



Chief Review Services

ARMoured PERSONNEL
CARRIER LIFE EXTENSION
PROJECTS

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SYNOPSIS

This report presents the results of an independent review of two projects to life extend selected vehicles from the fleets of tracked and wheeled Light Armoured Vehicles (LAV).

A life extension and capability improvement program was necessary because under the Armoured Personnel Carrier (APC) Replacement Project, less than half of the required quantity were deemed affordable. Consequently, the new LAV III vehicle is being acquired for only the forward fighting echelon. Combat support and combat service support elements of the Land Force will be provided with refurbished LAV whose operational capabilities have been enhanced. Upgrading the retained fleets to modern automotive standards is also intended to improve reliability and reduce support costs.

The APC Life Extension (APC LE) schedule is complicated by interdependence among the various projects and by current operations and training requirements that reduce flexibility to withdraw vehicles for the Depot Level Inspection and Repair and re-role work. The requirements and project management staff are cognizant of these factors and work together to address the issues. However, the WLAV LE definition process, although on schedule, still has many issues to resolve. The project will be unable to deliver some of the Bison and Grizzly re-rolled vehicles needed to satisfy the plan to replace all of the vehicles on Operation PALLADIUM Roto IX in the autumn of 2001. For example, there will be no suitable LAV ambulance to replace the Bison ambulance in theatre. Reconsideration of the options to enable revision of the LAV Fielding and Re-Role Plan is on-going.

Both tracked and wheeled life extension projects are using test and evaluation to advantage, although neither have a clear plan in this respect. We have recommended formulation of a Test and Evaluation Master Plan, as outlined in the draft DAOD on test and evaluation.

The APC LE risk analysis conducted by a contractor appropriately identified areas of risk and the two PMOs are addressing them. The Project Profile and Risk Assessment (PPRA), however, does not identify issues of medium and high risk, and the low risk issues identified could be understated. We have recommended that the PPRA reflect the areas of actual risk and the mitigation strategies.

The conclusions and recommendations appear at page 7 of this report. The PMO responses are at page 8.

REVIEW OF ARMoured PERSONNEL CARRIER LIFE EXTENSION PROJECTS

INTRODUCTION

1. In accordance with the Chief Review Services (CRS) Review Plan, CRS has completed an internal review of the Armoured Personnel Carrier Life Extension (APC LE) Projects. The focus was risk identification and mitigation pertaining to cost, performance and schedule factors and an assessment of any value for money and project management issues.

BACKGROUND

2. Experience in operations, deteriorating capability relative to current threats, and direction in the 1994 Defence White Paper underscored the need for APCs suitable for conducting mechanized operations. Project L2637, APC Replacement was established to meet this need. Due to budget constraints, however, the APC Replacement project will only replace APCs in the forward echelon of the Land Force (LF). Only 651 of the approximately 1,500 required Light Armoured Vehicle III (LAV III) were deemed affordable. The balance of the capability was to be satisfied through the APC LE project L2731, which achieved Preliminary Project Approval in October 1996.

3. As a result of the APC LE project definition, it was decided to split the project into wheeled and tracked versions. The Wheeled Light Armoured Vehicle (WLAV) portion has been assigned project number 00000058 while the tracked M113 portion continues as L2731. The APC LE projects will upgrade and re-role selected vehicles from the tracked and wheeled APC fleets to satisfy the equipment requirements of the LF's Equipment Rationalization Plan (ERP), 12 January 1999. The re-role of Grizzly infantry carriers to combat support and combat service support roles enables the re-use of Grizzly turrets on M113 variants, a very significant saving. The plan includes installation of a Protected Weapon Station (PWS) on wheeled and tracked variants where there was no available turret or no room for a turret. The LE program includes development and procurement of add-on armour kits for each of the fleets. The tracked project received Effective Project Approval for implementation on 19 November 1998, excluding the PWS portion, which received definition approval. The Wheeled project received Effective Project Approval for the Bison re-role implementation and for Grizzly/Husky re-role and PWS definition on 19 November 1998.

4. The tracked fleet rebuild will be executed at 202 Workshop Depot, Montreal. The wheeled fleet refurbishment and Bison re-role will be executed at Mirimachi N.B (formerly Chatham). The location of work on the Grizzly/Husky (AVGP) re-role will be determined during AVGP re-role definition and will be based on technical risk. The Depot Level Inspection and Repair (DLIR) of the AVGP portion of the WLAV fleet is closely related to the Life Extension project. DLIR is funded from National Procurement (Operations and Maintenance) accounts. DLIR is in fact an essential prerequisite that, where possible and affordable, will

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achieve upgrade and fleet commonality objectives of the 20 year old AVGP's with their younger cousins, the Bison and Coyote. This includes, for example, wheels, torsion bars, steering system, transfer case, some engine ancillary components, and in some cases refurbishment of specialist mission equipment. The DLIR contractor is now delivering refurbished AVGP's. The Senior Review Board meeting of 17 May 1999 approved the ADM(Mat) plan to include in the DLIR program, the Cougar vehicles to be retained in service. Land Force structure decisions have recently resolved the quantity of Cougar to be retained, and negotiations are underway to include them in the DLIR contract. Land Force structure factors are currently very dynamic.

Subsequent to the approval of the ERP, CLS directed a review of the M113LE project to confirm that it was consistent with Strategy 2020 and DPG 2000. Shortly thereafter, M113 LE was included with all other Capital Projects in the A&B Capital review. Both reviews have now been completed. The latter confirmed that the best course of action for DND is to continue with the M113 LE project. However, the project will be re-scoped to include as a contract option the M113 variants associated with capabilities, such as Air Defence, that are still under review, with a related impact on the quantities of PWS that are required. Figure 1 depicts the current basic plan.

Project	Veh	DLIR Contract	Revised Qty	Grizzly Turret Qty	PWS Qty
L2731 M113 LE	MTVL		*183	81	**49
	M113 A3		*158	80	**41
	Sub-total		*341	161	**90
AVGP DLIR	Grizzly	236	***195		
	Husky	27	27		
	Cougar		100		
	Sub-total	263	322		
00000058 WLAV LE & Re-role	Grizzly		***195	**58	**56
	Husky		27		**27
	Bison		199		**111
	Sub-total		***421	58	**194
Total M113 +WLAV LE			762	219	**284

* The 18 Oct 99 departmental decision on the M113LE project directed the insertion of 61 vehicles as a contract option.

**The PWS Definition Phase is still at the early stage and the numbers are indicative.

***This number includes the GRIZZLY ambulance variant (81), currently on hold.

Figure 1 – APC Life Extension Basic Plan

DISCUSSION OF ISSUES

Risk Assessment

5. The APCLE projects utilized consultant expertise in the identification of risk. Risk was categorized in terms of its probability of occurrence and impact on cost, schedule and other aspects of the projects. The risk analysis plan arising from this study is currently being followed. For example, one identified area of risk with high impact and medium probability of occurrence dealt with clarification of roles and responsibilities between all stakeholders, including the contractor and PMO. With PWGSC input, weekly review meetings are held with all stakeholders. It is interesting to note that none of the high risk areas detailed in the consultant's analysis, are discussed in the Project Profile and Risk Assessment (PPRA). In this document, all risks are shown as "Low" without a breakout of probability of occurrence or impact. This would indicate that the DMS Manual guidance concerning preparation of the PPRA does not necessarily lead to acknowledgement of the risks that actually exist in a capital project.

Test and Evaluation (T&E)

6. Although there is no clear T&E plan, both the tracked and wheeled LE and DLIR projects are using T&E to mitigate risks associated with the design and production of the basic vehicles and their variants. For example, the M113 LE project tested prototype MTVL and M113A3 built by the original equipment manufacturer (OEM). They conducted blast tests of surrogate MTVL. They have also purchased five modification kits that will be used for proof of concept and pre-construction procedures at 202 WD, where the production will take place. First article inspection of vehicles from the AVGP DLIR Contractor's facility ensured that vehicles returned to the Army were acceptable and within specification. To mitigate risk on Bison re-role the WLAV LE staff have produced sealed sample vehicles to validate all modification and conversion instructions that form the basis of the Bison re-role statement of work. The M113 LE staff and the WLAV LE staff have conducted tests on existing and future Bison variants. Testing has been based upon the complexity of the changes and if the changes are incorporated in other armoured vehicles. The WLAV LE project team is currently conducting extensive tests involving both operational users and technical experts to determine the feasibility and configuration of some AVGP variants. For example, the AVGP ambulance being developed is a recognized challenge for internal capacity, weight and mobility so trials are being conducted now while there is time to consider options. We would encourage the project staff to refer to the guidance in the Draft DAOD on T&E, particularly to formulate a Test and Evaluation Master Plan (TEMP).

Protected Weapon Station (PWS)

7. All LAV not equipped with a turret, except ambulance, M113 ADATS, Command Post and Electronic Warfare variants, require the capability for the vehicle crew commander to be able to operate and fire, by day and night, the vehicle medium machine gun in a self defence/anti-personnel role. A PWS is a common requirement among four different families of

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vehicles, the LAV III, Bison, AVGP and M113 LE variants. Although the vehicle platforms are quite different, the three projects involved are striving to coordinate their requirements in the interest of economy, efficiency and ILS. Each project will have to seek approval separately. The PWS is a recognized risk factor that is being mitigated by a teaming arrangement among the staffs of the three DND projects, [REDACTED] and [REDACTED]. [REDACTED] The performance specifications (operational, engineering, ILS, etc,) were prepared by representatives from all teams concerned. [REDACTED], on behalf of the team, was preparing a coordinated request for proposal that was in re-draft stage at the time of the review. We noted concern among some of the project staff that potentially the solution selected for the broader fleet requirement may not be optimal for a particular vehicle. Since each project team is aware of this factor, however, there is opportunity to resolve the issues, when they arise, for the common good of the LF.

Section 20(1)
c) d)

WLAV LE Definition

8. A number of contentious issues were unresolved at the time of the review. Some changes have already occurred and more are expected. Examples include:

- a. the suitability of the Grizzly platform for 81 ambulance and six Self Propelled Mine Detection System (SPMDS) variants;
- b. whether or not the existing Grizzly turret configuration provides sufficient volume for the 10 Radio rebroadcast and 23 MRT variants. The turret weighs approximately 1800 lbs and uses significant internal volume; and
- c. the relative merits of competing add-on armour products and the surface preparation needed to optimize the effectiveness.

Various options were being considered, including an unsolicited proposal from [REDACTED] that included a trade-in option, to supply Bison II/LAV III ambulances. The requirements and engineering staff are considering the factors. Depending on decisions yet to be taken, additional Grizzly turrets could possibly be available to the M113 LE project and the platform selected for some roles could change. The definition phase is being used to advantage by the WLAV LE project team.

Section 20(1) c)
d)

Schedule Factors

9. The APC LE schedule is complicated by interdependence among the various projects and by current operations and training requirements that reduce flexibility to withdraw vehicles for the DLIR and re-role work. For example, DLIR and re-role work on the WLAVs currently deployed overseas cannot be scheduled until the vehicles are returned to Canada. This will stretch the DLIR and Bison re-role production from six to 12 months in FY 2002/03. The M113 LE project is dependent upon the re-role of Grizzly vehicles as a source of turrets. Bison and

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Grizzly vehicles currently deployed overseas are to be replaced by a combination of LAV III and Bison vehicles that have completed Bison re-role. The project requirements staff are well aware of these factors and have published a LAV Fielding and Re-Role Plan that takes into account all the predicted needs and availabilities. The success of the TCCCS Iris vehicle mounted radio project is particularly critical. The LAV III installation kit electronic fits only the Iris radios, and training cannot start until it is fielded. The key event will be Op PALLADIUM Roto IX in the autumn of 2001, when all the deployed equipment is to be replaced with new or refurbished equipment incorporating the new radios. PMO WLAV LE is currently predicting that Roto IX is unachievable for some re-role vehicles, and there will be no re-roled ambulance available. There will, however, be vehicles that have completed the Grizzly/Husky DLIR that could be used as interim solutions. The PM WLAV LE has recognized the economic and operational advantage of simultaneous PWS installation with Bison and Grizzly re-role, and is seeking advancement of about [REDACTED] cash flow to enable this action. In summary, both the requirements and project management staff are cognizant of the factors that impinge upon the LE implementation schedule. The LAV Fielding and Re-Role Plan provides a sound basis for planning, although it is understood to be a living document that is likely to require adjustment as the various factors evolve.

Section 20(1) c)
d)

Cost Effectiveness

10. The M113 and WLAV LE projects are expected to deliver vehicles that provide acceptable levels of capacity, protection and mobility for the combat support and combat service support roles designated. For many of the troops in these roles, this will be an unprecedented and welcome enhancement over the light soft-skinned vehicles provided heretofore. It is being achieved with attention to economy, while upgrading the retained fleets to a modern automotive standard that should further reduce the operating costs. The support cost improvement will be most dramatic in the M113 LE project. The new track is expected to deliver almost double the life while costing about half the price of the current model. Further, labour costs for power train maintenance are expected to be reduced dramatically; e.g., two hours to exchange a new power pack vice 36 hours for the old one, and due to improved reliability, such work will be needed less often. The estimates below, derived from each project's price estimates, and admittedly not precise, indicate the economic advantage of life extending existing fleets, particularly the WLAV fleet.

Project	Project Cost Per Vehicle Including ILS (\$M)	
L2637, APC Replacement, Phase 2	XXXX	Section 20(1) c) d)
L2731, M113 LE	XXXX	
0058, WLAV LE (AVGP DLIR , Bison and AVGP re-role)	XXXX*	
*Average cost without the PWS, which could add about XXXXX.		

Disposal of Surplus Assets

11. Force structure decisions and the fielding of the new and refurbished LAVs will eventually result in several hundred vehicles being surplus to requirements. The staff of both tracked and wheeled LE PMOs are aware of sales potential for complete functional vehicles. Exploration of the possibilities for disposal at the higher value of functional vehicles rather than scrap should be encouraged.

CONCLUSIONS

- Documented analysis performed in support of the projects suggests that the life extension of the tracked and wheeled LAVs will save more than one billion dollars over procurement of new vehicles.
- The APC LE risk analysis conducted by a contractor appropriately identified areas of risk and the two PMOs are addressing them. Failure to identify in the PPRA issues of higher risk would indicate that the DMS Manual guidance concerning preparation of the PPRA does not necessarily lead to acknowledgement of the risks that actually exist in a capital project and identification of mitigating strategies.
- T&E is being used by both tracked and wheeled projects, but neither have a clear T&E Plan.
- The common requirement for a protected weapon station to fit the LAV III, Bison, AVGP and M113 LE variants is a recognized risk factor that is being coordinated carefully using a teaming arrangement among the three PMOs and two prime contractors involved.
- The WLAV LE project staff, together with CLS staff, are working on several definition issues that could have a significant impact on the use of vehicle platforms and quantity of Grizzly turrets available to the M113 LE project.
- Deployed operations will result in prolonging the Bison re-role by six months to one year and there may be some schedule slippage of the AVGP DLIR due to the addition of the Cougar and to uncertainty related to the repatriation/rotation of vehicles currently deployed on operations. The LAV Fielding and Re-role Plan provides a sound basis for planning, although the inevitability of its revision is recognized by all concerned.
- Elements of the plan to insert Bison and Grizzly re-roled vehicles in Op PALLADIUM at Roto IX are unachievable due to the current status of the RFP, operational commitments for Bison and the time needed for the Grizzly/Husky re-role definition and production lead time. There will be no suitable LAV ambulance available for Roto IX replacement of the Bison ambulance.

RECOMMENDATIONS

- Both the M113 LE and the WLAV LE projects should prepare a Test and Evaluation Master Plan as outlined in the draft DAOD on test and evaluation.
- The PPRA should reflect the areas of actual risk and the mitigation strategies.
- Disposal options for the surplus tracked and wheeled LAVs should be explored.

PMO RESPONSE

Risk Assessment

The documentation of risks is an ongoing activity to ensure that the acknowledgements of the risks are complete, current and accurate. Specifically:

- a. The WLAV LE project staff review risk on a recurring basis. They intend to update the PPRA to ensure all areas of risk are documented with a probability of occurrence and impact. In addition, the Bison Re-role portion of the LE project has produced sealed sample vehicles to validate the feasibility of proposed variants. Technical problems discovered during this development have been addressed and revised instructions have been incorporated into the Statement of Work. These sample vehicles will also be used by the winning bidder as examples of completed variants; and
- b. For the M113LE project, most of the high-risk items that were detailed in the consultant's analysis are no longer applicable since the project has been transferred to the matrix. Risk assessments are an integral part of the project and weekly meetings and Quarterly Progress Reviews are used extensively to mitigate the risk. A breakout of probability or impact will be documented and incorporated in the PPRA.

Test and Evaluation

A Test and Evaluation Master Plan (TEMP), using the guidance provided in the reference Draft DAOD, is being developed for both the WLAV LE and the M113 LE projects so that all testing is laid out in respective single documents. The WLAV LE PM staff is currently conducting extensive tests involving both operational users and technical experts to determine the feasibility and configuration of some AVGP variants. For the M113 LE, a cooling test at UDLF and the user trials of the variants are to occur at the CTC LFTEU during the 1999/01 timeframe. Both PM staffs view the TEMP as a valuable document that will benefit both projects by consolidating all tests into a single document.

WLAV LE Definition

Some of the contentious issues covered in this section are changing or being resolved. Early tests have shown that the Grizzly platform is not suited for use for the 81 ambulances and the six SPMDS variants. On 20 Sep 99, the Improved Landmine Detection System Senior Review Board, upon considering the high technical risks associated with the GRIZZLY SPMDS variant, approved transferal of the requirement to the M113A2 platform. The mobility and payload problems associated with the Grizzly ambulance variant have been briefed to the Land Staff and various alternatives for this requirement are being developed.

Schedule Factors

Scheduling of the WLAV LE has become even more complicated with the recent deployment of an additional 76 WLAV vehicles to OP KINETIC in Kosovo. This, combined with other schedule delays, makes it likely that some re-role vehicles will not be available for deployment on OP PALLADIUM Roto IX. The Army has received warning of this and various alternatives are now being developed.

Disposal

Disposal plans will be developed by DAVPM 3 for the surplus WLAV vehicles and by DAVPM 4 for surplus M113 vehicles. These plans will have input from the Land Staff and DDSAL (who will be responsible for implementation of the plans).

GLOSSARY

ADM(Mat)	Assistant Deputy Minister (Materiel)
ADATS	Air Defence Anti-tank System
APC	Armoured Personnel Carrier
APC LE	APC Life Extension
AVGP	6 X 6 Wheeled LAV (3 variants Cougar, Grizzly, Husky)
Bison	8 X 8 Wheeled LAV
CRS	Chief Review Services
Coyote	8 X 8 Wheeled LAV equipped with a 25mm cannon and specialist reconnaissance equipment
Cougar	Variant of the AVGP equipped with a 76mm cannon
CTC LFTU	Combat Training Centre, Land Force Test and Evaluation Unit
DAOD	Defence Administrative Orders and Directive
DDGM	Diesel Division General Motors
DLIR	Depot Level Inspection and Repair (a major overhaul)
DMS	Defence Management System
FY	Fiscal Year
Grizzly	Infantry Carrier Variant of the AVGP
Husky	Variant of AVGP equipped as a maintenance recovery vehicle
ILDS	Improved Landmine Detection System
KINETIC	The CF operation in Kosovo
LAV	Light Armoured Vehicle
LAV III	newest 8 X 8 wheeled LAV (third generation WLAV, not yet in service)
LE	Life Extension
LF	Land Force (the Army)
M113	Tracked LAV family (many have been upgraded to M113 A2 configuration)
M113A3	New upgraded model of M113
M113 LE	M113 Life Extension
MTVL	Mobile Tactical Vehicle Light (new stretched upgraded model of M113)
OEM	Original Equipment Manufacturer
PALLADIUM	The CF Operation in Bosnia
PMO	Project Management Office
PPRA	Project Profile and Risk Assessment
PWGSC	Public Works and Government Services Canada
PWS	Protected Weapon Station
RFP	Request for Proposal
SRB	Senior Review Board
T&E	Test and Evaluation
TCCCS	Tactical Command, Control, Communications System
TEMP	Test and Evaluation Master Plan
WLAV	Wheeled Light Armoured Vehicle
WLAV LE	WLAV Life Extension