

## CHAPTER VI: PROJECT MANAGEMENT IN VEHICLE RESEARCH AND DEVELOPMENT ESTABLISHMENT

### 6. Project Management in Vehicle Research and Development Establishment, Ahmednagar and Combat Vehicles Research and Development Establishment, Avadi

Staff projects taken up for delivery of products required by Defence Forces during the period April 1998 to March 2013 met with varying success. Two Staff projects were closed at CVRDE during April 1998 to March 2013 out of which one project was undergoing Transfer of Technology but was yet to be productionised. In another project though the system developed was accepted by the user, yet the project could not be productionised due to imposition of ban on the foreign vendor. At VRDE, of the nine closed projects during April 1998 to March 2013 only one underwent productionisation. Another project though stated to have been successfully completed by VRDE, yet the details of acceptance by the user leading to induction into Service could not be produced by the lab. Third project partly achieved the project requirement and the remaining six projects could not achieve success in terms of acceptance by the users. Initiation of projects without firm General Staff Qualitative Requirement, failure of the laboratory to develop the desired deliverables and defective planning were the main reasons for failure. The status of Technology Demonstration projects undertaken by the two labs was also not encouraging as 36 out of 51 closed projects did not lead to the utilisation of such technology in Staff projects.

#### 6.1 Introduction

Defence Research and Development Organisation (DRDO) is the prime and largest government organization engaged in Research and Development (R&D) for the Defence Services viz., Army, Navy and Air force. Two of its laboratories (labs), viz., Vehicle Research and Development Establishment (VRDE) Ahmednagar and Combat Vehicles Research and Development Establishment (CVRDE) Avadi fall under the discipline/cluster of Combat Vehicles.

VRDE is mandated with the design and development of light tracked vehicles for combat and specialist roles up to 25 ton class, wheeled vehicles piston and rotary engines for Aeronautical use in Unmanned Aerial Vehicles (UAVs) and trainer aircraft, all types of UAVs from 10 kg to 150 kg All Up Weight (AUW). Amongst its major achievements are design and development of the

Armoured Engineer Recce Vehicle on BMP<sup>69</sup>-II; Nuclear Biological Chemical (NBC) Recce Vehicle; Loader Cum Replenishment (LCR) Vehicle and Replenishment Vehicle (RV) for PINAKA, MBRLS; Jet Deflector Vehicle, Communication Vehicle (Mk-I & II), Special Purpose Transporter for SF&D (AI) Project.

CVRDE is mandated with design and development of Tracked Armoured Fighting Vehicles. Amongst its major achievements are design and development of Main Battle Tank Arjun MK-I, Armoured Patrol Car, Armoured Recovery Vehicles, 130 MM Self Propelled Gun-Catapult and Carrier Mortar Tracked on BMP-II Vehicle, Combat Improved Ajeya *etc.*

### **Organisational set-up of the two labs**

The DRDO functions under the Department of Defence Research and Development (DDR&D) of the Ministry of Defence (Ministry) and is headed by the Scientific Advisor to the RakshaMantri (SA to RM). The labs of the DRDO are organized into seven clusters based on technology domain and are headed by respective Director Generals. CVRDE and VRDE, both, function under the technical control of the Director General of Armaments and Combat Engineering Systems and are headed by a Director.

Director VRDE is assisted by Heads of Departments (HOD) heading six Project Groups *viz.*, Wheeled Vehicle Division (WVD), Tracked Vehicle Division (TVD), Vehicle Electrical Electronics Division (VEL), Mechanical Engineering Division (MED), Specialist Vehicle Division (SVD) and Engine Development Group (EDG). The laboratory activities are also supported by Management Information Group (MIG), Material Management Group (MMG), National Centre for Automotive Testing (NCAT), Vehicle Management (VM), *etc.*

Director CVRDE is assisted by Additional Directors heading 11 Project groups *viz.*, Vetrionics, Reliability and Quality Assurance (R&QA), Fire Control System, Main Battle Tank (MBT), Transmission, Engine, Simulator, Gun Control Systems, Specialist Vehicle, Running Gear and Robotics. The laboratory activities are also supported by Project Management Group, Mechanical Transport, *etc.*

VRDE and CVRDE deploy about 589 and 1,254 personnel respectively including Scientists, Technical Staff, Service Personnel and Allied Staff. During the past five years from 2008-09 to 2012-13, the expenditure on pay and allowances amounted to ₹ 131.31 crore in respect of VRDE and ₹ 354.26 crore in respect of CVRDE.

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<sup>69</sup> Boyevaya Mashina Pekhoty (BMP).

## **Types of Projects**

To achieve their respective mandates, both the labs mainly undertake two kinds of projects viz., Staff projects and R&D/TD projects.

### ***I: Staff Projects***

As per the DRDO's Technical Standing Orders (TSO) for R&D Organisation (August 1975) and DRDO's IX and X Five Year Plans, Staff projects are high priority projects based on well-defined user-requirements in terms of Qualitative Requirement (QR), deliverables and time frame. These projects are expected to culminate in the induction of the systems in the Services within a specified time frame.

### ***II: Research & Development/Technology Demonstrator (R&D/TD) Projects***

(a) R&D Projects, as per the TSO, are general competence build up projects in a given area of research or to solve specific problems arising out of or having a bearing on Staff projects.

(b) Technology Demonstration (TD) projects, as defined in DRDO's IX and X Five Year Plans, are planned in the areas where user's requirement is known but the technology is not yet matured for taking up a Staff project with well-defined cost and time frame. TD projects form basis of taking up user oriented future projects and are expected to be converted into deliverables in three to five years.

## **R&D endeavour of the labs in the past 15 years**

During the period covering April 1998 to March 2013, VRDE and CVRDE undertook 17 Staff and 70 R&D/TD projects at a cost of ₹ 162.84 crore and ₹737.38 crore respectively. Out of these, 11 Staff and 56 R&D/TD projects were closed at a cost of ₹ 29.73 crore and ₹ 272.19 crore respectively. Remaining six Staff and 14 R&D/TD projects were still in progress as on 31 March 2013 as detailed in **Annexure-IV**. Thus, in terms of expenditure DRDO had focused their efforts in these two labs on R&D/TD projects and lesser contribution towards user oriented Staff projects.

## **6.2 Scope of Audit**

We examined the project management of all the Staff and R&D/TD projects closed by VRDE (nine) and CVRDE (two) during the past 15 years *i.e.*, from 1 April 1998 to 31 March 2013, including closed sub-projects taken up by these labs on behalf of other sister DRDO labs as detailed in **Annexure-V**. The process leading to procurements made by the two labs did not form part of the scope of audit. We did not include classified projects undertaken by the

labs either. Examination of manpower, budgetary allocations and expenditure was restricted to past five years *viz.*, 2008-09 to 2012-13.

### **6.3 Audit Objective**

Audit objective was to make an independent evaluation of the success achieved by VRDE and CVRDE in their respective R&D endeavour. As such audit was carried out with a view to examine whether:

- i) the deliverables expected from Staff projects were successfully developed within the sanctioned cost and time, leading to its acceptance by the users and sound budgetary practices were followed in managing the projects;
- ii) the R&D/TD projects resulted in tangible product developments;
- iii) database indicating the area of expertise of each of its scientific/technical manpower was maintained for efficient deployment of manpower; and
- iv) the National Centre for Automotive Testing (NCAT) at VRDE is functioning effectively and efficiently.

### **6.4 Audit Criteria to determine success of Projects**

Following criteria were adopted for reviewing the performance:

- i) Adherence to the provisions of DRDO's Technical Standing Orders for R&D Organisation issued in August 1975 and Procedures for Project Formulation and Management (PPFM) in DRDO issued in 2006, regarding sanction, execution, monitoring and closure of projects;
- ii) Successful development of systems envisaged under a Staff project with reference to GSQR and its acceptance by the users resulting in introduction of the systems into Service through productionisation; and
- iii) Successful completion of R&D/TD projects with reference to qualitative requirements laid down in the project proposal and leading to undertaking Staff projects within 3-5 years as stated in the DRDO's IX and X Five Year Plans.

### **6.5 Audit Methodology**

The audit commenced in May 2013 and was completed in October 2013. Entry Conferences were held with the Directors of the two labs in May 2013 and July 2013 at VRDE and CVRDE respectively. Audit methodology mainly consisted of collection of data, cross verification of the data collected and data analysis. Procedures for sanction and execution of projects were studied and

projects were analysed. Various project related documents viz., project sanction registers, files, proposals, sanctions, user trial reports, minutes of meetings of various project monitoring committees, closure reports and expenditure cards were examined. Status of staff strength and budget provisions was also looked into.

The Draft Report was issued to both the labs in December 2013. The replies to the Draft Report received from VRDE (28 January 2014) and CVRDE (10 February 2014) were suitably incorporated in the Report. Exit Conferences with the respective Directors of the labs were held in February 2014 and their views duly taken into account while finalising the Report.

The matter was referred to the Ministry in June 2014; their reply was awaited (October 2014).

## **6.6 Audit Findings**

### **6.6.1 Non-maintenance of Project documents**

DRDO's instruction (March 1973) regarding retention and destruction of Documents/Records, stipulates that Government sanction for projects need to be maintained on permanent basis. Scrutiny of maintenance of project documents at VRDE revealed that files in respect of Staff projects for development of Multi Barrel Rocket Launcher System (MBRLS) PINAKA, SAMYUKTA<sup>70</sup> (except minutes of board meetings), Under-Carriage System for Air Defence (AD) Gun were not available. In addition, VRDE could not produce project sanctions of other projects<sup>71</sup>. In reply, the Director, VRDE stated that a new Project Management Software was underway which would improve and assist in record keeping. CVRDE however made available the documents called for in audit.

### **6.6.2 Staff Projects**

#### **6.6.2.1 Time overrun in Staff Projects**

The efficacy of project management is measured by delivery of project output within a given time frame and cost. Further, TSO for R&D Organisation (August 1975) and PPFM 2006 stipulate that the PDC of a project should normally not be changed except in very exceptional circumstances. We observed that extension of PDC of projects was a norm rather than an exception at VRDE and CVRDE.

<sup>70</sup> SAMYUKTA is a mobile integrated electronic warfare system developed jointly by DRDO, Bharat Electronics Limited, Electronics Corporation of India Limited and Corps of Signals of Indian Army and is meant for tactical battlefield use.

<sup>71</sup> Projects mentioned at Sl.No.3,13,14,16,17,18,20,23,24 and 26 of Annexure-V

A comment was earlier made in Paragraph 7.2.4 of the Report of the C&AG for the year ended March 2010 (No.24 of 2011-12 on 'Project Management in Armament Research and Development Establishment' (ARDE)) and Paragraph 7.4.4 of the Report of the C&AG for the year ended March 2011 (No.16 of 2012-13 on 'Project Management in Research and Development Establishment (Engineers) (R&DE (E)), regarding excessive time overrun in Staff projects. In the Action Taken Note (ATN) in respect of ARDE, the Ministry stated (November 2012) that DRDO HQ had drawn guidelines for undertaking new projects, monitoring and closure of projects after their successful completion. Further in the ATN in respect of R&DE (E), the Ministry stated (October 2013) that to consciously curtail time over-runs, various mechanisms were in place like (i) regular reviews at various levels, (ii) Project planning, execution and monitoring tools *etc.*, to ensure that the annual objectives were achieved.

We observed that inspite of Ministry's claim regarding various systems being in place to curtail time over-runs, eight<sup>72</sup> (VRDE: six and CVRDE: two) of the total 11 closed Staff projects underwent repeated time extensions (one to five times) resulting in time overrun of six to 173 months. Among the products of these eight projects only two<sup>73</sup> of them were accepted for induction in Service. Non induction of remaining six cases is discussed in Para 6.6.2.5.

We observed that time overrun in five projects<sup>74</sup> was on account of change in scope of the project by the user, to carry out the modifications suggested by the user in various trials and delay in fabrication of vehicle. In respect of three projects<sup>75</sup> (sub-projects of other DRDO labs), at VRDE, connected documents were not available with them.

In reply, Director VRDE stated that shortcomings regarding excessive time and cost overrun was being addressed seriously with periodic reviews of projects, implementation of project management software and greater quality checks and reviews at all stages of design and development to achieve success in the first attempt itself. No specific comments were offered by the Director CVRDE, who simply intimated reasons for PDC overrun in both of its Staff projects.

For ensuring completion of the project as per schedule, Decision Aid to Technology Evaluation (DATE) analysis has been implemented since 2002. We observed that inspite of the assurance most of the Staff projects (*i.e.*, eight out of the 11 closed Staff projects) were inordinately delayed.

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<sup>72</sup>Projects mentioned at Sl.No.1,2,3,4,5,8,10 and 11 of Annexure-V

<sup>73</sup>Projects mentioned at Sl.No. 1 and 11 of Annexure -V

<sup>74</sup>Projects mentioned at Sl.No.2,4,8,10 and 11 of Annexure-V

<sup>75</sup>Projects mentioned at Sl.No.1,3 and 5 of Annexure-V



### 6.6.2.2 Continuanace of Project activities after formal closure of the Project

As per the PPFM, no expenditure should be incurred in the project after formal closure of the project. We however observed that in seven<sup>76</sup> out of the total 11 closed Staff projects, activities like technical/user trials and related modifications were carried out after closure of the projects thus making project closures a mere formality. Further, carrying out user trials after closure of the projects precludes inclusion of the expenditure incurred on such trials and related activities, in the project cost, thereby understating the project expenditure, as was witnessed in two of the seven closed Staff projects examined by us. The details of expenditure incurred on such trials and related modifications in respect of other five projects<sup>77</sup> were not made available to us. Further, inspite of incurring expenditure on project activities after closure of the project, the two projects did not meet the user's requirement as mentioned subsequently under Para No.6.6.2.5(a) (Case-I)and under Para 6.6.2.5(c) below.

### 6.6.2.3 Cost overrun in Staff projects

A comment was made in Paragraph 7.5 of the Report of the C&AG for the year ended March 2011 (No.16 of 2012-13) on 'Project Management in Research and Development Establishment (Engineers) (R&DE (E)), regarding cost overrun in Staff Projects. No specific reply to our comment regarding cost over-run in Staff Projects was given in the ATN. However the Ministry mentioned that time and cost over-runs were due to techno-managerial reasons and despite best co-ordinated efforts, time and cost over-runs were sometimes inevitable due to reasons such as technological uncertainties associated with Research and Development, technological changes and obsolescence, changing user requirements, continuous product improvements, etc.

Analysis of the 11 closed Staff Projects revealed that in four projects<sup>78</sup> pertaining to VRDE, the total cost escalation ranged between 9.84 *per cent* and 107.30 *per cent*. Our analysis of these four projects revealed that only one project (MBRLS PINAKA) completed at 106.70 *per cent* cost escalation was successful in terms of acceptance by the user and underwent productionisation. Another project (SARVATRA) completed at 49.59 *per cent* cost escalation, partially met the user requirement with only one (15m Bridging System Vehicle) of the two Bridging System Vehicles (20m and 15m Bridging System Vehicle) being accepted by the user and undergoing productionisation as mentioned in Para6.6.2.5(c) below. In respect of the other two projects, one project completed at 107.30 *per cent* cost escalation failed to meet the user requirement as mentioned in Para 6.6.2.5(b) below and the other project, completed at cost escalation of 9.84 *per cent*, is yet to be

<sup>76</sup> Projects mentioned at Sl.No.1,2,4,7,8,9 and 11 of Annexure-V

<sup>77</sup> Projects mentioned at Sl.No.1,2,7,9 and 11 of Annexure-V

<sup>78</sup> Projects mentioned at Sl.No.1,2,3 and 4 of Annexure-V

inducted into Service due to non-achievement of the modifications desired by the user in the Limited Series Production (LSP) order placed by the user on VRDE as mentioned in Para 6.6.2.5(d) below.

In reply, the Director VRDE stated that shortcomings regarding excessive time and cost overrun was being addressed seriously with periodic reviews of projects, implementation of project management software and greater quality checks and reviews at all stages of design and development to achieve success in the first attempt itself. However, as seen in audit, the above cited measures adopted by VRDE to address the issue of excessive time and cost overrun were ineffective.

In CVRDE there was no cost overrun in the two Staff projects closed between April 1998 and March 2013.

Since Staff projects are undertaken on the basis of technologies already developed, these projects are likely to witness lower percentage of cost and time overrun as compared to R&D/TD projects which involve more uncertainties and unknown factors. But our scrutiny revealed that as compared to R&D/TD projects, the number of Staff projects with time and cost overrun were markedly more. At VRDE, as against 11.11 *per cent* (four out of 36) closed R&D/TD projects (as mentioned in Para 6.6.3.1 below) which underwent cost escalation, 44.44 *per cent* (four out of nine) closed Staff projects underwent cost escalation. Similarly as against 41.67 *per cent* (15 out of 36) closed R&D/TD projects which underwent time overrun (as mentioned in Para 6.6.3.1 below), 66.66 *per cent* (six out of nine as mentioned in Para 6.6.2.1 above) closed Staff projects underwent time overrun. At CVRDE, as against 85 *per cent* (17 out of the 20 closed R&D/TD) closed R&D/TD projects (as mentioned in Para 6.6.3.1 below) which underwent time over-run both the closed Staff projects had undergone time overrun as mentioned in Para 6.6.2.1 above.

#### **6.6.2.4** *Understatement of project cost due to non-inclusion of Manpower Cost*

Government order (February 1977) stipulates that the pay and allowances of the staff specially required to be recruited for the duration of project be taken into account for computation of cost of a project. It however does not specify inclusion of the cost of pay and allowances (P&A) of regular establishment, though a substantial portion of the overall budget allocations is spent on pay and allowances of the regular establishment of labs.

Comments were made in Paragraph 7.4 and Paragraph 7.8 of the Report of the C&AG of India, No.24 of 2011-12 and No.16 of 2012-13 regarding non-inclusion of regular manpower cost in the project cost. While the Ministry was silent about this issue in its ATN against Report No.24 of 2011-12, yet in the ATN in respect of Report No.16 of 2012-13 it was stated that both project and



the manpower cost were borne by the same Department/Ministry. However, the Ministry further stated that a suitable method of apportioning manpower cost for computation of the actual cost of a project was being explored.

Our analysis at VRDE and CVRDE revealed that during the period 2008-09 to 2012-13, the year-wise expenditure on pay and allowances of regular establishment *vis-a-vis* the overall expenditure, ranged between 43 *per cent* and 66 *per cent* but the labs continued to book the expenditure separately without charging the same to the project. Manpower cost of regular establishment forms a significant portion of the total expenditure of the labs, exclusion of manpower cost of regular establishment results in highly understating the project cost and cost overrun in respect of delayed projects.

In reply, Director VRDE stated that the decision regarding inclusion of permanent manpower cost of the lab in project costing has to be taken by DRDO Headquarters. Director CVRDE stated that inclusion of manpower cost is not part of the PPFM and therefore not incorporated as a part of the project proposal and execution.

#### **6.6.2.5** *Non-achievement of objectives of Staff projects*

Staff projects are undertaken on the basis of General Staff Qualitative Requirement (GSQR) projected by the user and are sanctioned in accordance with the procedure laid down in the TSO and PPFM. The objective of these projects is to culminate in the induction of the systems in the Services within a specified time frame. All projects have an integrated review and monitoring mechanism approved by the Competent Authority at the time of sanctioning the project, for reviewing the overall progress of the project.

We observed that though review and monitoring mechanism was in place and was being adhered to at both the labs, the number of projects which finally resulted in induction into the Services through productionisation was not encouraging as described below;

Of the two Staff projects closed during the review period by CVRDE, one project<sup>79</sup> after successful development at a cost of ₹ 6.68 crore was recommended for introduction into Service by the users and was undergoing Transfer of Technology (ToT) (February 2014). The other project though accepted by the user, did not result in production, due to imposition of ban on the foreign vendor as mentioned under Para 6.6.2.5(e) below.

In respect of VRDE, the success rate of closed Staff projects in terms of achievement of its objective was low, as out of the nine closed Staff projects, only one<sup>80</sup> project underwent induction into Service through productionisation (March 2006). Another project witnessed part achievement with only one of

<sup>79</sup>Projects mentioned at Sl.No.11 of Annexure-V

<sup>80</sup>Projects mentioned at Sl.No.1 of Annexure-V

the two systems developed under the project undergoing productionisation as mentioned under Para6.6.2.5(c) below. The claim of success in respect of third project<sup>81</sup> could not be verified by us due to non-availability of project documents during the audit period. All the three projects were sub projects of other sister labs. Balance six Staff projects<sup>82</sup> did not achieve the objective of induction into Services through productionisation.

### **Reasons for non-achievement of objectives of Staff projects**

As a result of scrutiny of closed Staff projects at VRDE and CVRDE, we observed that the failure of the two labs in achieving the objective of a Staff project of induction into Services through productionisation were due to following reasons:

- (a) Taking up projects without a GSQR (VRDE: two projects);
- (b) Failure in development of the engine for Aerial applications (VRDE: one project);
- (c) Premature closure of the project resulting in part achievement of project requirement. (VRDE: one project);
- (d) Delay in completion of LSP order (VRDE: one project); and
- (e) Imposition of ban on the Foreign Vendor by the Ministry (CVRDE: one project).

The reasons for failure of the Staff projects in achieving the objective of induction into Services through productionisation, enumerated above, were similar to what was observed by us in ARDE and R&DE (E) and reported in Paragraph 7 of Report No.24 of 2011-12 and Paragraph 7 of Report No.16 of 2012-13, respectively. The Ministry in the ATN on Paragraph 7 of Report No.24 of 2011-12 had stated that DRDO HQ had drawn guidelines for undertaking new projects, monitoring and closure of projects after their successful completion. Further, the Ministry in the ATN on Paragraph 7 of Report No.16 of 2012-13 had stated that as a remedial measure, more periodic reviews with user and implementation of effective Integrated Management System for compliance of guidelines and to meet the timelines of the projects would be undertaken. We observed that an effective Integrated Management System for compliance of guidelines and to meet the timelines of the projects was yet (February 2014) to be implemented at both the labs. Also, we observed that no new guidelines for undertaking new projects, monitoring and closure of projects after their successful completion had been issued so far. (February 2014)

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<sup>81</sup>Projects mentioned at Sl.No.5 of Annexure-V

<sup>82</sup>Projects mentioned at Sl.No.2,3,6,7,8 and 9 of Annexure-V

The above referred six Staff projects, which did not meet the objective of induction into Services through productionisation, are discussed below:

**(a) Taking up projects without a GSQR**

Staff projects are to be undertaken on the basis of the requirement projected by the Services in the GSQR stipulating the functional and operational characteristics of the proposed equipment, the time frame for its development along with prototypes required for trials. As such formulation of the GSQR is of prime importance for undertaking a Staff project. We observed during the audit of VRDE, sanctioning of Staff projects by DRDO without waiting for finalisation and issue of the GSQR by the user. The following two cases illustrate our findings.

***Case-I: Development of Loader cum Replenishment Vehicle for Project PINAKA***

VRDE had successfully developed Loader cum Replenishment Vehicle (LCR) for Project PINAKA and by March 2010, 40 LCRs had been supplied for the first four regiments of the Army. Subsequently Army desired (March 2010), VRDE to reduce the overall height of the vehicle to facilitate rail transportation and to increase the operational ceiling height of TATRA vehicle of LCR from the existing altitude of 2,400m to 5,000m for Mountains/High Altitude Area (HAA) deployment for V<sup>th</sup> regiment onwards.

To meet this requirement, Director VRDE in November 2010 sanctioned a Staff project at a cost of ₹ 2.72 crore for development of the LCR Vehicle MK-II, though there was no GSQR for LCR MK-II. Consequently the LCR MK-II developed (July 2012) at a cost of ₹ 2.33 crore was neither trial evaluated nor accepted by the Army, as it had yet to firm up its requirement of the LCR MK-II vehicle. Moreover the LCR MK-II was not likely to be accepted by the user as BEML could not supply TATRA 8x8 vehicle with HAA Kit so as to enable the vehicle to be deployed in high altitude area. The project was therefore closed (July 2012) at an expenditure of ₹ 2.33 crore.

In reply, Director VRDE contended that in case VRDE waited for sanction it would not have been able to deliver in time and such risks were genuine as such it is always endeavoured to be future ready. VRDE's contention is not acceptable as, though there would have been some delay in issue of the GSQR, yet a system developed as per a GSQR would have ensured its acceptance by the Army. At present the LCR developed by VRDE has neither been trial evaluated nor accepted by the Army.

***Case-II: Development of BMP Urban Survival Kit (BUSK)***

Army in January 2010 prepared a feasibility study report for development of Urban Survival Kit for BMP for the Indian Army. Based on this feasibility study report, Director VRDE in January 2011 sanctioned a project for development of an Urban Survival Kit for BMP at a cost of ₹ 0.68 crore though there was no GSQR for the same. Consequently the BUSK developed (July 2011) at a cost of ₹ 0.42 crore was not accepted by the Army as it's requirement was of a BUSK which could withstand fire from 84mm Rocket Launcher (RL), 14.5mm and 7.62 B 32 Ammunition whereas the BUSK developed by VRDE was capable of providing protection against 14.5 Armour Piercing Incendiary (API) B 32 ammunition and Rocket Propelled Guns (RPGs) only.

Director VRDE in reply stated that cases like 'BUSK' would be avoided in future.

**(b) Failure in development of the engine for Aerial applications**

Even after passage of almost 11 years, VRDE was unable to develop Two-Stroke Light Weight Engine for Remotely Piloted Vehicle (RPV) application due to certain technical problems.

***Development of Two-Stroke Light Weight Engine for Remotely Piloted Vehicle (RPV) application***

Against a sub-project allotted (August 1992) to VRDE by Aeronautical Development Establishment (ADE), Bangalore at a revised cost of ₹ 1.21 crore, for development of Two-Stroke Light Weight Air Cooled Engine for Remotely Piloted Vehicle (RPV) with power output of 38-40 hp and engine weight of 12-16 kg, VRDE developed (March 2003) three types of engines viz., (i) single-cylinder, two-stroke, air cooled (ii) Twin-cylinder horizontally opposed two stroke, air cooled, (iii) Four-cylinder horizontally opposed, two stroke, air cooled engine at a cost of ₹ 1.16 crore. However none of the engines met the user's requirement of power output (38-40 hp) and engine weight (12-16 kg). The single-cylinder two-stroke engine had maximum power output of 11 hp and the twin-cylinder two-stroke engine had the power output of 21 hp. Though, the four-cylinder two-stroke engine had the power output of 38 hp but during the various ground and endurance tests carried out by ADE, Bangalore the engine failed because of failure of the crankpin/crank shaft.

Director VRDE, while accepting that the project had failed, contended that the experience gained while attempting development of the two stroke engine for RPV was very useful in subsequent project for development of Rotary Engine and as such efforts in terms of time and cost have proven its worth. The VRDE's contention is not acceptable as the aim of the subject Staff project

was development of certain deliverables *i.e.*, light weight two-stroke engines for RPVs, for induction into Service, which had not been met. Further the project taken up for Development of Rotary Engines by VRDE was a Technology Development Project and not a Staff project.

**(c) Premature closure of the project resulted in shortfall in achieving the target requirement**

The equipment/systems developed by DRDO are inducted into the Services based on its performance during trials by the user and the project is considered for closure. In the event of user suggesting further trials/modifications, the project activities are continued, to achieve the desired results. However, closure of the projects by DRDO even before validation in trials on the grounds of having successfully developed the system precludes its acceptance by the user and introduction into Service. This not only negates the investment made in time and money on development of the equipment but also adversely impacts the user's requirement especially if the project envisages development of two systems to be used in conjunction with each other to enhance the capability of the system as a whole as detailed below.

***Development of Bridge Assault Mechanically Launched (SARVATRA)***

Army's requirement was of five span bridging system comprising of 15m and 20m bridging systems complementary to each other and to be used in conjunction with each other so as to bridge gaps from 15m to 100m. To meet this requirement, R&DE (E), Dighi undertook a project for development of Bridge Assault Mechanically Launched 'SARVATRA' in December 1992 and in February 1993 allotted a sub project to VRDE, Ahmednagar for development of suitable vehicles for transport and launching of 15m and 20m long bridges at a revised cost of ₹ 3.77 crore .

The 15m Bridge laying vehicles were accepted by the user and introduced into service but the 20m Bridge laying vehicles were found to be unsuitable for cross country mobility in desert terrain during the user trials and were not accepted. As such the user recommended (March 2001) re-powering of the engine of the prime mover and making the vehicle into 10x10 instead of existing axle configuration of 10x8, but VRDE had already closed the project in December 2000 at a cost of ₹ 3.77 crore. As a result though VRDE expended an amount of ₹ 24.96 lakh out of Build-up funds and ₹ 3.62 lakh out of another Project for Integrated Transfer of Technology (closed in October 2004), on re-powering of 20m Bridging System vehicle with an axle configuration of 10x8, but since the Army's requirement was of vehicle with 10x10 axle configuration, the same was again turned down (November 2004) by the user. As a consequence, the 'SARVATRA' Bridging system offered to the user was capable of bridging gaps of only 75m (15m x 5 span) whereas the user requirement was of bridging gaps up to 100m (20m x 5 span).

Director VRDE in reply, stated that 10x10 vehicles were not available during that period and as such non availability of technology had led to the above mentioned situation. The reply is not tenable since VRDE had as early as in December 1998 informed the user that re-powering of vehicle by 425 hp engine was being planned for 10x10 vehicle which would enhance the power to weight ratio and result in high mobility and high payload of the vehicle.

**(d) Delay in completion of Limited Series Production (LSP) order**

Prototypes accepted for introduction into service by users are expected to be promptly followed by transfer of technology by the designer to the production agencies for their bulk production. Where the accepted prototypes are stipulated to undergo further modifications, the post development activities follow the route of Limited Series Production (LSP) before entering into the phase of Series Production (Bulk Production) for delivery to the Services. Mismanagement and/or delay in the LSP Phase by the designer not only nullifies the efforts of the designer in developing the system but also results in non-availability of the system to the users thereby delaying their induction into Service. The delay in LSP Phase may also result in import by users, to meet their immediate requirement. In the case illustrated below, the LSP order suffered inordinate delay in development/ modifications of the system as per the users requirement. The delay in completion of the LSP order by the lab resulted in import of the system by the user to meet its immediate requirement:

***Development of variants on BMP- II***

Against a project sanctioned by DDR&D in January 1990, VRDE had successfully developed (June 1998) Armoured High Mobility Logistic Carrier (Ammunition), Armoured High Mobility Logistic Carrier (FOL) and Armoured Amphibious Dozer on BMP-II at a cost of ₹ 0.62 crore. Though AHMLC (FOL) and AHMLC (Ammunition) were not inducted into Service as the Army in March 1994 directed these variants be kept as reference vehicles, but the AAD was accepted for introduction into service by the Army in December 2001 as MK-I version, subject to certain modifications to Floatation, Mobility, Earth Moving Capability, Rocket Propelled Anchor (RPA), Nuclear Biological Chemical (NBC) protection *etc.*

Accordingly Ministry, in January 2002 placed an order on VRDE for purchase of six AADs at a cost of ₹ 26.94 crore. Though the Pilot sample was required to be offered in 10 months after placement of LSP order by the Ministry, however even after passage of more than 12 years since issue of LSP order, the equipment was yet (February 2014) to undergo bulk production and induction into Service because of inability on the part of VRDE to achieve the modifications desired by the user in the LSP unit. As a consequence, user per force had to consider importing the equipment to meet its urgent operational requirement. Moreover, VRDE incurred an additional expenditure of ₹ 2.07 crore to re-configure the First off Production Model (pilot sample) to



acceptable level of users, which was likely to adversely affect the production cost of the LSP order for AADs.

Director VRDE in reply stated (January 2014) that the recommendations of time bound development activity and understanding post development issues urgently had been noted down and would be kept in mind for future projects, however placing/execution of LSP order is conjunct to the commitment of funds by the user and acceptance by the Production agencies (Ordnance Factories) based on their own schedules, hence the delay was not entirely the fault of the lab. The reply is generic in nature and as such is not acceptable in audit.

**(e) Imposition of ban by the Ministry on the foreign vendor**

Dependency on a particular foreign vendor(s)/firm(s) for any technology carries the risk of non-availability of the foreign technology at a later date leading to non productionisation of a system developed. As commented in the following case, unforeseen circumstances like imposition of ban on the foreign vendor by the Ministry rendered the efforts of the developing agency fruitless despite successful development of the system by the DRDO in collaboration with the foreign vendor and acceptance of the same by the user.

***Development of Self-propelled Gun system***

DDR&D sanctioned (April 1998) a project for “Development of 155 mm SP Gun System” named BHIM T6 to integrate T6 Turret of M/s LIW (DENEL), South Africa and AS 90 turret of M/s VSEL, UK on to Arjun derivative chassis and offer the resulting two SP Gun systems for user evaluation at a cost of ₹ 3 crore. The user trials of the BHIM T6 developed by integrating T6 turret of M/s LIW (DENEL) onto Arjun derivate chasis, under the project were carried out in July-August 1998 and recommended for induction into service in November 1999, after successful trial evaluation. As the integration and user Trial evaluation of 155 mm SP Gun was successfully completed, the project was closed (12 April 2000) at an expenditure of ₹ 0.60 crore.

For integration of AS 90 turret system on Arjun MBT, though in the initial phases, M/s VSEL had been interacting with CVRDE to finalise the chassis/turret interface design, but their interaction gradually tapered off. Thus, due to non-participation of M/s VSEL with AS 90 turret, the fielding and trial evaluation of SP Gun was limited to BHIM T6 only.

M/s BEML was nominated as the production agency in 2002 and the price negotiation went up to 2004. However, further pursuit of tie-up with M/s DENEL had to be cancelled due to imposition of ban in June 2005 by the Ministry on all contracts with M/s. LIW (DENEL) on alleged payment of agency commission to a British agent. As such in the absence of turrets from M/s DENEL, BHIM T6 could not be productionised.

In reply, Director CVRDE stated (10 February 2014) that the product was found (December 1999) to be successful and recommended (December 1999) for induction by the user and finalisation of the Production Order was the responsibility of the user, in which there was no role to be played by CVRDE.

Thus due to imposition of ban on the foreign vendor by the Ministry, efforts of the developing agency were rendered fruitless despite successful development of the system by the DRDO and acceptance by the user.

### **6.6.3 Research & Development (R&D) and Technology Demonstration (TD) Projects**

During the period under review VRDE undertook 41 R&D/TD Projects (including projects in hand as on 1 April 1998) sanctioned at a cost of ₹ 279.04 crore, out of which 36 projects were closed<sup>83</sup> at an expenditure of ₹ 100.23 crore and five were on-going as on 31 March 2013. Similarly, CVRDE undertook 29 R&D/TD projects (including projects in hand as on 1 April 1998) sanctioned at a cost of ₹ 458.34 crore, out of which 20 projects were closed<sup>84</sup> at an expenditure of ₹ 171.96 crore and nine were on-going projects as on 31 March 2013 (**Annexure-IV**).

#### **6.6.3.1 Cost and Time overrun in R&D/TD Projects**

Of the 36 projects closed by VRDE, four projects involved cost overrun<sup>85</sup> which ranged between ₹ 0.36 crore and ₹ 1.5 crore and was mainly on account of change in scope of work and increase in the estimated cost of subsystems. There was no cost over-run in the 20 R&D/TD projects closed by the CVRDE.

32 projects (VRDE: 15<sup>86</sup>, CVRDE: 17<sup>87</sup>) showed time over-run ranging between two months and 66 months. The main reasons for time overrun were delay in conducting trials, increase in scope of work, delay in completion of the development activities, delay in procurement and changes/modifications suggested during the course of the project.

In reply, Director VRDE stated that further improvements to minimise the time and cost overrun were being made. Director CVRDE stated that although all efforts are made to complete the projects in time, the time delay is inevitable as various unknown factors influence R&D projects in execution.

<sup>83</sup> Projects mentioned at Sl.No.12 to 47 of Annexure-V

<sup>84</sup> Projects mentioned at Sl.No.48 to 67 of Annexure-V

<sup>85</sup> Projects mentioned at Sl.No.12,15,34 and 40 of Annexure-V

<sup>86</sup> Projects mentioned at Sl.No.12,14,18,19,24,27,32,33,34,36,38,39,40,41 and 43 of Annexure-V

<sup>87</sup> Projects mentioned at Sl.No.48 to 59,61,62,64,65 and 67 of Annexure-V

### 6.6.3.2 Degree of success achieved in R&D/TD Projects

R&D and TD projects are expected to eventually find application in Staff projects. Moreover such projects have the potential of creating a certain extent of intellectual property that is patentable. Scrutiny of 36 R&D/TD projects closed by VRDE at an expenditure of ₹ 100.23 crore revealed that 25 projects closed<sup>88</sup> at an expenditure of ₹ 89.14 crore did not find application in Staff projects, nor were any patents filed on the basis of research carried out under these projects, except in one case<sup>89</sup> where the patent was filed in respect of one of the technologies *i.e.*, ‘Hydro mechanical steering system using rack & pinion system’. Out of the balance 11 projects, five R&D/TD projects were sub-projects of other DRDO labs which were successfully completed<sup>90</sup> and the Systems developed were handed over to the main project holders. Three projects found application<sup>91</sup> in Staff Projects, one involved development of instruments and calibration facilities for NCAT which was successfully completed balance two involved work like documentation, trial & evaluation of vehicles *etc.*, which were not aimed to culminate into staff projects.

At CVRDE, our scrutiny revealed that of the 20 closed projects, five projects<sup>92</sup> involved ToT or preparation of drawings for ToT and did not involve any research activity. These projects were closed at an expenditure of ₹ 16.77 crore. Of the balance 15 R&D projects, 11 projects closed<sup>93</sup> at an expenditure of ₹ 115.39 crore did not find application in any Staff project. Three projects were closed<sup>94</sup> successfully after incurring a total expenditure of ₹ 39.80 crore and production order/Staff project was placed by the user/undertaken by CVRDE. One project was short-closed<sup>95</sup> without incurring any expenditure as user did not evince interest in the same.

Further analysis of these projects by us revealed that main reasons for the technologies successfully developed under various R&D/TD projects not finding application in any of the Staff projects were either lack of user requirement or the system developed not meeting the users requirement of the system. This is indicative of lack of co-relation between users’ requirements and the Research activities undertaken by the lab. Since these R&D/TD projects were mostly taken up on DRDO’s own initiative and the envisaged end users of the technologies/systems developed under the R&D/TD projects being the Armed Forces, it would have been more prudent had the projects been undertaken after ascertaining the requirements/futuristic requirements of the end users.

<sup>88</sup>Projects mentioned at Sl.No.12,16 to 28,30,31,34,35,37,38,39,43,45,46 and 47 of Annexure-V

<sup>89</sup>Projects mentioned at Sl.No.35 of Annexure-V

<sup>90</sup>Projects mentioned at Sl.No.32,33,40,41 and 42 of Annexure-V

<sup>91</sup>Projects mentioned at Sl.No.15,36 and 44 of Annexure-V

<sup>92</sup>Projects mentioned at Sl.No.48,49,51,59 and 62 of Annexure-V

<sup>93</sup>Projects mentioned at Sl.No.52,53,54,56,57,58,60,63,64,65 and 67 of Annexure-V

<sup>94</sup>Projects mentioned at Sl.No.50,55 and 61 of Annexure-V

<sup>95</sup>Projects mentioned at Sl.No.66 of Annexure-V

In reply, Director VRDE stated that for technology demonstration projects, irrespective of the immediate use of the technology, there is a need to continue working on the similar technology areas for their upgradation/performance improvements so that the labs achieve domain excellence in the selected areas and keep themselves fully armed for the futuristic needs of the users by way of achieving experience and expertise in the particular area. It was further stated that in most of the cases even when the complete system developed under TD project does not get into a Staff project, the sub-systems developed do find application in other projects. However, the contention is not acceptable as in terms of the definition of TD projects given in DRDO IX and X Five Year Plans, these projects form basis of taking up user oriented future projects and are expected to be converted into deliverables in three to five years. We however found in audit that none of the systems developed under these projects had resulted in undertaking of a Staff project to meet the user's (Armed Forces) requirement. Further in most of the R&D/TD projects undertaken by VRDE, the aim of the R&D/TD projects was not just development of certain enabling technologies/sub-systems/components but development of a prototype of the system/equipment.

In reply, Director CVRDE contended that GSQR is generally provided for major system broadly defining its functional requirements. He further stated that the user neither provides GSQR nor specifications for many sub-systems involved in the major systems such as tank. Under the circumstances sub-systems/components are developed under R&D/TD projects and directly incorporated in Staff product. However, no such instances of incorporating sub system components in major systems were observed in audit.

In the ATN to Report No.16 of 2012-13, the Ministry stated that constant interaction with users in the form of Quarterly Interaction Meeting and reviews at different levels is a part of the project execution process. Also the user is involved in the Peer Review Committee Meeting prior to the project sanction. The Ministry's reply is not acceptable since at VRDE, we did not come across any minutes of Quarterly Interaction Meeting held by VRDE with the users in respect of R&D/TD projects undertaken by VRDE. Further Ministry's contention that user is involved in the Peer Review Committee Meeting prior to the project sanction is also not correct as user was not involved in the Peer Review Committee Meeting in respect of R&D/TD Projects undertaken by VRDE. Further in two R&D/TD Projects the Peer Review was not at all conducted.

Thus in spite of the systems/equipment having been developed successfully as per the project closure reports by VRDE and CVRDE, the same were either not required by the user or did not meet the user's requirement indicating lack of co-relation between users' requirements and the Research activities undertaken by the labs, as illustrated in **Cases 1 to 11** below:

Table-12: Successfully developed TD/R&amp;D projects with no end use

S. No.	Name of the project and objective	Date of sanction / Sanctioned Cost (₹in crore)	Completion cost (₹in crore)	Original PDC/ Revised PDC	Status	Audit comment and Auditees response
1	Design and Development of Futuristic Infantry Combat Vehicle (FICV)	July 1998 <b>38.00</b>	<b>37.37</b>	June 2004 December 2006	Closed in December 2006	<p>DDR&amp;D sanctioned a project for design and development of FICV. Draft GSQR stipulated the requirement of FICV with amphibious capability. The FICV developed by VRDE was however non-amphibious and thus did not meet the users requirement.</p> <p>VRDE in response stated that technologies like power pack packaging, cooling systems <i>etc.</i>, developed under the project were used in the development of AAD MK-I and Counter Mine Flail. The reply is not acceptable since the aim of the project was not just development of sub-technologies but development of a complete system.</p>
2	Development of Unmanned Ground Vehicle (UGV)	February 2004 <b>11.52</b>	<b>10.98</b>	February 2008	Closed in February 2008	<p>DDR&amp;D sanctioned a project for development of UGV. VRDE took up the development of the UGV based on 2.5 ton 'B' vehicle without first consulting the user. The user's requirement was a 50 kg Chemical Biological Radiological Nuclear (CBRN) UGV and hence the UGV developed by VRDE was not accepted.</p> <p>VRDE contented that most of the technologies developed under the TD project were independent of the vehicle platform and could be applied to different categories of UGVs. The reply is not tenable as we observed that another S&amp;T project for development of UGV for NBC reconnaissance had been undertaken by VRDE which indicates that the technologies developed under the project did not meet the user's requirement.</p>
3	Design and development of Extra-long Multi Axle Transporter (ELMAT)	November 1992 <b>4.05</b>	<b>4.00</b>	November 1996 May 1998	Closed in May 1998	<p>DDR&amp;D sanctioned a project for development of ELMAT to transport and launch unusually long military equipment. As the vehicle developed by VRDE was designed to carry and provide launch platform for heavy bridging equipment only, the nomenclature was changed to 'Multi Axle Bridge Carrier'. However even a lapse of 15 years since successful completion of the project; no staff project has been taken up for development of the ELMAT by VRDE, indicating lack of user interest.</p> <p>VRDE stated that the technologies of ELMAT had been implemented in the development of 10x10 and 12x12 vehicle system of Brahmos and that the knowledge base had also been used</p>

						in two other projects viz 'SARVATRA' & 'Wheeled Armoured Platform' (WHAP). The reply is not acceptable as the ELMAT developed by VRDE is essentially a bridge carrier vehicle and the projects SARVATRA & ELMAT were simultaneously sanctioned. The project for development of WHAP is not a staff project but an ongoing TD project.
4	Development of Technologies for Combat Vehicle Systems	December 2002 <b>4.40</b>	<b>3.05</b>	December 2007	Closed in December 2007	<p>DDR&amp;D sanctioned a project for development of five technologies for combat vehicle systems which were successfully developed by VRDE. However, even after lapse of six years since successful completion of the project, the technologies developed under this project did not find application in any staff project, indicating lack of user interest.</p> <p>VRDE stated that Staff projects are taken up on need basis as per users requirement and as and when the requirement was generated, the technology developed under the project would be used. The reply corroborates our comment that user requirement did not exist for the technology developed under the project.</p>
5	Development of Electronic Fuel Injection System for Two Stroke Engines (EFIS)	June 2006 <b>4.95</b>	<b>3.28</b>	December 2008 June 2010	Closed in June 2010	<p>DDR&amp;D sanctioned a project for development of EFIS for two stroke engines. The project envisaged development of Gasoline Direct Injection (GDI) system for two stroke opposed piston engine for aerial applications. This would improve the fuel efficiency and power output for a given Electronic Fuel Injection system incorporated engine against a conventional engine. However, even after three years since successful completion of the Electronic Fuel Injection System for two stroke engines by VRDE, the system did not find application in any staff project indicating lack of user requirement.</p> <p>In reply VRDE stated that the Electronic Control Unit (ECU) technology developed under the project was used successfully in the development of rotary engines for NISHANT UAV and would find applicability in future four stroke engines. The contention is not acceptable as the technology developed under this project was for two stroke engines whereas the engines currently being developed by VRDE (under two projects sanctioned in June 2010 and January 2013) are for rotary engines. Furthermore, development of EFIS for rotary engines was also separately undertaken in the project sanctioned in January 2013.</p>
6	Development of Technologies for Rotary Engine	November 2002 <b>5.40</b>	<b>5.26</b>	May 2008 December 2009	Closed in December 2009	The project was sanctioned for development of technologies for Rotary Engine. Two prototypes of rotary engines were successfully developed by VRDE. However, even after four years since successful completion of the project, the same did not find application in any staff project. We



						<p>further observed that two more TD projects were subsequently undertaken by VRDE viz. (i) Development of 15 prototypes of rotary engines for trials with NISHANT UAV (₹4.70 crore) and (ii) Development of advanced technologies for Rotary engine (₹69.23 crore).</p> <p>VRDE stated that after successful completion of the project a DRDO Mission Mode project for development of flight rotary engine to power NISHANT UAV had been undertaken to prove the complete endurance of the indigenous rotary engine to confirm its application for indigenous NISHANT UAV. However the fact remained that even after successful development of technology for rotary engines, no staff project was undertaken. Instead two more TD projects were undertaken subsequently indicating that the technology developed under the project did not meet the user's requirement.</p>
7	Development of Bullet Proof Light Vehicles (BPLV)	May 2006 <b>1.95</b>	<b>1.92</b>	May 2007 November 2007	Closed in November 2007	<p>DDR&amp;D sanctioned a project for development of BPLV. The aim of the project was development of 10 prototypes for proving automobile aggregates and armour material. The project was successfully completed and 10 BPLV's armoured through trade were handed over to various DRDO labs. However, even after six years since successful completion of the project, the technology developed under the project did not find application in any staff project indicating lack of user interest.</p> <p>In reply VRDE stated that the technologies of BPLV were successfully incorporated in Light Armoured Troops Carrier and VAJRA (Mini) and a Transfer of Technology (ToT) realized with M/s Tata Motors Ltd. The reply is not tenable as agreements for ToT with M/s Tata Motors were concluded in November 2005 &amp; February 2006 respectively <i>i.e.</i>, prior to sanction of the subject project in May 2006.</p>
8	Development of Electro Hydraulic Gun Control System (GCS).	December 1998 <b>5.99</b>	<b>4.67</b>	April 2001 December 2002	Closed in December 2002	<p>DDR&amp;D sanctioned a project for Development of GCS. The aim of the project was indigenous development of GCS for armoured fighting vehicles and supply of two systems. The project was successfully completed by CVRDE. However, even after 11 years since successful completion of the project, the technology developed under the project did not find application in any staff project indicating lack of user interest.</p> <p>In reply CVRDE stated that by the time the trial under this project was completed, the configuration of Arjun MBT MK-I was firmed up by the user for productionisation. It was further stated that the user was contemplating placement of an indent for 118 nos. of MBT Arjun MK—II, which was not an economically</p>

						<p>viable quantity for productionisation of GCS. The reply corroborates our comment that the technology developed under the project did not find application in a Staff project.</p>
9	Manufacture & Integration of Power Booster Conversion Kits on T-72 base Engines and Vehicle Trial	November 1997 <b>1.95</b>	<b>1.87</b>	November 1998 November 2001	Closed in November 2001	<p>DDR&amp;D sanctioned a project for Manufacture &amp; Integration of Power Booster Conversion Kits on T-72 base Engines and Vehicle Trial. Five conversion kits were developed and integrated with two base engines and the uprated engines were successfully integrated with the vehicles by CVRDE. However, even after 12 years since successful completion of the project, the technology developed under the project did not find application in any staff project indicating lack of user interest.</p> <p>In reply CVRDE stated that the T-72 uprated engine successfully developed by CVRDE had performed comparable to Russian T-90 engines during trials in 2011. The reply is not acceptable as we observed that during trials held in 2011 the uprated engine developed by CVRDE had multiple problems including overheating of the engines. Hence, the user recommended further trials which were yet to be under taken as of February 2014.</p>
10	Development of Experimental Tank	April 2003 <b>22.64</b>	<b>20.66</b>	April 2006	Closed in April 2006	<p>DDR&amp;D sanctioned a project to develop an experimental tank by integrating T-72 M1 chassis with the turret of modified MBT Arjun. The project was successfully closed after achieving the hybrid tank technology by integrating the upgraded chassis and automotive system of T-72 M1 tank and the optimized turret of MBT Arjun. However, even after 7 years since successful completion of the project, the technology developed under the project did not find application in any staff project indicating lack of user interest.</p> <p>CVRDE in reply stated that the system developed under the project was successful and could be used if user desired. However, the fact remained that the user did not show any interest in the system developed by VRDE.</p>
11	Projects undertaken for improvements to MBT Arjun MK-I for incorporation in MBT Arjun MK-II.	(i) April 2003 <b>9.80</b> (ii) September 2005 <b>14.99</b> (iii) May 2010 <b>13.05</b>	<b>8.73</b> <b>14.49</b> <b>11.79</b>	April 2004  September 2009 August 2010  May 2012 March 2013	Closed in April 2004  Closed in August 2010.  Closed in March 2013	<p>DDR&amp;D sanctioned three projects (i) Development of Defensive Aid Systems (ii) Demonstration of Missile Firing capability and (iii) Development of Advanced Chassis and Automotive Systems for up gradation of MBT Arjun MK-I to MK-II. The projects were successfully completed by CVRDE. However, even after successful completion of the projects, the technologies developed under the projects did not find application in any staff project.</p> <p>In reply, Director CVRDE stated that the GSQR was generally provided by the users for major systems only and not for sub systems of the main system. He further contended that the sub</p>

						systems developed under the TD projects were directly incorporated into the products which may not be through an exclusive Staff project. The reply is not tenable as the projects were taken up to meet the users requirement of MBT Arjun MK-II, the same should have been taken up as Staff projects on the basis of a GSQR which would have ensured acceptance of the systems by the user.
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#### 6.6.4 Absence of database on Scientist wise tasks and contribution

An R&D organisation, through human resource and knowledge management, builds on the available technology to develop the futuristic technologies. This implies an interactive process whereby the Scientists who have obtained exposure to technologies at an earlier stage continue to work on similar technology later. The non-maintenance of such a knowledge base precludes expertise based deployment of its personnel on projects undertaken by it, which could result in projects not coming to fruition or being inordinately delayed.

A comment was made in Paragraph 7.3 of the C&AG's Report No 24 of 2011-12 and Paragraph 7.7 of the C&AG's Report No 16 of 2012-13 regarding absence of a mechanism to correlate success or failure of projects with personnel deputed, at ARDE and R&DE (E) respectively. In the ATN on these Reports, Ministry had stated (November 2012/October 2013) that success or failure could be related to efforts put in by the entire team rather than an individual. It was further stated that accountability could not be attributed to individuals but to a team working on the Project and individuals in the laboratory work in Matrix Management where an individual may work simultaneously on multiple projects. Further in order to effectively nurture and utilise talents, a matrix based organisation structure was implemented wherein an individual simultaneously contributed to several projects of the Establishment.

Our scrutiny revealed that both the labs *viz.*, VRDE and CVRDE did not have database on Scientist-wise tasks and contribution, which could facilitate the assessment of the output of Scientists/Technical Officers. On being enquired in Audit whether any database to correlate the success or failure of projects as well as the expertise gained thereof with personnel deputed on them, was maintained by the lab, VRDE furnished project-wisedetails of some of the Scientists/Technical Officers in respect of 16 projects as against 45 projects closed during the period covered under the review.

In reply, Director VRDE stated that a new Project Management System under implementation would adequately address the issue, which substantiates our comment that there was no mechanism in place to co-relate success or failure of Projects with Personnel deputed on them.

In reply, Director CVRDE stated (January 2014) that it would be difficult to relate the success or failure of the project in comprehensive manner on an individual or smaller set of Scientists/Technical Officers as it would involve complex factors of multi-disciplinary nature. CVRDE's reply is in contravention to the Ministry's response in ATN and also not in consonance with the reply given by VRDE.

#### 6.6.5 Resource Generation in National Centre for Automotive Testing (NCAT)

Government of India, Ministry of Road Transport and Highways authorised (in late 1980s) VRDE to test all types of commercial vehicles for proving their compliance to Central Motor Vehicle Rule (CMVR) No.126. The infrastructure comprising of test tracks and various indoor testing facilities for defence and civil vehicles is available at National Centre for Automotive Testing (NCAT). These facilities are extended to the Private Industries on hiring basis. Charges for Hiring/Testing of commercial vehicles are worked out by VRDE in accordance with the provisions contained in DDR&D letter dated 01January 1993.

Scrutiny of records at NCAT revealed that an amount of ₹ 71.65 crore was generated as revenue on account of hiring of test facilities by private industries during the past five years *i.e.*, from 2008-09 to 2012-13.

**Table-13: Total number of vehicles tested and revenue generated during 2008-09 to 2012-13**

Year	No of commercial vehicles/ components tested	No of project vehicles on which technical evaluation trials were conducted and completed.	No of Army vehicles on which technical evaluation trials were conducted and completed.	Revenue generated (₹in crore)
2008-2009	607	-	5	17.67
2009-2010	702	6	7	12.00
2010-2011	1,166	6	7	13.16
2011-2012	511	6	7	16.19
2012-2013	711	8	9	12.63
<b>Total</b>	<b>3,697</b>	<b>26</b>	<b>35</b>	<b>71.65</b>

We did not come across any case regarding non availability of the testing facility for project vehicles thereby leading to delay in completion of the project. However certain interesting cases, regarding resource generation on account of hiring/testing of commercial vehicles, observed during the audit of NCAT are illustrated hereunder:

***Case-I: Undue benefit of ₹ 0.68 crore to private firms due to non-recovery of Service Tax by VRDE and payment of the same out of Resource Generation Fund***

Government of India, Ministry of Finance, under Notification (20 June 2003), introduced Service Tax on Technical Inspection and Certification Service, leviable with effect from 1 July 2003. Since Test and evaluation facilities created at VRDE are utilized for Technical Inspection and Certification of commercial vehicles of private parties, for which charges are recovered from them as per the rates fixed periodically by VRDE, Service Tax was also required to be recovered by VRDE from the private parties. However, as seen in Audit, Director VRDE neither levied nor recovered the same from the private parties from 1 July 2003 to 31 March 2006, despite the Excise authorities clarification (1 September 2005) that Service Tax was leviable on the Technical Inspection and Certification Service from Defence Establishments as well.

VRDE took up (August 2006) the matter with the DRDO Headquarters for exemption of Service Tax amounting to ₹ 2.64 crore payable to the Central Excise and Customs authority for the period 1 July 2003 to 31 March 2006, on the ground that it could not be levied on the firms at belated stage. Instead, DRDO sanctioned (8 August 2008) payment of ₹ 2.64 crore, out of Resource Generation Fund, to be paid to the Central Excise and Customs authorities to clear the dues. The actual amount payable to Central Excise and Customs Department of ₹ 2.13 crore was worked out by VRDE and payment made in March 2009 to clear the outstanding payment of Service Tax for the period from 1 July 2003 to 31 March 2006. Since the Service Tax payable by the firms/private parties was actually paid by DRDO, the loss incurred due to non-recovery of the Service Tax from the concerned private firms, was asked to be regularized by Audit. Out of the amount of ₹ 2.13 crore, an amount of ₹ 1.45 crore was recovered upto 1 January 2014. The balance amount of ₹ 0.68 crore was yet to be recovered.

***Case-II: Fixation of Hiring and Testing charges of Tracks and other facilities at NCAT on ad hoc basis***

During the review period, five Boards assembled at VRDE in 1999, 2003, 2005, 2008 and 2011 for revising the charges for testing and hiring of test tracks/instruments/facilities by private parties. Our scrutiny of the fixation of hiring/testing charges applicable for testing of commercial vehicles as detailed hereunder resulted in less recovery of hiring/testing charges.

**A: Non adherence to stipulated periodicity for fixation of hiring and testing charges in respect of commercial vehicles**

As per provisions contained in DDR&D letter dated 01 January 1993, the rates for hiring and testing facilities were required to be revised every two years.

However, we observed that during the period of 15 years from April 1998 to March 2013, on two occasions the rates were revised after a gap of four years. The biennial revision was omitted in 2001 and 2007 at the behest of Revision-Cum-Costing Board of VRDE in February 1999 and Principal Controller of Defence Accounts (PCDA) R&D in 2007 respectively. As a consequence, the rates of 1999 and 2005 were applied for four years resulting in loss of revenue due to non-revision of rates biennially as stipulated by DDR&D instructions of 1993.

**B: Inconsistency in factors considered for fixation of rates of hiring and testing charges**

- (i) The hourly cost of utilisation of the machines was required to be worked out taking into account the cost of machines/equipment/facilities along with cost of infrastructure, lands, buildings including its maintenance cost and a certain percentage added to the cost so arrived. It was however seen in audit that the land cost was considered for working out the revised rates for the first time by the Board of March 2003 and was worked out as ₹51crore, proposed to be recovered in 100 years *i.e.*, at the rate of ₹ 0.51 crore per annum. Not taking into account this element by the earlier Boards resulted in under fixation of hiring and testing charges.
- (ii) The rates of hiring/testing facilities were required to be revised by Revision-Cum-Costing Boards once in two years. Hence, manpower cost for two years needed to be taken into account while fixing the rates. We, however, observed that manpower cost for one year only was taken into account by every Board while fixing the rates resulting in under fixation of hiring and testing charges.
- (iii) The Revision-Cum-Costing Board of December 2008 worked out the cost of hiring of various tracks and testing of automobiles by considering the overheads cost at 15 *per cent* instead of 150 *per cent* overheads stipulated in the DDR&D letter of January 1993 for resource generation. Further, eight *per cent* Incidental and Miscellaneous expenses and 10 *per cent* profit were considered for working out the charges, as against, manpower cost plus 150 *per cent* overheads, 25 *per cent* overheads on manpower, material & facilities, 15 *per cent* Incidental & Miscellaneous (I&M), profit 12.5 *per cent* and five *per cent* infrastructure cost considered by the earlier Boards. The justification for adopting different percentages and elements while working out the hiring/testing charges by the various Boards were not recorded in the respective Board Proceedings.
- (iv) As per Para 5.4 of DDR&D letter of January 1993, while quoting the rental cost to the outside agencies, the market cost would also be taken into account and the profit element would be adjusted in the manner that the basic cost and the profit element does not go beyond the on-going market cost of hiring similar facilities or what market can bear. The Board



of December 2008 also opined that the testing charges at NCAT should be comparable to the charges of similar tests conducted by other testing agencies like Automotive Research Association of India (ARAI) and Central Institute of Road Transport (CIRT). However we observed that though the competitor's charges in respect of nine tracks<sup>96</sup> only were available with the Board, but the Board proposed reduction of hiring charges *vis-a-vis* existing charges in respect of 15<sup>97</sup> of the 25 Facilities/Tracks<sup>98</sup> and 11<sup>99</sup> of the 26 Instruments<sup>100</sup>. Moreover the rates recommended by the Board of 2008, were in some cases<sup>101</sup> more than the competitor's rates and in some cases<sup>102</sup> less than the competitor's/market rates. The revised rates were made applicable by VRDE with effect from 1 July 2009. As a consequence of this adhocism in fixation of rates by the Board of 2008, the unjustified reduction in charges in respect of the tracks and Instruments *vis-a-vis* existing charges resulted in less recovery of ₹ 3.21crore during the period July 2009 to June 2011.

No reply was furnished (January 2014) by VRDE in respect of our comment regarding not taking into account the manpower cost of two years while fixing the charges applicable for two years and non-inclusion of cost of land by the Boards held prior to Board of March 2003. However with reference to non-adherence of periodicity in holding Boards for revision of rates, Director, VRDE stated that the periodicity of convening the Boards was in accordance with the suggestions of the previous Boards/PCDA. From 2009 onwards the periodicity had been strictly followed.

<sup>96</sup>(1) High Speed Track (2) Straight Track (3) Steering Pad (4) Gradient track (5) Serpentine 2 wheeler (6) Serpentine 4 wheeler (7) Cross county track (8) Deep wading trough (9) Durability circuit

<sup>97</sup> (1) High Speed Track (2) Straight track (3) Belgian Track (4) Steering Pad (5) Gradient track (6) Serpentine 4 wheeler (7) Corrugated 50 mm (8) Long Wave pitching (9) Pot hole track (10) Mud track (11) Sand track (12) Shallow water trough (13) Durability circuit (14) 100t weigh M/C (15) OATS for EMI test

<sup>98</sup> 25 Facilities /Tracks –(1) High Speed Track (2) Straight Track (3) Belgian Track (4) Steering Pad (5) Gradient track (6) Serpentine 2 wheeler (7) Serpentine 4 wheeler (8) Corrugated 50 mm (9) Corrugated 100 mm (10) Long Wave pitching (11) Cross Country Track (12) Pot hole track (13) Mud track (14) Sand track (15) Shallow water trough (16) Deep Wading trough (17) Dust tunnel (18) Durability circuit (19) 100t weigh M/C (20) 30t weigh M/C (21) Anchor block (22) Crane (23) Tilting Platform (24) OATS for EMI test (25) Inspection area.

<sup>99</sup> 1) Correvit L Digital 2) Sound Level meter 3) Articulation Test Rig 4) Graphtech Meter 5) Correvit H Sensor-4 6) FFT Analyser 7) Datron EEP-2 8) Correvitq Sensor 9) Datron Steering Wheel 10) Ride quality meter 11) Corryss DAS IA

<sup>100</sup> Instruments-(1) Correvit L Digital (2) Sound Level meter (3) Engine Tachometer (4) Articulation Test Rig (5) Steering Torque Meter (6) Graphtech Meter (7) Correvit H Sensor-4 (8) Vibration Meter (9) Human Res Vib Meter (10) Temperature Meter (11) Digital Barometer (12) Hygrometer (13) FFT Analyser (14) Datron EEP-2 (15) Datron Rolenth (16) Datron WPT (17) Datron Break Switch (18) Correvitq Sensor (19) Datron Steering Wheel (20) Break Pedal force (21) PLU fuel Transducer (22) Ride quality meter (23) Corryss DAS IA (24) Accelerometer (25) Anemometer (26) Pressure Calibrator.

<sup>101</sup> 1) Cross Country Track 2) Deep Wading Trough 3) Measurement of interior noise for N2,N3 and M2 category 4) Measurement of interior noise for M3 category

<sup>102</sup> (1) Steering Pad (2) Serpentine 4 Wheeler (3) Mass Emission test on 4 Wheeler Chassis Dynamometer (4) Dimensional check-ups (5) EMI measurement for type approval as per AIS -004.

The reply is not acceptable since, as per Para 5.3 of DDR&D letter dated 01 January 1993 the rates were to be revised every two years. As such neither the Boards nor the PCDA were empowered to recommend revision of rates after four years.

### **Conclusion**

Comments were made in Paragraph 7.4 of the Report of the C&AG of India, No.24 of 2011-12 on 'Project Management in Armament Research and Development Establishment (ARDE)' and Paragraph 7.8 of the Report of the C&AG of India, No.16 of 2012-13 on 'Project Management in Research and Development Establishment (Engineers) (R&DE(E))' regarding certain systemic failures in management of projects by the respective labs. In response the Ministry in the ATNs (November 2012 and October 2013) had stated that DRDO HQ had drawn guidelines for undertaking new projects, monitoring and closure of projects after their successful completion. Ministry further assured that various remedial measures including more periodic reviews with user and implementation of effective Integrated Management System for compliance of guidelines would be undertaken. We however observed that lapses similar to those reported earlier persisted in VRDE and CVRDE also.

The Staff projects taken up by VRDE/CVRDE for delivery of products required by the Defence Forces witnessed very low rates of success in induction of systems into the services. Many of these failed mainly because of taking up projects before firming up of requirement by the user, failure to develop the desired deliverables, imposition of ban on foreign vendor and mismanagement in the post development activities. Time and cost overruns were significantly high in majority of the projects, which is an indication of underestimation of cost and time or overestimation of capabilities.

The main reason for the technologies developed under R&D/TD Projects not leading to their exploitation in Staff projects was lack of proper assessment of the user requirement.

Non-maintenance of any data regarding the Scientists and Technical Officers deployed on various projects by the lab and their output in terms of success or failure of the projects may, in the long run, result in failure to tap the expertise built up in the earlier projects or repeating the same mistake of deploying the same Scientists/Technical Officers who could not contribute much in the field of activities in which they were deployed earlier. Non booking of pay and allowances of the manpower deployed on project activities, even though significant, has resulted in understating the project costs.

Inconsistency in factors considered for fixation of rates of hiring and testing charges by VRDE for arriving at rates chargeable from private firms/companies for utilisation of the facilities at NCAT, even after passage of more than three decades since establishment of NCAT and utilisation of the

same by private firms as well, has resulted in under recovery of hiring and testing charges.

### **Recommendations**

- *DRDO may consider pro-active focus of their activities on user oriented Staff Projects in terms of overall expenditure and efforts.*
- *To enhance the results of Staff projects, close and formal joint monitoring by the user and DRDO since its inception to the closure is indispensable to avoid mismatch between the GSQR and technological capabilities. A suitable mechanism should be evolved to correctly reflect the user's assessment of the system developed in the closure report.*
- *High value R&D and TD projects need to be undertaken after due consultation with the users to appropriately assess user requirement, so that technologies developed under these projects by the DRDO lead to Staff Projects in three to five years.*
- *DRDO may consider developing database on scientist-wise task and contribution associated with each of the projects which may serve as an institutional memory and enhance transparency and accountability.*
- *A suitable method of apportioning manpower cost may be devised for computation of the cost of the Project.*