

CHAPTER VII: PROJECT MANAGEMENT IN ARMAMENT RESEARCH AND DEVELOPMENT ESTABLISHMENT

Staff projects taken up for delivery of products required by Defence Forces during the last 15 years met with varying success. Out of 46 closed projects scrutinized in audit, only 13 underwent production while in the remaining either no production was required or claims of success could not be substantiated in Audit. Projects were initiated without General Staff Qualitative Requirements (GSQR). Frequent changes to QRs by Users, excessive time overrun also contributed to non realization of the project deliverables and in many cases this eventually led to import of items.

7.1 Introduction

The Armament Research & Development Establishment Pune (ARDE) is a Defence Research & Development Organisation (DRDO) Laboratory responsible for development of conventional armament systems and related technologies. During the last five decades, ARDE's efforts led to the induction of many significant weapons systems in the Services like 5.56 mm Indian Small Arms System Rifle, Light Machine Gun and ammunition, PINAKA Multi Barrel Rocket Launcher System, Armament of Main Battle Tank Arjun, Canopy Severance System for Light Combat Aircraft & HJT-36 Trainer Aircrafts etc.

ARDE like other DRDO laboratories takes up essentially two categories of projects namely Staff Projects and Technology Development Projects. Staff Projects are taken up on the basis of specific demands from the User Organizations- mainly the Services. These are expected to be based on well defined requirements framed by Users²⁹ in term of General Staff Qualitative Requirements (GSQR). These projects usually involve deliverables within a specified time frame for induction in service. The second category variously known as Technology Demonstration(TD)/ Research & Development (R&D)/ Science and Technology (S&T)/ Infrastructure Development Projects are taken up for general competence-building in a given area of research or to solve specific problems arising out of Staff projects. TD Projects are planned to establish technologies which would find application in Staff projects in future based on Users' requirement.

7.1.1 Scope of Audit

The present report is the result of an audit appraisal of projects taken up by the Laboratory from the point of view of project management. Staff projects were taken up for review. Only those projects which have been closed were taken up by audit in order to make an assessment whether such projects were closed after achievement of the projected deliverables. In case of on-going projects

²⁹ Users are Army, Air Force and Navy

such an assessment cannot be done and hence they were not considered in audit.

The present review by Audit scrutinizes the projects taken up by the Laboratory to examine whether the deliverables envisaged in the projects were achieved within the projected time and cost framework. In order to form a fair and balanced view of the success of the projects undertaken by the Laboratory, 55 (46 closed and remaining on going) Staff Projects valuing ₹ 387.35 crore were scrutinized.

The issues relating to Users were examined in Directorate General Infantry, Artillery, Engineer's-in-Chief Branch (E-in C) and Director General Ordnance Services (DGOS) for import of ammunition. The responses of respective User directorates, DGOS and E-in C's Branch have been suitably incorporated as and where applicable.

7.1.2 Criteria to determine success of Projects

Staff projects normally should be high priority projects taken up by DRDO based on well-defined User-requirements in terms of QR, deliverables and time frame. Successful Staff projects involve Technology transfer and post-project production activities. A Staff Project can be considered successful only if the deliverables in terms of equipments or systems are accepted by the Users for induction into service after satisfactory users' trials, thereby leading to their bulk production.

7.2 Staff Projects

7.2.1 Lack of production and induction of the outcome of Staff Projects

Out of the 55 Staff Projects, 46 projects were closed and the remaining nine were ongoing as on February 2011. Of these 46 closed projects, only 13 closed projects, completed at a cost of ₹ 67.83 crore, underwent production.

Ministry claimed 31 projects as successful. Ministry's claims were however based on unilateral claims by the DRDO regarding success of these projects. In many cases, Ministry had claimed that users did not indent or no production was involved. In a few cases, it claimed that the development as per the quality requirements was completed but the users changed the quality parameters at a later date. The details are given below:

Sl. No.	Category of Project	No. of Projects	Remarks of Audit
1	Projects successfully completed in which production started	13	No remarks
2	(i) Projects successfully completed meeting original GSQR. However not productionised as no requirement projected by Users. (ii) Projects successfully completed	06 02	Projects treated as unsuccessful by audit as staff projects not translated into deliverables to the service.

	but GSQR changed and no production order was placed by users.		
3	Projects completed but under TOT	02	The stage of such technology transfer was not clarified. Further, details regarding commencement of production or placement of indent by the Users were not provided.
4	Project completed but no production involved	08	The claims of successful completion could not be verified in audit as no records in support of the claims were made available.
	Total	31	

Ministry's reply would indicate a serious disconnect between the organization responsible for development of technology and the users. Without close synergy between the users and the technology development agency, much of the development efforts would go in vain, as the success rate of projects in this particular laboratory amply demonstrates.

While the rate of induction of the deliverables into service or bulk production was much to be desired, it was noticed in audit that the reasons for the same were complex and varied. Development of cutting edge technology of complex armament systems requires long term commitment on the part of both the laboratory and the user organisations.

Admittedly Staff projects are inherently more complex than TD/R&D projects. This is so because in case of Staff projects not only does the developer have to establish the technology in terms of a prototype acceptable to the User but has also to document the production process and arrange the transfer of technology to the domestic industry for bulk production. The capability of the industry to absorb the technology is in turn dependent upon the technological maturity level of the domestic industry.

As audit analysis indicated, it is not always the laboratory which is solely responsible for failure of Staff projects. Staff projects require constant cooperation between the users and developers. The users are also required to articulate their requirements in concrete and achievable terms.

In many cases, it was noticed that the projects were closed as there was no unanimity regarding success between the laboratory and the users. In many cases, the Ministry of Defence, Department of R&D replied to audit putting the onus of responsibility of failure of the projects on the User Organization. Both these Organizations are parts of Ministry of Defence and yet, there is no authority to reconcile the differences. Autonomous functioning of these organizations without a strong umpire to oversee and resolve differences also was responsible for slow progress of such projects.

Study of projects indicated that failure could mainly be attributed to the following:

- Taking up projects without GSQR;
- Frequent changes to the GSQR by the Users;
- Excessive time over run often making the developed technology obsolete;
- Project Closures without waiting for Users' acceptance; and
- Failure of the Laboratory to develop the desired deliverables.

Ministry in its reply, while agreeing with audit contention stated that staff projects are generally undertaken against GSQR/Draft GSQR. However, there are certain developments wherein GSQR is not necessary as it could be of the nature of upgradation of equipment, compilation of range table and development of software.

7.2.2 Taking up projects without GSQR

The process of development of equipments starts with the formulation of user requirements i.e. General Staff Qualitative Requirements (GSQR)³⁰. As far as Army is concerned, GSQRs are formulated by the User directorates in Army HQ and vetted by the General Staff Equipment Policy Committee. Formulation of a Qualitative Requirements is of prime importance for undertaking a Staff project as it defines in precise terms the deliverables to be achieved. Taking up Staff projects without GSQR carries the risk of the system developed not meeting the Users' requirements or not being required by the Users at all. The following two cases illustrate the risks arising out of the ad hoc method of sanctioning Staff projects:

Case I: Design & Development of 125 mm Fin Stabilized Armored Piercing Discarding Sabot (FSAPDS) (Soft Core) MK-II Ammunition for T-72 tank

Ministry of Defence, Department of Defence Research and Development (DDRD) in May 1996 sanctioned the above project at a cost of ₹ 2.30 crore to be completed by May 1998. It was sanctioned by DRDO without GSQR from Army HQ. The project after four revisions of probable date of completion (PDC) and three cost revisions, was closed in December 2004 after an expenditure ₹ 7.27 crore.

The ammunition developed by the Laboratory did not meet the Users' requirement as Users expressed an apprehension as to whether the trials conducted for MK-II ammunition in the absence of GSQR for this ammunition would qualify as user trials. To resolve the issue, the ammunition was subjected to Accelerated User Cum Reliability Trials (AUCRT) in August 2007 which again proved to be unsatisfactory.

³⁰ Qualitative Requirements for Air Force are Air Staff Requirements and for Navy are Naval Staff Qualitative Requirements

Ministry of Defence in its reply in February 2011 stated that trials with 30 rounds of improved ammunition, have been successfully completed in May 2010 and Army HQ has given go ahead for accelerated user trials with 500 rounds of the improved ammunition. Ministry's reply should be viewed in the background of the fact that even after a lapse of 15 years the ammunition is yet to be inducted. Such ammunition is still being imported by Army.

Case II: Design and Development of ammunition 'A'

Air Headquarters 1984 had projected requirement for the above mentioned ammunition. In November 1997, Air HQ changed the specification of ammunition 'A'. However, without waiting for modified/fresh Air Staff Requirement (ASR) from Air Force, Department of Defence Research & Development(DDRD) in August 1998 accorded sanction for undertaking above Staff project at an estimated cost of ₹ 2.90 crore for completion by August 2001. In December 1998, DDRD requested Air HQ to update/issue a fresh ASR. As there was delay in revision of Air Staff Requirement, Design Review Committee of DRDO in October 2001 decided to close the project after spending ₹18.63 lakh.

Ministry in reply, while agreeing with the above facts stated that development of certain technology takes a long time and to cut short the time, the project was undertaken before finalisation of ASR. Ministry's reply should be viewed in the light of the fact that nothing was achieved from this project.

7.2.3 Frequent changes to the Qualitative Requirement by the Users

While project implementation must have a certain degree of flexibility to enable incorporation of the latest technology, it was noticed that indecision of the Users regarding design parameters resulted in frequent changes in the QR which affected the development and adversely impacted time and cost projections leading to foreclosures of projects without attaining the objectives.

This is evident from closure of three Staff projects including related Technology Demonstration projects on which an expenditure of ₹ 21.69 crore was incurred. The cases are narrated below.

Case I: Design and Development of 120 mm Long Range Mortar (LRM) System and its ammunition

Based on GSQR, Department of Defence Research & Development in June 1997 sanctioned the development of LRM System at a cost of ₹ 9.52 crore with Probable Date of Completion (PDC) as June 2001. The scope of the project included development of a family of High explosive (HE), Smoke and Illuminating ammunition. The GSQR envisaged the weapon system to have a range of 10 Km, rate of fire of 8-10 bombs per minute, with a burst fire capability of 12-15 rounds per minute. For portability, the mass of the equipment was not to exceed 700 kg and the weight of the three main components required for man/mule packing was not to exceed 450 Kg. The system also had to be capable of being split into three convenient loads. Two prototypes of the weapon system were required for trials. In February 2000 Army HQ issued fresh GSQR which was silent as to the mass of the three

main components of the equipment to facilitate handling by man and mule packing.

Till June 2001, only one weapon and 200 HE bombs could be offered for User trials. To avoid further delay, DRDO de-linked development of Smoke and Illuminating bombs from the main LRM project and sanctioned a separate Staff project in October 2003 for these at a cost of ₹ 5.85 crore with PDC as October 2006.

The LRM developed by DRDO could not achieve the GSQR parameters as the desired range and rate of fire or burst fire capability could not be met with a low weight Mortar which was an inconsistency in the GSQR framed by the Army. Director General (DG) Artillery, decided against going ahead with the project. As a result, DRDO foreclosed the main project from December 2004 after incurring expenditure of ₹ 9.29 crore. Subsequently the other project for Smoke and Illumination ammunition was also foreclosed in December 2005 after incurring an expenditure of ₹ 1.08 crore. Army HQ while asking for foreclosure of the project in December 2004 accepted that the range of 10000 meters was not achievable with the low weight stipulations. It was also accepted that a mortar system with such QRs is not available in the world market and therefore a fresh GSQR was being initiated.

Ministry in its reply agreed with audit and stated that decision has been taken to procure the item through global tenders by diluting the GSQR parameters. However, the fact remains that due to unrealistic GSQR framed by the Army and DDRD's pursuance of it, the Staff project could not come to fruition even after an expenditure of ₹ 10.37 crore.

Case II: Development of 30 mm Fair Weather Towed Air Defence (AD) Gun System

For indigenization of technology for AD Gun, GSQR was framed by the Army in October 1985. DDRD in May 1986 sanctioned a Technology Demonstration project for design and development of Towed AD Gun, ammunition system and associated technology (Sharp shooter) at an estimated cost of ₹ 9.44 crore with the PDC of 5 years. The project was completed in September 1992 at a cost of ₹ 8.24 crore, after achieving rate of fire of 1200 rounds per minutes as against rate of 1000 rounds per minute specified in the GSQR. Later, a Staff Project (SL-PX-2K referred to at SI No 4 below) was taken up in September 2000 for ₹ 17.70 crore to improve upon the rate of fire to 2000 rounds per minute. The project had to be foreclosed after an expenditure of ₹ 14.68 lakh as the Army again changed the parameters of the gun.

A total of nine changes in the GSQR were made impacting the basic parameters of the gun system such as caliber, rate of fire, size, number of barrels, weight etc. as detailed below:

Sl No.	GSQR No. & Month of Issue	Specifications of AD Gun	Revision to GSQR	Sanction of Project & its status
1.	GSQR 554 of October 1985	All weather, 30 mm, Towed, Multi-barrel, Rate Of Fire (ROF) not less than 1000 rpm		RDS-PX-86/ARD-826 in May 1986 for ₹ 9.44 crore. Successfully completed in September 1992 at a cost of ₹ 8.24 crore.
2.		No Revised QR. DRDO unilaterally decided to develop item with enhanced specifications to Multi-barrel, Gatling Gun with ROF 4200 rpm	Army in October 1995 suggested two types of AD guns. One with weight around 1000 – 1500 Kg and other weighing 4000–5000 Kg with ROF 1000–2000 rounds in each case.	RDR-PX-93/ARD-984 in August 1993 for ₹1.98 crore. Since Gatling gun did not meet the user requirement the project was foreclosed in October 1995 at an expenditure of ₹ 48.5 lakh
3.	Draft GSQR of May 1997	30 mm, Towed, Single Barrel, ROF not less than 1000 rpm, and Weight not more than 1500 Kg.	July 1998 Twin Barrel Gun ROF 2000 rpm Weight 3500 – 3800 Kg	RDX-PX-97/ARD-1080 in August 1997 for ₹ 9.85 core. Closed in April 2000 at an expenditure of ₹ 51.19 lakh.
4.	GSQR 767 of January 2000	Fair weather, 30 mm, Two Barrel, Towed AD Gun, Weight 3500–3800 Kg and ROF 2000 rpm		SL-PX-2K/ARD-1148 in September 2000 for ₹ 17.70 crore. Due to decision of the Army to upgrade in service 40 mm L/70 and 23mm ZU Gun, Project foreclosed in October 2001 at a cost of ₹14.68 lakh.
5.	GSQR 910 of October 2002	As a common successor to L/70 and 23mm ZU Gun. All weather, Two Barrel, ROF not less than 1000 per barrel	Amended in May 2004.	No project undertaken as GSQR was revised in September 2004
6.	GSQR 998 of September 2004	All weather, Towed/HMV mounted, 30/35mm, Two Barrel with ROF 1000 rpm and Weight about 4.5 ton	Amended in August 2006 Light Weight Air Defence Gun	No project undertaken as the GSQR was amended in August 2006 and revised GSQR superseding all the previous GSQRs was received in January 2007
7.	GSQR 1166 Received in January 2007 to replace L/70 and 23mm ZU Gun	Towed, HMV mounted, ROF 1000 rpm and weight Not < 6000 Kg		No project undertaken till date by ARDE

In August 2010 the User Directorate in Army HQ stated that revisions to GSQR in this case had become essential, as the features had become outdated during preceding 20 years and the proposed gun system was required to relate to the envisaged air threat. The User categorically denied any responsibility for the failure in development by DRDO and insisted that they had not agreed to any dilution in specifications of most critical of the GSQR parameters.

Consequently, even though three R&D projects and one Staff project were undertaken by the laboratory, the AD Gun system could not be developed by DRDO to satisfy the frequently revised requirements of the Users. This resulted in their mid-way closure after incurring an expenditure of ₹ 9.38 crore on the staff project in addition to the expenditure on the technology demonstration project.

Ministry in its reply agreed with the audit contention of non finalisation/frequent changes to QR leading to failure to develop a Gun system acceptable to the Users.

Case III: Design & Development of Vehicle Based ammunition 'B' laying system

DDRD in September 2000 sanctioned the above Staff project at a cost of ₹ 4.71 crore with PDC as September 2004. During the course of development, the Users proposed to enhance ammunition 'B' laying capability of the system from 70 metres in QR to 300 metres to meet its futuristic requirements. Accordingly, an engineering prototype capable of 300 metre range was initially developed but as further integrated trials of the system could be undertaken only after satisfactory development of Anti Tank and ammunition 'B' being developed under another project, ARDE in October 2003 sought extension of PDC of the project up to September 2007.

Army HQ in March 2004 intimated its requirement of traverse of 330 degrees and revised the range to 750 metres. DRDO in May 2004 expressed its inability to enhance the range to 750 metres with existing design/configuration and suggested that present design without traverse be treated as Mk I. Traverse of 330 degrees was proposed to be provided in Mk II to be undertaken separately as technology demonstration project.

However, during the bi-annual review of DRDO projects in April 2004 by Vice Chief of Army Staff (VCOAS), it was again decided to revise the system requirements and formulate a new GSQR. Accordingly the project was closed from September 2004 after incurring an expenditure of ₹ 1.94 crore. In July 2007 ARDE informed the Army that it could not deliver the system within three years when Army HQ asked it for comments for adopting the route of 'Buy' and 'Make' through TOT. E-in-C Branch in August 2010 stated that system after being categorized as 'Buy global' was being processed for procurement as due to technological advancement and operational requirements, amendment to GSQR became necessary. Ministry in their reply stated that the project was closed due to frequent changes in GSQR.

7.2.4 Excessive Time Overrun in Staff Projects

Effectiveness of project management is measured by the delivery of project output within the given time and cost. However, it was seen that time over run/extension was the norm rather than an exception in Staff Projects. 37 Staff projects constituting 80 per cent of the 46 closed Staff projects reviewed by audit did not adhere to the original time schedule. The number of extensions granted to projects ranged from one to 10 while extension in terms of number of months was between eight months to 146 months. In many cases frequent extensions to PDC also did not lead to success in the projects as shown in six cases below:

Unsuccessful projects involving frequent PDC extensions

Sl. No.	Project No	Original PDC	Actual time taken	Number of PDC extensions	Status of the projects
1	ARD-804	2years	13 years 7months	08	Not accepted by Users
2	ARD-813	3years	15 years 2 months	07	Unsuccessful
3	ARD-972	3years	15 years 2 months	10	Unsuccessful
4	ARD-1045	2years	8 years 7 months	05	Not accepted by Users
5	ARD-1053	2years	7 years 4 months	05	Not accepted by Users
6	ARD-1078	2years	9 years 6 months	04	Unsuccessful

Non adherence to time schedule originally committed is indicative of overestimation of capabilities by the laboratory as well as unrealistic projection of time frames.

At least in case of four staff projects, failure of the Laboratory to develop the weapon/ammunition within the stipulated time frame after an expenditure of ₹ 6.11 crore led to closure of them and Army had to resort to import to fulfill its requirement. The details of each case are given below.

Case I: Design & Development of 84 mm RL MK III along with its Ammunition

As replacement of in-service 84mm Rocket Launcher, a shoulder fired weapon, Army HQ, in November 1997, issued GSQR for design and development of new light weight 84mm Rocket Launcher (RL MK III) along with five types of ammunition and sighting system. In contrast to the normal practice of taking up a project in totality, ARDE proposed to first develop the launcher, followed by the ammunition.

Project for development of Rocket Launcher was earlier sanctioned in April 1997 by DDRD at a cost of ₹ 75 lakh and PDC as October 1999 in anticipation of the Staff requirement. The launcher was stated to be successfully trial evaluated by DRDO and accordingly project was closed with effect from 31 March 2000 after an expenditure of ₹ 60.32 lakh.

DDRD in February 2002 sanctioned a staff project for undertaking design and development of ammunition for 84mm RL MK III by the laboratory at an estimated cost of ₹ 6.35 crore with PDC of four years.

DRDO was to offer five Light Weight Rocket Launchers for troop trials by March 2001 but it conveyed that tubes could be offered in June 2002 and that too without enhanced range sights and ammunition which would take another three years to develop. To meet the requirement of carrying out troop trials with modified tube, DDRD in March 2001 sanctioned another project at a cost of ₹ 90 lakh with PDC as November 2002. The launcher was claimed to be successfully trial evaluated under this project, and was closed in March 2004 at a cost of ₹ 79.96 lakh.

It was noticed in audit that Army HQ had concluded contract in March 2002 and March 2003 to procure 3000 Rocket Launchers Mk-III, 3000 telescopic sight and 36000 HEAT ammunition from M/s FFV, AB Sweden at a total cost of SEK 859.90 Million. Further OFB also entered into a contract in February 2005 with M/s FFV, AB Sweden for TOT for 84 mm RL MK-III Weapon and HEAT 551 ammunition at a cost of SEK 17 Million for which they received technology for all parts of the weapon except for Carbon Filament Winding (CFW) of the barrel. In the meantime Ordnance Factory Board received TOT of ammunition in 2005 consequent to which the project was foreclosed.

Ordnance Factory Board Kolkata informed the laboratory that the Army had an urgent requirement of the ammunition. As development of the ammunition would take further four years, the Users could not wait that long and had decided to import the launcher system and ammunition system. The Army also intimated that they did not need the indigenous system any more.

Ministry in its reply contended that the development had culminated in fruitful indigenization of composite technology.

Ministry's reply is not tenable as Directorate General of Infantry in April 2011 stated that the launcher developed by ARDE was trial evaluated four times and after each trial there were defects to be rectified/modifications required to be carried out.

Case II: Development of Electronic equipment for three types of ammunition

The DDRD in May 1985 sanctioned the above mentioned Staff project for ₹ 1.86 crore to be completed by May 1987. The GSQR envisaged as essential qualitative requirement of the equipment that the mean deviation of the equipment should not exceed 0.1 seconds; on firing it should be safe for up to 1 ± 0.05 seconds and the equipment should be reliable up to 95 *per cent* of Air Burst and 99 *per cent* on percussion setting.

Though initial PDC of the project was May 1987 user trials could be conducted only in December 1990. As the reliability and consistency of the equipment was poor during these trials, Army suggested further improvements and modifications before offering the electronic equipment for retrials.

In September 1991 Army HQ stressed that the equipment should achieve the results within +0.05 seconds deviation which were erroneously indicated as 0.5 sec in GSQR and should have consistency in height of burst. ARDE in October 1991 claimed that since the GSQR parameters regarding mean deviation were achieved, the item be considered acceptable. Eventually, in May 1993, DRDO expressed its inability to achieve the time accuracies indicated by Army, but offered a modified equipment for user trials in 1994. However user trials were inordinately delayed. Phase-I trials of modified equipment were conducted in February and March 1996. The equipment did not perform satisfactorily during the trial but during Phase-II user trials

conducted in September 1997 the equipment performed satisfactorily and met the GSQR requirements.

In the meanwhile Ministry of Defence in August 1997, entered into a contract with M/s Electronic Corporation of India Limited (ECIL) for supply of 21000 equipment from M/s Bulova Technologies, USA at a total cost of ₹ 12.13 crore. The imported equipment was trial evaluated along with DRDO equipment, in October 1997. Army HQ, in August 1998 indicated that the performance of the imported equipment was superior to the equipment developed by DRDO in terms of both reliability and technology. It recommended that the project be short closed as it was based on GSQR of 1984 vintage, and directed for generation of fresh GSQR. Finally, the project was closed in August 2003 with retrospective effect from December 1998 after incurring an expenditure of ₹ 1.88 crore. Army accepted imported equipment in the interim.

While Army HQ did not respond to audit, Ministry in its reply claimed that electronic equipment had given performance of 94.88 per cent as per ARDE's evaluation. Regarding consistent height of burst (HOB) by reduction in mean deviation, it stated that GSQR acceptance criteria for electronic equipment was only the timing accuracy and not the HOB. However, the fact remains that the fuze could not be developed by ARDE within the initial PDC of May 1987 and finally, its performance was found to be poor in terms of reliability and consistency leading to its import by the Users.

Case III: Indigenization of ammunition 'C' for Automatic Launcher System

DDRD in August 1991 sanctioned a Staff project for indigenous development of ammunition 'C' for Automatic Launcher (AL) at a cost of ₹ 1.45 crore to be completed by August 1994. Its mass production was expected to result in foreign exchange (FE) saving of ₹ 760 crore.

In user trials of August 1994 Army suggested certain improvements. However, as the PDC of the project was over, the project was closed after an expenditure of ₹ 93.30 lakh and improvements were undertaken under a separate project. The expenditure incurred for development of the ammunition 'C' under the second project was ₹ 27.73 lakh. The reliability of the fuze could not be achieved in the 12 trials conducted between May 2000 and April 2006, and a proposal of Ordnance Factory Board agreed to by DRDO in June 2005 to use imported fuze in place of indigenous one for initial 50,000 rounds of ammunition 'C' was not agreed to by the Army.

Army HQ in August 2010 informed audit that since the year 2000, Army had procured 37,50,000 units/rounds of the ammunition 'C' from Bulgaria/ROE Russia at a cost of USD 72.19 million i.e. ₹ 340 crore.

Ministry accepted the facts but stated that development of ammunition 'C' was not wasteful as Border Security Force (BSF) has placed an indent for supply of

Qty 50,000 rounds with imported fuze. The fact however remains that Army did not find ammunition 'C' acceptable.

Case IV: Design and Development of equipment for Aircraft ammunition

Based on Air Service Requirement, DDRD in October 1985 sanctioned the above Staff project at a cost of ₹ 62.50 lakh with PDC as October 1988. The project underwent seven PDC extensions up to December 2000 and cost of the project was revised to ₹ 2.12 crore.

As 10 development flight trials conducted till October 1998 failed, Air Safety Technical Establishment (ASTE) recommended complete design review before conduct of further trials. However, the 11th trial also ended up with similar results. The delay in development of the equipment led to import by the Air Force to make good the shortfall. The project was closed from December 2000 after incurring an expenditure of ₹ 1.62 crore without achieving its aim.

Ministry stated that the failure or success of the project should not be based on the results of the development trials. However, the fact remains that repeated trials could not meet the requirement of Air Force even after 15 years of sanction of the project.

7.2.5 Unilateral closure of projects

The Weapon system developed by DRDO is inducted into service based on performance during trials by the Users and the project is considered for closure. In the event of Users suggesting further trials/ modifications, the project activities are continued to achieve the desired results. However, unilateral closure of projects by DRDO even before validation in trials, on the ground of having successfully developed the system, precludes its acceptance and introduction into service by the User. This not only negates the investment made in time and money on development of the weapon system but also adversely impacts the defence preparedness of the Users. Two projects of those reviewed by audit were closed after incurring an expenditure of ₹ 2.58 crore without waiting for acceptance by the User. The details of the cases are given below.

Case I: Design & Development of 125 mm FSAPDS Practice Ammunition for T-72 Tank

To reduce the cost of training, a Staff project based on GSQR for the development of a training version of the FSAPDS ammunition was sanctioned in August 1996 at a cost of ₹ 95 lakh to be completed by August 1998. The project was closed in December 2003 after incurring an expenditure of ₹ 1.82 crore without its acceptance by Army.

Though ARDE claimed the ammunition to be successful in trial evaluation; Army differed in their inference from the trial results. Interestingly ARDE in

2009 acknowledged the limitation in the practice ammunition developed by them, which it claimed could be overcome by changes in its design and formulation of a new GSQR.

ARDE further contended that the expenditure incurred is not infructuous since new technology established in the project will be utilized for development of practice ammunition for T-90 and Arjun tanks. This needs to be considered in the light of the fact that Staff projects are expected to culminate in a deliverable as stipulated in the GSQR followed by induction of the system into the services. The Ministry in its reply did not offer any comment on unilateral closure of project without consulting the Users.

Case II: Validation of Provisional Firing Tables for 105 mm Illuminating MK-II Ammunition

DDRD in July 1998 sanctioned a Staff project for the above project at a cost of ₹ 73 lakh with PDC as December 1999, revised to December 2000. Validation firings were carried out in September/November 2000 but without waiting for Users' acceptance of the trial results, DDRD closed the project from December 2000 after an expenditure of ₹ 75.52 lakh on the grounds of avoidance of audit objections.

DG Artillery in February 2001 and again in November 2001 pointed out certain inaccuracies in the firing table which needed to be resolved before being subjected to user trials. Though ARDE stated that three Firing Tables viz Sea level, 2000 metres and 4000 metres altitudes are being used by the Indian Army and so far ARDE has not received any adverse feedback, ARDE in March 2001 had requested Ordnance Factory Dehu Road to look in to the quality aspects of the ammunition used to validate the firing tables to avoid failures.

No information as to whether the observations made by Army HQ were rectified or not was furnished by ARDE. In reply, Ministry stated that there is a separate forum to address and solve issues related to quality during production thereby suggesting that the quality of the ammunition needed to be examined.

7.2.6 Failure in development

In the following three Staff projects and related two R&D projects in spite of a development time of sixteen years, eight years and seven years, respectively and after an expenditure of ₹ 17.62 crore, the technology could not be developed due to technical problems in design/development of the systems.

Ministry, while agreeing to the audit comment, stated that since the year 2002, DRDO has introduced Decision Aid in Technology Evaluation (DATE), a process whereby the DATE committee scrutinizes the project proposals and recommends for its further processing based on the maturity of technologies, which should minimize the failures due to under assessment of complexity of technologies. However no comment on the effectiveness of the DATE process

is feasible at this stage as none of the projects taken up at ARDE after its adoption has come to fruition.

Case I: Design & Development of Remotely Delivered Mine System (RDMS) – Anti Tank & Anti Personnel based on existing 122 mm GRAD Rocket

DDRD in October 1992 sanctioned above mentioned Staff project for ₹ 1.75 crore with PDC of three years. Both, Anti tank (AT) and Anti personnel (AP) mines were to be developed under the Project. Initially AP mines with blast effect were to be developed under the project and in 1995, the Users projected the requirement of AP mines with both blast and fragmentation effect including self destruction element. The change in requirement necessitated undertaking of a separate project for AP mines in June 1997 at a cost of ₹ 1.50 crore with PDC of two years.

Despite ten PDC revisions, repeated cost revisions and 16 technical trials and one Pre User Trial Evaluation (PUTE) trial conducted from December 1996 to October 2006, the AT mine system failed to meet the Users requirement and as such further modifications to the system were suggested by the Users. After implementing the modifications and conducting confirmatory trials in May 2007 the system was recommended for user trials.

However the Army did not agree for user trials stating that RDMS was based on the existing 122 mm GRAD, BM-Rocket system which was going to be phased out in next three to five years and production of BM-21 launcher had also been stopped. Accordingly in April 2008 Army HQ designated PINAKA Rocket Regiments as the launcher for RDMS and instructed ARDE that development /procurement of remotely delivered AT/AP mines be progressed as a part of 'New Family of Mines'. Consequently, DRDO closed the project for Anti Tank mines from December 2007 at a cost of ₹ 8.49 crore without fulfilling the objective even after 15 years of development.

Moreover, in spite of sanction in June 1997 of a separate project for development of the AP mines at a cost of ₹ 1.90 crore , the same could not come to fruition even after four PDC revisions up to December 2006. By that time, Users had projected a new GSQR for AP mines under the project 'New Family of mines' and the project was closed in April 2007 after incurring an expenditure of ₹ 2.51 crore.

Ministry's contention that the project should not be treated as failure, as technologies of sub-munition (AT minelet) developed for 122mm Grad rockets have been transferred to Pinaka for its AT sub-munition warhead development is to be viewed in light of the fact that the aim of the Staff project was development of RDMS based on existing 122mm GRAD Rocket and not technology development of sub-munition for PINAKA.

Case II: Design and Development of Universal Variable Time Fuze for Guns

Based on GSQR, DDRD in January 1998 sanctioned this Staff project at an estimated cost of ₹ 3.20 crore with PDC as January 2001 which was extended up to March 2004 by grant of two PDC extensions. DDRD granted further extension of PDC up to 31 March 2006 on ARDE's proposal on the ground that development was almost 90 *per cent* complete, halting at this stage and under taking a new project would hinder its pace.

Despite three PDC revisions up to March 2006, ARDE was unable to develop the fuze in time due to technological problems in designing the system, resulting in closure of the project from 31 March 2006 after incurring an expenditure of ₹ 1.88 crore.

Ministry's contention that the expenditure of ₹ 1.88 crore has not been unfruitful as the sub-systems and technologies developed during the project tenure shall be utilized in future development of proximity fuzes does not justify the fact that the objective of the Staff project of development of deliverable in the form of Universal Variable Time Fuze was not achieved.

Case III: Development of Ammunition for various Artillery systems

In accordance with the GSQR of April 1995, DDRD in January 1998 accorded sanction for development of ammunition for various artillery systems i.e. 155mm, 130mm, 105mm guns, 120 mm mortar and 122mm GRAD rocket at an estimated cost of ₹ 16.35 crore. The PDC was January 2002.

Since Army had gone for import of ammunition for 155 mm guns, DRDO took up development of 130 mm ammunition on priority. As ARDE could not develop the ammunition within the PDC, it requested DRDO HQ for extension of PDC which did not materialize. In the meanwhile, the User decided to import 130mm ammunition too and DRDO HQ decided to short close the current Staff project and take up a technology development project to establish the technologies needed. Accordingly the project was short closed from January 2002 with an expenditure of ₹ 2.79 crore.

DDRD in February 2003 sanctioned two separate technology development projects one for technology demonstration of sub munition projectile for 130 mm caliber and the other for design and development of fuze DA/SD³¹ for non spinning sub munition at a cost of ₹ 4.72 crore and ₹ 2.19 crore respectively to be completed by February 2005. Neither project could be completed within the original PDC. As further extensions were not forthcoming, both were closed from February 2005, after incurring an expenditure of ₹ 1.67 crore and ₹ 28.07 lakh, respectively.

³¹ Direct Action/ Self Destructing

The frequent sanctions and closures indicate that the complexities of the technologies involved in the development of the above three projects were not fully addressed before undertaking them. Resultantly, ARDE was unable to develop the ammunition and the projects had to be closed without achievement of any deliverables in spite of having incurred an expenditure of ₹ 4.74 crore. In reply, Ministry stated that all projects sanctions are given after due vetting of statement of cases. The experience gained on this project was utilized for development of ammunition for Pinaka system. The reply of Ministry is not tenable as the purpose of development of ammunition for various artillery systems given in GSQR remains unfulfilled.

7.3 Absence of a mechanism to correlate success or failure of projects

In ARDE there was no mechanism in place to relate success or failure of Projects with personnel deputed on them, which could facilitate the assessment of the output of Scientists/Technical Officers. This is evidenced from the fact that despite repeated requests, the lab could not furnish any data regarding Scientists and Technical Officers deployed on various projects and their output in terms of success or failure of the project and expertise gained.

ARDE in its reply agreed that for the initial years of the period covered by audit, the information correlating the success and failure of a project to personnel or individuals is not available in the data base and maintaining this information is a difficult exercise though possible. Though ARDE further claimed that all project related information regarding the achievement of technologies established and manpower involved is documented in the Technical Closing Reports of the projects, however ARDE could not furnish this information even for the past five years.

Ministry stated in February 2011 that Design and Development of projects is a dynamic process and manpower deployment changes depending on stage of the project. R&D project is obviously a team works either within a Lab or multi disciplinary involving other DRDO Labs. In view of this it will not be feasible to correlate success and failure of project to an individual.

While the reply clearly endorsed the view point of audit that ARDE had no mechanism in place to assess the output of its human resource deployed on project activities, it also indicated lack of accountability of personnel towards success or failure of the projects.

7.4 Understatement of project cost due to exclusion of Manpower Cost

As manpower cost of regular establishment forms a significant portion of the expenditure of the Laboratory, exclusion of manpower cost of regular establishment results in highly understating the project cost. Further, it also results in understatement of cost overrun in cases of delayed projects.

Audit analysis in this regard revealed that during the period 2004-05 to 2008-09 year-wise expenditure incurred on Pay & Allowances of regular establishment of ARDE ranged between 36 *per cent* and 54 *per cent* when compared to the overall expenditure of the ARDE as indicated below:

Percentage of Pay & Allowances to total expenditure

Year	Total Expenditure (₹ in crore)	Expenditure on Pay & Allowances (₹ in crore)	Percentage w.r.t Total expenditure
2004-05	48.28	25.98	53.80
2005-06	49.35	25.80	52.27
2006-07	54.00	26.61	49.27
2007-08	77.44	27.98	36.12
2008-09	92.03	43.54	47.31
Total	321.10	149.91	46.68

Ministry stated in February 2011 that the project manpower is merged with the Peace Establishment of the Lab/Establishment. Hence this objection is not valid.

Ministry's reply needs to be viewed in the context that the core functions of the Lab are the projects and the scientific and technical manpower are dedicated to the projects. Hence project costs should include the manpower cost, particularly because substantial portion of the expenditure of the laboratory comprises of manpower costs.

7.5 Conclusion

DRDO needs to acknowledge and address the reasons for the high failure rate of Staff projects, failing which its credibility as a R&D organisation will be at risk. The organisation which has a history of its projects suffering endemic time and cost overrun needs to sanctions projects and decides PDCs on the basis of a conservative assessment of technology available and a realistic costing system. The success or failure of projects should be identified with the Scientists working on them so as to decide on their future assignments. The Ministry should fix responsibility in cases where PDC extensions become necessary due to overstating the capabilities available or failure to account for the complexities of technologies.

The matter was reported to the Ministry in December 2010. The Ministry in its reply of February 2011 has broadly agreed with the facts brought out in the paragraph but differed in some cases with the conclusions drawn from these facts. Replies of the Ministry have been suitably incorporated.