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[32] As against Govt authorised 75 LLTRs, IAF held (July 2005) 38 technologically obsolescent LLTR.

[33] Sanctioned cost of AEW&C was ₹1800 crore with a PDC of April 2011. The cost of the project was revised twice up to ₹2275 crore. PDC was also revised twice up to December 2015.

[34] L-STAR project was carried out to demonstrate active phased array technology.

[35] Embraer aircraft is platform for AEW&C system.

Further, PDC for all the tasks of PR including Final Operational Clearance (FOC) which were expected to be completed by April 2011 had been extended from time to time with latest extension up to December 2015. LRDE had incurred an expenditure of ₹66.90 crore (March 2015) towards development of CU and RPU.

Audit observed (March 2015) that PDC extensions for sub-project of PR were not sought by LRDE, but were given by CABS to synchronise with overall development of AEW&C system and the flight trials of PR was under progress.

LRDE stated (March 2015) that flight trials of the primary radar were going on and the phase-I of Initial Operational Clearance (IOC) of the PR was expected to commence in May 2015. However, LRDE subsequently stated (July 2015) that there was no plan to conduct IOC and FOC for PR and Acceptance Test Procedure (ATP) was planned to commence and complete in November 2015.

Thus, acceptance of primary radar jointly developed by LRDE and CABS has been delayed as ATP of PR is expected to be completed in November 2015.

3.1.8.13 Dual Colour Missile Approach Warning System (DC MAWS)

Missile Approach Warning System (MAWS) is essential for all airborne platforms to warn pilot of missile attacks. Defence Acquisition Council (DAC) accorded (September 2004) clearance for installation of MAWS[36] in 100 aircraft. Hence, DARE, Bengaluru proposed (January 2005) to Air HQ a project to design and development of Dual Colour (DC) MAWS, jointly with Israel Ministry of Defence (MoD) and M/s Elisra, Israel. Air HQ accepted (July 2006) the proposal, agreed (March 2008) to install DC Infra-Red (IR)

[36] MAWS- Dual Colour IR MAWS, the IR wave length band is divided into two bands, one for noise and one for missile plume. Ratio of signals in both the bands is taken, thereby achieving less false alarm rate over single colour IR MAWS. Further, UV based MAWS is used for slow moving platforms such as transport aircraft and helicopter, whereas IR DC MAWS is suitable for fighter aircraft.

MAWS on Su-30 MKI aircraft and projected an initial requirement of 50 DC MAWS system.

Ministry of Defence (MoD) accorded (November 2008) sanction for development and integration of Dual Colour IR MAWS on Su-30 MKI aircraft by DARE at a total cost of ₹193 crore (including FE of ₹172 crore), with a PDC of 55 months (June 2013) under MM category.

DARE signed (December 2008) a tripartite contract with Israel MoD and M/s Elisra, Israel at a cost of 37 MUSD (₹148 crore) for joint development[37] of DC MAW system[38] with a PDC of 48 months (December 2012). The scope of contract *inter-alia* included delivery of six Infra-Red (IR) sensors. M/s Hindustan Aeronautics Limited (HAL)[39] was selected by IAF / DARE as agency for modification of Su-30 MKI aircraft for integration of IR sensors on the aircraft.

DARE found the model version of IR sensors submitted by M/s Elisra to be heavier and bigger in dimension (24 cm in height and 4 kg in weight) and hence, informed (May 2009) M/s Elisra that the system might not be accepted for fitment on aircraft as it would cause serious restriction on flight envelope[40]. Air HQ also expressed (March 2010) the same view. However, vendor expressed (June 2010) its inability to make any significant weight reduction.

Installation of six IR sensors on Su-30 MKI aircraft was not cleared (December 2012) by an Expert Committee(EC)[41] at locations specified by DARE as it would involve cutting internal structure of aircraft, thermal

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37 Ms Elisra will develop IR sensors and DARE would develop hardware for sensors.

38 DC MAWS consists of three LRUs *viz.*, IR sensor, Central Processor Unit and an Air Borne recording system.

39 The licensed manufacturing and repair agency of Su-30MKI aircraft.

40 Flight Envelope of an aircraft refers to the capabilities in terms of airspeed and load factor. Broadly it is range of combinations of speed, altitude, angle of attack, *etc.*, within which an aircraft is aerodynamically stable.

41 The Expert Committee on Aerodynamics consists of members from CEMILAC, ADE, ADA and RCMA (Nasik).

masking[42] and aircraft plume (trail), *etc.* Subsequently, the EC cleared (January 2013) aircraft with only four sensors upto 15 *degrees* (as against the Su-30 MKI aircraft capability of 90 *degrees)* angle of attack (AoA)[43].

DARE approached (February 2013) the Original Equipment Manufacturer (OEM)[44] of Su-30 MKI aircraft for expert review and clearance of the proposal for aircraft modification to integrate DC MAWS sensors on aircraft. The OEM clarified (May 2013) that on integration of DC MAWS sensors, performance of aircraft would worsen significantly.

The project cost enhanced (December 2011) by the Ministry to ₹228.80 crore due to exchange rate variation (ERV), was again enhanced (July 2013) to ₹273.80 crore (*i.e.*by ₹50 crore). The Ministry also extended (July 2013) PDC of the project by 24 months (up to June 2015).

Audit observed (October 2014) that though increase in weight of IR sensors was a cause of concern to Air HQ as well as DARE, IR sensors were accepted with its present weight and with this, possibility of adverse effect on flight envelop of Su-30 MKI aircraft remained.

In response to audit observation regarding delay in development of DC MAWS and its operational impact, DARE agreed (January 2015) that MAWS capability of Su-30 MKI aircraft would be limited in its absence. It further added that DC MAWS requirement on Su-30 MKI aircraft was not envisaged by IAF and hence executed it as a TD project instead of MM project and the project was wrongly categorized as MM.

Subsequently, DARE relocated installation of IR sensors on the aircraft to the satisfaction of Air HQ and expert committee, who concurred (February 2015) the installation of all the six sensors. M/s Elisra, Israel delivered (March/April 2015) all the six IR sensors only after the completion of factory acceptance test (FAT). The flight evaluation of DC MAWS was also carried out (March - April 2015) on a test bed (Cheyenne - a transport aircraft) available with M/s Elisra. An amount of ₹194.16 crore had been incurred on the project (March 2015).

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[42] The heat emitted by aircraft plume and release of missiles will mask the IR sensors which in turn increases the thermal capacity of the sensors beyond saturated point thereby affecting its performance.

[43] The angle of attack is the angle between the wind and the nose of the aircraft during its flight.

[44] M/s Rosoboronexport, Russia.

Air HQ stated (April 2015) that flight trials of DC MAWS on Su-30MKI aircraft were expected to commence in December 2015.

Audit also observed (June 2015) that in order to meet the latest PDC (June 2015) of the project, DARE, after development and testing of the system on test bed of transport aircraft available with M/s Elisra and not Su-30 MKI aircraft, closed the project claiming it successful. In order to prove the developed DC MAWS system on Su-30 MKI aircraft, DARE had proposed (June 2015) to take up a separate project.

DARE further stated (June 2015) that the delay in development was due to time taken (from February 2012 to February 2015) by Air HQ to assess the impact on aerodynamics of the Su-30 MKI aircraft on fitment of sensors.

In response to Draft Report (April 2015), the DRDO HQ reiterated (June 2015) the views of DARE that DC MAWS project was taken up as a TD project and suggested to exclude the project from draft report.

The replies may be seen in light of the fact that Air HQ had clearly projected (March 2008) the requirement of DC MAWS for Su-30 MKI aircraft and accordingly, the project was sanctioned under MM category**.** Also neither DRDO HQ nor DARE took any initiative during development to obtain an amendment to sanction from MM to TD project. Further, flight evaluation of developed DC MAWS was carried out on test bed of Cheyenne transport aircraft and as such, the success or otherwise of DC MAWS with oversized sensors, would be known only after flight evaluation on modified Su-30MKI aircraft, for which a separate sanction was awaited. Till then, Su-30 MKI aircraft fleet would have to operate without missile approach warning capability.

3.1.8.14 Electronic Warfare Suite (D-29 system) for modified MiG-29 aircraft

Electronic warfare (EW) consisting of electronic attack (EA), electronic protection (EP) and electronic warfare support has become an important component of modern warfare.

Based on Air HQ ORs (October 2006) for an EW suite[45] for fitment on MiG 29 upgrade[46] aircraft, DARE, Bengaluru proposed (October 2007) joint development of a state-of-art EW suite (D-29 system[47]) with M/s Elisra, Israel.

MoD sanctioned (March 2010) the project to DARE under Mission Mode for design and development of D-29 system at a cost of ₹168.85 crore (FE ₹157.55 crore) with a PDC of 33 months (December 2012). Accordingly, DARE signed (April 2010) a tripartite agreement with the Ministry of Defence, Israel and M/s Elisra at a cost of 26 MUSD (₹115.57 crore @ 1USD= ₹44.45) with a PDC of 28 months (August 2012).

Meanwhile, based on Ministry's sanction (March 2009), DARE concluded (March 2009) a contract with OEM (M/s RAC MiG) of MiG-29 aircraft for structural modification of six MiG-29 aircraft (which were already positioned with the OEM for up-gradation) for fitment of the proposed D-29 system at a total cost of 14.25 MUSD (₹74.10 crore) with a PDC of 20 months (November 2010).

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45 IAF projected requirement for EW suite as MiG-29 aircraft fitted with Tarang 1 B RWR did not have self protection jammer.

46 Air HQ concluded (March 2008) a contract with OEM (M/s RAC MiG) for up-gradation and life extension of 63 MiG-29 aircraft. The contract was to be carried out in two stages *i.e.*, (a) Design and Development (D&D) in two years (2008-2010) on six aircraft in Russia and (b) Series upgrade of remaining 57 aircraft in India (2010-2014).

47 D-29 system consist of Unified Receiver Exciter Processor (UREP) which encompass Radar Warning Receiver (RWR), Electronic Support measure (ESM) and Electronic Counter measure (ECM) along with Special Protection Jammer 'SPJ'(Transceiver) of M/s Elettronica, Italy.

Scrutiny (October 2014) of the documents revealed that:

a) During structural modification, OEM encountered issues related to positioning and installation of Line Replaceable Units (LRU)[48] of D-29 system for which DARE suggested (June 2011) certain additional modification on the six MiG-29 aircraft. However, three aircraft after upgradation were delivered (December 2012) to IAF by the OEM without additional modification to facilitate training of pilots on the upgraded aircraft.

b) The D-29 system was developed by DARE in March 2013 but it could not be evaluated on the three aircraft received in India without the additional modification, which was necessary to carry out testing of the system.

c) The remaining three aircraft, after upgradation and structural modification (including additional modification) for fitment of D-29 system were received in India only in December 2013 due to delay in upgradation by the OEM.

d) The evaluation of D-29 system was further held up (October 2014) as IAF used the upgraded aircraft for testing various systems that were fitted by the OEM for upgrading the aircraft.

Thus, there was lack of synchronisation of upgradation with structural modification (including additional modification) of MiG-29 aircraft and development of D-29 system for the aircraft.

In response to an audit query (October 2014) regarding absence of EW suite (D-29) on operational capability of MiG- 29 aircraft, Air HQ stated (October 2014) that absence of EW system in upgraded MiG-29 aircraft was an operational limitation.

In response to audit observation (December 2014) regarding non-synchronisation of the activities and consequent delay in proving the

[48] The LRUs are RWR, ECM , SPJ

D-29 system on MiG-29 aircraft, DARE stated (January 2015) that delay in completion of up-gradation of aircraft was beyond the control of laboratory and testing of the developed D-29 system was delayed for want of aircraft. For operational limitation, DARE stated that 'Tarang' 1B RWR[49] would be used in absence of D-29 system.

Reply may be seen in light of the fact that 'Tarang' 1B RWR was without a Special Protection Jammer (SPJ), because of which, IAF projected the requirement for D-29 system. Therefore, 'Tarang' IB RWR cannot be treated as a substitute for an effective EW system.

Audit noticed (April 2015) that DARE had spent ₹199.82crore[50] (March 2015) on development of D-29 system and structural modification of MiG-29 aircraft.

In response to draft report (April 2015), the DRDO HQ while reiterating the views expressed by DARE, stated (June 2015) that additional modifications were initiated at the behest of IAF for easy operation/ maintenance. DRDO HQ agreed with Audit that synchronization of activities is to be ensured in cases where more than one agency was involved.

Thus, evaluation of the D-29 system on MiG-29 aircraft developed by DARE under Mission Mode has been pending since March 2013. Further, though Air HQ admitted (October 2014) that the absence of an EW suite was an operational limitation in MiG-29 aircraft, delay by IAF/DARE in evaluating the D-29 system only reduces its utilization as the upgraded MiG-29 aircraft has a Total Technical Life of 20 years only.

3.1.8.15 ESM and SPS for AEW&C system

Electronic Support Measure[51] (ESM) and Special Protection Suite (SPS)[52] are two major sub-systems of AEW&C system being developed by CABS as

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[49] DARE developed Tarang RWR in late 90s and its improved version Tarang 1B RWR (without a SPJ) was developed by DARE in 2002 and ToT to BEL (in November 2004).Tarang 1B will be fitted during the series upgrade of MiG-29 aircraft in India and will be replaced by D-29 system after its development and manufactured by BEL.

[50] ₹138 crore towards development + ₹62 crore towards structural modification.

[51] ESM includes Radar Warning Receiver (RWR).

[52] SPS includes Communication Measure System (CSM) , Ultra Violet (UV) Missile Approach Warning System (MAWS) and Counter Measure Dispenser System (CMDS)

mentioned in *paragraph 3.1.8.12*. The Electronic Support Measure (ESM) is intended to aid in identification / classification, based on the various emissions from the targets, whereas, SPS is a self-defence suite comprising of Radar Warning Receiver (RWR) [53], Missile Approach Warning System (MAWS)[54] and Counter Measure Dispensing system[55] (CMDS).

DARE proposed (February 2005) to build one laboratory prototype followed by one engineering prototype and two flight worthy systems of Integrated RWR-ESM-SPS System (IRESS) with indigenous content of 30 *per cent* and 70 *per cent* during development and production phases respectively. CABS sanctioned (May 2005) two separate sub-projects for development of three sets each of ESM and SPS at a cost of ₹75.00 crore and ₹18.00 crore respectively with a time frame up to April 2011 (in line with overall PDC of AEW&C system).

DARE placed 15 (ten foreign and five Indian vendors) supply orders between March 2006 and June 2012 with different vendors. Delays in receipt / acceptance of some of these stores which affected overall project are given in **Annexure-X**. Main delay was in receipt of an important part of ESM/RWR system *viz.*, Multiple Channel Radio Frequency Signal Processor (MRDSP) from M/s Elta, Israel which was delivered with ToT, after a delay of 34 months (August 2011) from the original PDC (October 2008) [56] due to delay in conduct of Preliminary Design review (PDR) as well as Critical Design Review (CDR) by DARE.

Audit observed that:

a) Even after lapse of nine years, the flight trials of ESM and ground trials of SPS were in progress.

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[53] Radar Warning Receiver-it receives signals emitted from enemy radars and warns the pilot.

[54] MAWS is a Passive System operating in UV region. It is designed to detect potential missile threats in initial launch phases to provide maximum warning time.

[55] When the aircraft sensors detect a threat, the CMDS automatically launches radiofrequency and infrared countermeasures at the optimum time to defeat incoming missiles.

[56] PDC was extended twice-October 2010 and August 2011

b) As per CEMILAC (certifying agency), minimum essential standard[57] to assess the flight safety of the equipment during developmental phase and final deliverable of SPS were level-C[58] and level-B respectively, whereas, DARE had developed SPS, only up to Level-D (August 2014), citing paucity of time thus compromising flight safety.

c) CABS extended the PDC of the sub-project thrice[59] in line with extensions of the main AEW&C programme, without DARE request.

d) Out of sanctioned amount of ₹76.36 crore towards FE, DARE had incurred (March 2015) an amount of ₹72.61 crore (*i.e.*, 77 *per cent)* towards FE), which indicated high import content in the development However, except in MRDSP, no ToT was obtained as stated in the project proposal.

In response to audit observation, DARE stated (July 2015) that ground trials of SPS were completed and flight trials of ESM were expected to be completed in September 2015. Further, ToT was planned only for MRDSP as competence existed with several vendors for all other LRUs. Also, DARE attributed the high import content to inclusion of only bought out items in cost and cost did not include the software developed in-house and manpower of the laboratory.

DARE reply may be viewed in light of the fact that import component in development of ESM and SPS was 77 *per cent* as against the sanctioned 70 *per cent.* Further, ESM and SPS were yet to be proved (June 2015) despite lapse of more than nine years from its sanction.

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[57] DO-178B guidelines.

[58] Five levels of flight safety criticality standard of the airborne item prescribed by CEMILAC (Level-A is catastrophic failure condition, Level-B is hazardous / severe failure, Level –C is major failure, Level-D is minor failure and Level-E is no effect).

[59] April 2014, October 2014 and the latest December 2015

3.1.9 Conclusion

DRDO takes up Mission Mode projects as per user (Services) requirement at short notice and these normally depend on technologies that are already available, proven and readily accessible.

Audit examination of 14 Mission Mode projects carried out by DRDO Laboratories revealed that all the projects failed their timelines and their PDC were extended many times. In five projects there was cost overrun as well.

Further, although Operational Requirements/Qualitative Requirements/Broad Technical Requirements of IAF existed in all projects, the requirements of IAF were met to their satisfaction only in one completed project *viz.,* project 'Rohini'. In the same project the technology was also transferred leading to its productionisation by BEL and final induction into IAF. The systems developed in other closed projects were yet to be accepted by IAF.

The delays could partly be explained by inadequate monitoring by different committees and partly by change of requirements by IAF (three projects). Lack of harmonisation (where multiple agencies were involved) was also noticed in two projects.

The projects were therefore not carried out in spirit of Mission Mode which adversely affected Air Defence plans of IAF.

3.1.10 Recommendations

Recommendations after audit analysis are as under:

I. Mission Mode project should be considered complete and successful only after it meets user requirements.

(Paragraph 3.1.8.5 and 3.1.8.9).

II. Any modification/ improvisation should be at prototype stage. Modifications at production stage should be avoided.

(*Paragraph 3.1.8.6)*

III. In cases of projects involving multiple agencies for development of a product, effective synchronisation between their activities is necessary to avoid slippages.

(Paragraph 3.1.8.7)

IV. User requirements should be well defined before commencement of the Mission Mode project.

(Paragraph 3.1.8.8)

V. In cases of projects involving multiple agencies for development of a product, effective harmonisation between their activities is necessary to avoid slippages.

(Paragraph 3.1.8.14)