ARMY PROCUREMENT OF THE M561, GAMA GOAT

HEARING

BEFORE THE

ARMED SERVICES INVESTIGATING SUBCOMMITTEE

OF THE

COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES

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WEDNESDAY, MAY 24, 1972

HOUSE OF REPRESENTATIVES,
COMMITTEE ON ARMED SERVICES,
ARMED SERVICES INVESTIGATING SUBCOMMITTEE,
Washington, D.C.

The special subcommittee met at 10 a.m. in room 2337, Rayburn House Office Building, Hon. Otis G. Pike presiding.

Members present: Hon. Otis G. Pike, Hon. W. C. (Dan) Daniel and Hon. Durward G. Hall.

Staff present: John T. M. Reddan, Counsel; John F. Lally, Assistant Counsel; and Richard A. Ransom, professional staff member.

Mr. PIKE. The committee will come to order.

This morning we will begin taking testimony in connection with our examination of the Army's procurement of the M561, known as the Gama Goat. This vehicle is a 6-wheel-drive 1¼-ton cargo truck designed to be a weapons carrier which is produced in two configurations, cargo and ambulance.

In order that the testimony of the witnesses this morning might be viewed in proper perspective, I think I should briefly review the history of the Gama Goat's development.

This background information was obtained by the subcommittee as a result of the examination of pertinent documents relating to this procurement. From these documents it appears that the Gama Goat is one of the offshoots of the Army's mobility improvement program which began in 1961. The Army's requirements for this vehicle were established in 1961 and included the following:

> It will be used as a prime mover for direct support artillery.
>
> It must have a 90 percent probability of completing in a military environment 10,000 miles with organizational maintenance only, and 20,000 miles without the need to evacuate the vehicle beyond the direct support maintenance echelon. During the first 10,000 miles of operation, the unscheduled maintenance hours should not exceed the scheduled maintenance hours.
>
> It is essential that it possess an inherent swimming capability in inland waters under all load conditions.
>
> It shall be capable of accepting kits to mount the flexible version of the current standard 7.62 millimeter and caliber .50 machine guns, the Vehicle Rapid Fire System, the anti-tank guided missile, the current standard heavy recoilless rifle, and the Davy Crocket XM28 and XM29 system.
>
> It should be in the hands of troops as soon as possible.

The new truck was to replace the M37 ¾-ton weapons carrier, the M170 ¼-ton front-line ambulance and the M43 ¾-ton ambulance, which had been in inventory since World War II, and it was estimated that it would cost approximately $5,000. As of June 30, 1971, it was estimated each vehicle would cost $15,400.

In 1963, a design contract was awarded to Ling-Temco-Vought (LTV) to manufacture two test rig prototypes. These test vehicles were subjected to engineering design tests by the Army's Test and Evaluation Command (TECOM) in 1964. During that year, before the testing had been completed, the Army ordered LTV to begin the fabrication of eight prototypes for engineering and service testing. This series of tests began in January 1965 and was completed in April 1966. Upon completion of these latter tests TECOM concluded in March of 1966 that as tested, the Gama Goat would not be suitable for Army use until modifications and further testing were accomplished.

In June 1966, the Gama Goat program manager moved to have the Gama Goat classified as standard A. Such classification in 1966 would signify that the Goat was suitable for the Army's use to fill an operational requirement and which was being produced or could be produced to fill shortages. Parenthetically, but importantly, it should be pointed out that such a classification is also required before funds could be obtained for the mass production of the item.

Despite test results which might have been expected to raise doubts as to the Gama Goat's suitability for Army use, representatives of the major Army elements approved the Goat as standard A. The only dissenter appears to have been the Combat Developments Command (CDC), the Command which represents the Army's users. However, the project manager obtained CDC's consent by promising that the standard A classification would be "conditional" until further tests verified the vehicle's suitability, and that a production contract would not be awarded prior to the satisfactory completion of these tests.

On December 1, 1966, the Army requested DOD to release production funds, and to date the committee has found no documentary evidence that the conditional nature of the Gama Goat's standard A type classification was made known to DOD.

On July 22, 1967, DOD approved the release of funds and granted procurement authority; and in September 1967, the Army put out an invitation for bids.

In December of 1967, TECOM stated that the vehicle still failed to meet the reliability requirement for Army use as tested since it contained five major deficiencies requiring essential design corrections and recommended that it be released for production on a low, early output.

In April 1968, representatives of the major Army elements again met at an in-process review, at which time it was generally concluded that the truck could be released for production "on a risk basis." CDC was again a lone dissenter, although that decision was subsequently reversed.

On June 10, 1968, the Assistant Secretary of the Army (Installations and Logistics) approved the award of the contract to CONDEC, and on June 11, 1968, a contract in the amount of $132 million, calling for the production of 15,274 vehicles was executed. Of this total number of vehicles 1,758 were being procured by the Army for the Marine Corps. The contract provided that the vehicles would be delivered between October 1969 and May 1972. At present, delivery of production vehicles is scheduled to be completed in July 1973.

Testing of the first two preproduction items manufactured by CONDEC in August 1969 demonstrated that the vehicles were satis-

factory except in the areas of maintenance reliability and durability, where serious problems existed.

In April 1970, CONDEC delivered 11 units to be used for validation testing. All 11 units were rejected by the testing command for quality control defects. Three months later CONDEC delivered another 11 vehicles, again with quality control deficiencies. However, due to the fact that the program had already slipped about 8 months, the Army corrected as many deficiencies as possible and began the initial production tests (IPT) in June of 1970. That test was terminated before completion due to numerous failures which occurred during the first few months. A combination of design deficiencies and poor quality control led TECOM to conclude the vehicle was not suitable for conditional release. One of the problems which TECOM encountered related to the Gama Goat's unsatisfactory swimming capability. On June 10 the project manager asked CONDEC to look into this problem. On August 13 CONDEC replied that, based on their investigation, the condition complained of "does not exist in the field." This assurance may have satisfied the project manager, but it did nothing to keep the Goat afloat. In field tests it continued to sink.

Subsequently, two other test programs were initiated. They were known as Phase II and Phase III IPT tests. However, both were terminated before completion due to the design and quality control problems which still made the vehicles unsuitable for Army use until correction of all deficiencies. By this time IPT testing had stretched from June 1970 to October 1971.

Despite the obvious deficiencies in the vehicle, CONDEC producduction lines continued to turn out thousands of Gama Goats. The first 4,400 went directly to Army warehouses and are still there awaiting redesign solutions and retrofit, the cost of which will apparently be borne by the Government. Included in those 4,400 vehicles are the 1,758 vehicles assigned to the Marine Corps.

In March 1971, the Gama Goat was released in small quantities to training units in the continental United States; however, the Army concluded that the risk was too great for worldwide deployment because of uncorrected design deficiencies and quality control problems.

On December 14, 1971, TECOM informed the project manager that the Gama Goat would not be suitable for release without restriction unless 19 deficiencies, and as many of the 27 shortcomings as feasible, had been corrected.

On December 29, 1971, a decision was reached for worldwide release of the Gama Goat. Units are now being delivered to Army depots preparatory to deployment to Europe. Reports from these depots indicate a continuing problem with quality control and design deficiencies.

We had planned to have the officers who have been the project managers from 1964 to date testify first in this hearing. The Army has requested that General Ellis be permitted to testify first. We are going to accede to that request.

I am obliged to say, however, General Ellis, that the Army knew that we were planning to have you testify last. We did not receive your statement, contrary to the rules of the committee, until late yesterday afternoon. Accordingly, while I don't know your personal

scheduling problems, we are perfectly willing to have you testify first; however, the staff has not had an opportunity to really study your statement. I think you were fully aware that we planned to have you testify last. Accordingly, we may ask you to come back for questioning at a later date.

With these understandings, General, I will ask you to proceed.

General ELLIS. Thank you very much, Mr. Chairman.

STATEMENT OF MAJ. GEN. VINCENT H. ELLIS, DEPUTY, MATERIEL ACQUISITION, OFFICE OF THE ASSISTANT SECRETARY OF THE ARMY FOR INSTALLATIONS AND LOGISTICS

General ELLIS. Mr. Chairman, members of the committee, I am most grateful that you have acceded to the Army's request and allowed me to read my opening statement. At least I think it will facilitate our communication and place the proper terms of reference and scale of values within which this matter needs to be judged.

Mr. PIKE. Before you start with your statement, General, I notice it is not for public release until released by the House Appropriations Committee. At what time do you plan to submit this statement to the House Appropriations Committee?

General ELLIS. I am very sorry and embarrassed over that error, sir.

You are now in receipt of copies properly releasable by the House Armed Services Committee.

Mr. PIKE. I am glad to hear that statement, because it is going to be be very difficult to keep it secret in an open hearing.

General ELLIS. Yes, sir.

Sir, my name is Maj. Gen. Vincent H. Ellis. I am the Deputy for Materiel Acquisition, Office of the Assistant Secretary of the Army for Installations and Logistics.

I am pleased to have this opportunity to appear before this subcommittee to present a summary of the M561 Gama Goat program. In its assigned role, the Gama Goat will perform better than any other vehicle known in the world today. It is an articulated high mobility vehicle designed to operate over extremely difficult terrain. In order to achieve this level of performance, it has been necessary to incorporate design features not found in wheeled military vehicles. Consequently, the Gama Goat is not a conventional truck. Some complexity has been necessary to achieve the exceptional mobility. Due to this complexity in design, the M561 program has experienced some setbacks and problems. These have largely been overcome and we consider the M561 to be an extremely effective item of equipment.

We are reasonably satisfied with the Gama Goat program from its inception to release of the vehicle to troops. The kinds of problems we encountered are those which are usually experienced in a program which seeks something new and better. The important thing is that personnel associated with the program have taken positive action to solve problems promptly as they were identified. The Army feels that management at all levels has been effective and that, all in all, the Gama Goat program has been a successful one.

The Gama Goat is an outgrowth of a recommendation contained in the CONARC study entitled MOVER (motor vehicle requirements

army in the field). The qualitative materiel requirement (QMR) was approved in May 1961. The Gama Goat will be issued to active Army units which habitually operate forward of the brigade rear boundary; that is, units in actual contact with the enemy, where mobility pays off the most.

The Gama Goat system consists of two body styles, the M561 cargo truck and the M792 ambulance. They are both articulated, two-body vehicles, powered by a 3-cylinder diesel engine. Some of the military characteristics which we sought in this vehicle are: improved cross-country mobility and better fuel economy compared to other wheeled vehicles in this weight class, a capability of towing trailers up to 50 percent gross vehicle weight (GVW), sustained highway speed of 50 m.p.h., air transportability, a capability of aerial delivery, and an inherent swimming capability.

Following approval of military characteristics in December 1961, a request for proposals (RFP) was announced to industry for truck cargo, 1¼-ton, 6 x 6, M561 on February 8, 1962. Proposals were received from six major corporations in the final consideration during May 1962:

Chrysler Corp	$2,394,992
Chevrolet Division of General Motors	2,500,000
LTV (short wheelbase version)	2,854,983
Willys Motors	5,154,776
American Motors	6,546,839
Ford Motors	8,471,500

Following an in-depth evaluation, LTV was selected since their proposal offered the greatest probability of achieving the desired increase in mobility.

A cost-plus-incentive fee contract for the development of the 1¼-ton M561 was signed in March 1963 for $2,480,070 and LTV initiated basic design and mockup fabrication. An official Army-wide review called an in-process review was held in May 1963 to evaluate this design. This review resulted in approval of the proposed configuration of the XM561, and LTV was authorized to proceed with preparation of facility drawings and construction of two test rigs. These vehicles were completed in January 1964, and tests were initiated at Dallas, Tex., and Aberdeen Proving Ground (APG), Md. Release was given to LTV in July 1964 to fabricate 12 Army prototypes.

Testing at the various USATECOM test sites exposed the XM561 to heavy use in every environment, with encouraging results. For instance, three trucks were tested in excess of 30,000 miles each at Yuma and Aberdeen. The results indicated that the vehicle was durable and had a high (90 percent) drawbar pull/weight ratio. The normal for wheeled vehicles is in the vicinity of 50 percent.

A test rig was air dropped at YPG. Tests conducted at Aberdeen Proving Ground revealed that the XM561 fuel economy was over 9 miles per gallon during normal military use, compared to 6 miles per gallon on the vehicle being replaced.

Tests at the service boards, Fort Sill, Fort Knox, and Fort Benning verified the service potential of the vehicle, especially with the various XM561 kits. The swimming ability of the vehicle added a new dimension to small-unit mobility. Tests at both the tropic and arctic centers proved that the XM561 would go many places a normal wheeled vehi-

cle will not go. The XM561 was tested alongside the M37 ¾-ton truck in most cases, since it was scheduled to replace this vehicle in all units normally employed forward of the brigade rear boundary. The XM561 performance was superior to the M37. More than 240,000 miles of testing was completed on the R. & D. prototype vehicles.

The XM561 was type classified standard A in June 1966. All essential and most desirable requirements had been met except one—durability.

At the time of type classification, an indepth review was conducted of all possible alternative courses of action. It was decided that the risk of proceeding with the program was minimal and more cost effective because: (1) Design corrections were known for unresolved problems. These involved minor components and it was not economically feasible to build additional R. & D. prototypes at a cost of $250,000 each to verify modifications; and (2) the next program phase (advance production engineering) was already underway and during this phase preproduction vehicles would be built and tested.

Type classification as standard A was concluded with the provision that advance production engineering vehicles would be tested and a special inprocess review conducted before award of the production contract.

During the final phases of the development, authority was obtained to award a cost-plus fixed fee advance production engineering contract to LTV.

The contract was awarded to LTV in June 1965. The scope of work included preparation of a technical data package and fabrication and delivery of six preproduction pilot vehicles.

Production drawings were completed by LTV during the period December 1965 through August 1966 with initial release of the tech data package in September 1966 and a supplementary release in January 1967. Four pilot model trucks were tested to validate the tech data package. Three of the trucks ran a total of 60,000 miles, while the remaining truck was used for maintenance and training purposes.

A special Army review was conducted in April 1968 to assess the test results of the final APE design. The following conclusions were reached:

1. The M561 truck met performance and maintenance requirements.
2. Reliability requirements were not completely demonstrated but appeared definitely obtainable.
3. Unresolved R. & D. (ET/ST) deficiencies and shortcomings discussed at inprocess review V (IPR V) had been corrected and verified by test.
4. Additional problems disclosed during APE testing had been corrected.
5. The risk of continuing the program to production was minimal and reasonable since the corrections for all problems were known and production vehicles would be subjected to future testing by TECOM.

Based on a detailed cost effectiveness and requirements analysis conducted by the Army, OSD approved, in August of 1967, the procurement of 13,050 Gama Goats for Army use and 2,224 trucks for the Marine Corps for a total of 15,274 trucks.

These numbers have since been revised to 12,516 Army, 1,758 Marine trucks, and one truck for Italy for a total of 14,275. A 3-year multi-year contract was approved.

It is noteworthy to recall the prevailing climate at that time. Truck assets in this weight class were in short supply. We had decided to stop sole source procurement of the M37 ¾ ton. We were determined to meet this commitment while at the same time watching our dwindling assets.

Although the foregoing environment was certainly in the minds of those who made the decision, the most important considerations in the decision to proceed with production were the status of development and the fact that the Gama Goat had demonstrated a distinct breakthrough in wheeled mobility, one which would provide the Army a highly desirable increase in capability.

Prior to release of the data package to industry, the package was given a thorough review.

A senior blue ribbon committee at the Tank and Automotive Command (TACOM) personally checked the package to verify its completeness of coverage.

To assure an indepth evaluation of the bids, a Procurement Evaluation Board and Council were established to review both steps of this 2-step procurement. These groups were chaired by a civilian super-grade procurement expert and a general officer respectively.

Two new techniques were incorporated which we had not heretofore employed on an automotive type contract. These were:

A. A plan for augmented contractor support of the trucks during the early phases of deployment. The plan included phased provisioning, contractor field representatives and a review of the technical manuals.

B. The other technique is preproduction evaluation, PPE. This concept was adapted from a similar approach already in use at the Frankford Arsenal.

Phased provisioning as incorporated into the Gama Goat contract is a contractor-managed system to assure a rapid replenishment for selected repair parts during early operational phases of the system. Parts which are peculiar to the Gama Goat are the principal candidates.

To implement this idea, the contractor established a buffer depot. The contractor maintains a small prescribed stock level of the Gama Goat peculiar parts specified by the Government. He will provide these as replacement parts until enough trucks are deployed and usage rates are determined to allow for proper Government provisioning.

Also included in this concept are a small number of contract field service representatives, and contractor verification and correction of the technical manuals for the truck.

The preproduction evaluation of the technical data package has proved to be a very effective instrument in avoiding costly changes of the type sometimes used by the contractors to get well.

This evaluation places the risk on the contractor to verify the accuracy of the drawings and specifications before he procures the parts for his assembly line. This verification for form, fit, and ease of

manufacture—form, fit, and possibility of manufacture—requires the contractor to detect and correct any errors, omissions, and manufacturing interferences during the early phases of his production leadtime. He must make these corrective actions within the fixed price and schedule of the contract. This includes corrections not made before he orders parts for his assembly line.

The results of this PPE have been very gratifying. To date we have received 1,597 separate PPE proposals from the contractor and have approved 1,311 of these—252 were rejected by the Government. The remaining few were withdrawn or combined with others.

Every one of the 1,311 actions approved resulted in a correction at no additional cost to the Government. This has resulted in no costs for change except those Army-directed changes aimed at improving performance, that is, correcting deficiencies and overcoming safety problems—now estimated at $286 per truck—a little over 3 percent of the value. This figure includes approximately $70.05 for definitized changes and the balance for those changes still being negotiated.

PPE is now also being employed in the GOER and M151 Jeep procurements. A comparison of PPE proposals of these three programs is:

	Received	Approved	Rejected	Other
GAMA GOAT	1,597	1,311	252	34
GOER	528	400	103	25
Jeep	298	288		10

It should be noted that the Gama Goat is a case where the producer (CONDEC) is a firm other than the developer (LTV). It is also a first production of a unique vehicle which has never before been produced by American industry.

On the other hand, the GOER is a case where the developer won the production contract. This is also a first production, with no vehicles yet delivered. In spite of the fact that this contractor is building to his own drawings, he has already detected, early in production leadtime, 528 flaws in his own data. I am reasonably sure he will find more.

The Jeep contract is the sixth production contract in 14 years. Over 170,000 of these vehicles have been built during this time. This is the second production contract for this firm. In spite of this, there have been 288 approvals. This is an indication of the long-range value of the PPE technique as a way to avoid costs for correction of data mistakes, often made in the first place by the claimant.

Moving now to the actual procurement, a two-step invitation for bid (IFB) was released on September 18, 1967.

Every possible effort was made to assure a positive and healthy competition.

Six responsible firms responded to both steps of the IFB. I will read these and the amount of their bids in the order of bid value:

	Millions
Consolidated Diesel Electric Co	$132.1
Ford Motor Co	153.4
LTV Aerospace/Kaiser Jeep Corp. (joint venture)	160.0
Baifield Industries, Inc	168.5
Chrysler Motor Corp	184.3
Bowen-McLaughlin-York, Inc	184.5

The total spread of these bids was $52.4 million.

The low bidder, CONDEC, was $21.3 million below the next lowest bidder. Obviously this wide variance required that a careful scrutiny of the bids be made before a contract award.

Here again, experienced and qualified personnel were assigned to the task. A greatly expanded preaward survey was made.

The question of whether CONDEC's bid price represented an attempt to "buy in" was specifically examined by the Procurement Evaluation Board during the preaward survey.

CONDEC, as well as Ford and LTV, provided cost breakdown data to the Government teams. This was highly unusual. In an advertised procurement, a bidder is not required to reveal any cost details to the Government.

The preaward survey explored every detail and included visits to planned offshore vendors.

After a thorough price evaluation, the Board concluded (on page 1, paragraph 1d, of its report dated April 16, 1968), and I quote:

> The bid price of Condec is realistic, fair and reasonable. There was no evidence of a buy-in or mistake in bid.

The contract was awarded on June 11, 1968, to Consolidated Diesel Electric Co.

Since award, there have been few, if any, opportunities for CONDEC to "get well" through change orders, claims or follow-on awards.

A solid inhibiting factor has been the requirement that CONDEC submit a complete cost breakdown with each proposal involving changes. These breakdowns have been subjected to extensive analyses. In addition, CONDEC has furnished a certificate of current cost and pricing data in connection with all settlements over $100,000 which are subject to review by the Government for any possible defective pricing.

The $132.1 million basic contract has been amended a number of times for various reasons. The dollar value of these changes to date is $10.4 million. This amount includes $1 million for engineering changes. Other negotiated changes are: escalation, $4.4 million; provisioning, that is, necessary repair parts, $2.7 million; conversion of 1,246 trucks to ambulances, $1.7 million; documentation, $0.1 million; and $0.5 million, miscellaneous. This is about 8 percent of the basic contract price. In addition, $3.3 million of unnegotiated changes are under consideration.

As I stated earlier, there have been no opportunities for unusual price growth in this contract and none are expected. With the reduction of 1,000 trucks, we expect the final contract price to be $139.7 million.

In summary, the entire program including cost growth is considerably less than what would have been expended with the next highest bidder. Competitive bidding and the contractor's performance have resulted in a net cost avoidance of at least $9 million.

I will now move from cost aspects to the subjects of production and release rationale.

Initial production tests began in June 1970 with 11 vehicles. A total of 450,000 miles of testing on 27 vehicles was accumulated before the end of IP testing in October 1971. Because of the relative complexity of the vehicle design and the rigorous test program, some problems

were expected and were experienced. Test vehicles were operated additional miles to prove out design changes applied in process.

The Gama Goat experienced problems, particularly during the early phase of testing, but not unlike those experienced on other similar programs. The requirement for the initial production test—before troop issue—was initiated in 1968 across the board for all military vehicles. Our experience on other military vehicles demonstrated the need for this protective measure. Of course we know that commercial industry conducts extensive testing of their products before putting them on the market. There is no difference in experience; however, they do not broadcast their test results to the user as is the case with military vehicles. We send out test results to 45 addressees within the military.

The Gama Goat was developed by LTV; CONDEC is producing it in quantity production for the first time. New or different suppliers are providing many of the components and subassemblies. We, the Army, retain design responsibility while attempting to maximize performance and minimize cost. We insist on maximum standardization of hardware and have acquired drawing rights so that secondary procurement of spare parts in later years may be competitive and all parts completely interchangeable. It is not unusual that problems were found on the first production units being tested. Problems would have been found regardless of the development effort, or who produced the truck.

Quality performance in the beginning of the M561 program was less than desired. The first 11 vehicles sent to the test sites were returned to the manufacturer for replacement due to deficiencies found during pretest inspection. All of the vehicles produced during this time frame were corrected for contractual quality problems by the manufacturer to the satisfaction of, and at no cost to, the Government.

The Army, together with DCAS, the Defense Contract Administration Service, established intensive management of the quality assurance program for the inspection and acceptance of the M561 vehicles at both manufacturing sites. The average number of defects per vehicle, in vehicle lots submitted by the contractor for acceptance, decreased by more than 80 percent between June 1970 and June 1971 and has remained constant since June 1971. Since production deliveries commenced on the Gama Goat program, 23 of 563 lots submitted to the Government have been rejected for a 4-percent lot rejection rate. Progressive improvement in CONDEC's quality performance is evidenced by the fact that none of the 177 vehicle lots submitted since July 1971 have been rejected.

An in-depth review of the Gama Goat was conducted by a panel of general officers representing the Assistant Chief of Staff for Force Development; Deputy Chief of Staff for Logistics; U.S. Continental Army Command; U.S. Army Combat Developments Command; U.S. Army Materiel Command; and U.S. Army Test and Evaluation Command in May 1971. The panel decided to release vehicles to troops within the continental United States.

Considerations and rationale for that decision were extensive and are contained within the Final Report of Special Review Panel M561 (Gama Goat) 1¼ Truck which has been furnished to the subcommittee.

In March and April 1971, 48 Gama Goats were issued to the 4th Infantry Division at Fort Carson, Colo., to determine initial troop re-

action and gain experience on the truck under normal troop use and to check the adequacy of the logistical support plan.

On November 9, 1971, a final report was issued on these trucks after a total of 24,081 miles had been accumulated. The report in essence stated that the trucks had proved to be exceptional vehicles in overall performance and their maintenance problems had been minimal.

Since that date an additional 346 vehicles have been issued to Fort Carson. At the conclusion of 14 months of use, the 4th Infantry Division (mechanized) states that, "The cross-county capability of the Gama Goat is unparalleled and the Gama Goat provides mobility not attainable with other wheeled vehicles." The operational availability of the vehicle has been outstanding, with minimal direct and general support maintenance required.

Approximately 1,500 additional vehicles have been issued to other CONUS units. Based upon experience to date, the consensus is that the Gama Goat is an outstanding vehicle under field conditions and can operate over almost any terrain.

Approximately 4,400 M561 trucks have been stored in depots pending verification of all modifications designed as a result of tests.

A $6.3 million retrofit program for these vehicles is underway. Installation of some changes was initiated in August 1971. With the remaining parts now available, this program will be resumed about June 1, 1972. All retrofitting will be completed during the next 12 months. This program is necessary to incorporate into the early production vehicles the corrections resulting from initial production testing.

This program will bring all vehicles to the approved configuration.

Retrofit seems to be a way of life in the manufacture of automobiles. For example, manufacturers of domestic vehicles have found it necessary to effect motor vehicle safety defect recall campaigns for the purpose of correcting deficiencies on production vehicles. During the period September 1, 1966, through December 31, 1971, there was a total of 52,668,313 domestic vehicles produced in the United States. To date 22,619,139 of these vehicles or approximately 43 percent of the total production have been recalled for safety modifications. The figures will continue to increase as new recalls are issued and would be considerably greater right now if domestic vehicles with reliability and maintainability deficiencies were recalled for correction.

Next I want to address reliability. Reliability is the one area that was of major concern and is a direct indication of vehicle dependability and maintenance man-hours that will be expended to keep trucks operational. Reliability is a measure of the degree of effectiveness of all the design improvements and emphasis on quality control that I have just covered.

There have been several ways of measuring or depicting reliability. For example, it can be stated in terms of mean miles between failure or, as was the case with the M561, stated in terms of maintenance. This was a suitable means in the past because it was descriptive to the designer. Reliability requirements stated that way had one drawback: it was difficult to quantify test results or compare performance of one vehicle with another.

During the years since the drafting of the Gama Goat requirement a more sophisticated means of stating our requirements has evolved. We have borrowed from the electronics field. Vehicle requirements are

now stated in terms of a probability that a specific function will be performed for a specific time under given conditions. An exponential formula is used to calculate values based on given test results. This has proven to be a useful tool to the decisionmaker because all systems can be compared on an equal basis and a given system can be tracked to show improvements.

For example, the reliability of the Gama Goat increased during the sequential production testing from 85 to 92 percent. This compares very favorably with other vehicles in the fleet. Initial reports on trucks in the hands of the user approximately 1 year, show a reliability of more than 98 percent. That is the result of low mileage and new vehicles. The 85 and 92 percent are spread over the first 10,000 miles.

Summing up, we find the reliability of the Gama Goat acceptable as it is now being produced.

The M561 represents a significant advance in wheeled vehicle mobility.

The M561 vehicle meets the essential requirements stated in military characteristics documents.

User reports indicate satisfaction with the capabilities and performance of the Gama Goat, and only minimal problems.

As a high mobility vehicle, the Gama Goat will require more maintenance than the conventional wheeled vehicles which it replaces but less than the tracked vehicles it accompanies.

As I mentioned earlier, quality control has been a problem. However, TACOM, CONDEC, and DCAS have increased their efforts in this area as problems were identified. Current production demonstrates a significant improvement in the quality of the product.

As of May 9, 1972, CONDEC has produced 9,526 vehicles. The Army has accepted 7,980 vehicles including the 4,400 early production models which will require some correction before release.

The transition from development to quantity production is always complex and difficult. The M561—the Army's biggest step forward in many years in terms of ground mobilty—has effected that transition and troops in the field are now receiving a good, dependable vehicle. Testing has revealed problems in vehicle design and problems in quality. The problems have been corrected. The Army has developed a product improvement program which will further enhance the Gama Goat's capability. The truck has been in use by our soldiers for 14 months and has given a good account of itself. With the Gama Goat, our fighting man now has a degree of ground mobility never before achieved with wheeled vehicles.

Mr. PIKE. General Ellis, that was such a magnificent testimonial to a wholly successful program that I frankly wonder why we are here.

Dr. Hall, do you have any questions?

Mr. HALL. Yes, Mr. Chairman, I have a whole passel of questions. But I understand some of the members of the committee have to leave. I am set for as long as we need be here. I will be glad to yield.

Mr. PIKE. Mr. Daniel? I am going to have questions too, obviously.

Mr. DANIEL. Are you going ahead with the questions on the general's testimony now?

Mr. PIKE. Yes. We will ask questions to the extent anyone wants to. Go ahead, Mr. Daniel.

Mr. DANIEL. How many M561's did you contract for, General?

General ELLIS. The initial contract, sir, including the Marine Corp vehicles, was, if I recall correctly, 15,274. Am I right?

Yes.

Mr. DANIEL. How many of these vehicles have been delivered?

General ELLIS. Delivery to date, sir, is in the vicinity of 9,000. As of May 9, 9,526, sir.

Mr. DANIEL. What contract price did you agree on?

General ELLIS. $132.1 million, initial contract price.

Mr. DANIEL. How much per vehicle is that?

General ELLIS. The division of the contract price by the number of vehicles yields a number that we refer to as the contract unit price, which is different from an "all-up" price, including R. & D., other costs, inhouse costs, engineering.

The unit contract price as originally signed—$8,450 on the average.

Mr. DANIEL. $8,450. What is the other term you used? "up and away contract"?

General ELLIS. Total program costs. When we present our budget to the Congress we have to include a lot of costs to the program, such as the engines, which are GFE, inhouse engineering, a lot of other things. The "all-up" cost as of now is just slightly less than $15,000 per copy.

Mr. DANIEL. In your initial contract talks was it $8,450, or $15,000?

General ELLIS. Contract, $8,450. That is contract with the vehicle producer not including the cost to us of furnishing the engine, cost to us of testing and managing the program.

Mr. DANIEL. Where does the $5,000 figure come from?

General ELLIS. That was a very early estimate, sir, in the sequence of the program prior to any development effort being done. We were then even thinking it would come out in the ¾-ton weight class. That $5,000 is an early estimate that improvements to the design of the vehicle during the course of a normal development program increased.

Mr. DANIEL. How much of the increase was caused by design change?

General ELLIS. I would say practically all of it, sir.

Mr. DANIEL. Practically all the additional cost was caused by design changes requested by the Army?

General ELLIS. Yes, sir; during the course of development. We thought very early in the game that the vehicle would be smaller; and we did not anticipate the growth of the vehicle that would occur during the development process except for that which would be classified as a "poor estimate" in the first place, and we have no way of stripping that out at this moment. The $5,000 may have been a low estimate.

Then, the rest is due to design changes and escalation.

Mr. DANIEL. Let's talk about the 4,400 that are in the garage, in storage.

Mr. HALL. Mr. Chairman, would the gentleman yield for a question on this subject?

Mr. DANIEL. Certainly.

Mr. HALL. I have a question concerning the percentage of increase based on changes in engineering requested by the Army, of the producer. Did these come before or after it was classified standard type A?

General ELLIS. The part we are addressing now, from the $5,000

up to the contract price in the vicinity of $8,000, all occurred during the development stage, prior to award of a production contract. These were about half and half: Half of them due to design changes that occurred during the development program, approximately half due to price escalation though occurred during that period.

Mr. HALL. Mr. Chairman, I wonder now if he can answer my question?

Before or after it was—whatever you call it—type classified standard A?

General ELLIS. Before. Before.

Mr. HALL. Thank you.

Mr. PIKE. Excuse me, Mr. Daniel.

You are saying, General, there have been no design changes since it was type classified standard A?

General ELLIS. No, sir.

Mr. PIKE. Then I have difficulty understanding your response to Dr. Hall. To Dr. Hall you said that these changes occurred before it was type classified standard A. Now you are saying there have been changes after? Are you saying the changes after it was type classified standard A did not cost anything?

General ELLIS. No, sir; I am not saying that. I am saying the difference between the estimate of $5,000, that was raised, and the $8,000-plus-contract price entered into were the result of design changes and escalation that preceded type classification standard A.

There have been additional changes to the design of the vehicle since it was type classified standard A, that have now raised the contractual cost, the contractual hardware cost, to above $9,000 a vehicle.

There has been somewhat over $1,000 per vehicle in design changes that we have found necessary to make subsequent to type classification standard A, and entering into production.

Mr. PIKE. That is $9,000 without the engine?

General ELLIS. Without the engine, without the other program costs that run it up to about $15,000 a copy.

Mr. DANIEL. Mr. Chairman, wouldn't it be helpful to get all these costs into one package, so we know what we are talking about?

General ELLIS. Yes, sir.

Mr. PIKE. I think it would be.

General ELLIS. I would be delighted to provide such a package.

(The following chart was subsequently furnished for the record.)

M561 PROGRAM COSTS

	1 Original program (May 1964) Army materiel program	2 At contract award (April 1968) Army materiel program	3 Selected Acquisition Report (June 30, 1971)	4 (Mar. 31, 1972)	5 Present w/USMC
Program acquisition cost (PEMA and R.D.T. & E.) (millions)	$65.7	$163.9	$181.1	$185.1	$206.4
Number of vehicles	9,000	13,050	[1] 12,530	[1] 12,530	14,293
Program unit cost	$7,300	$12,550	$14,453	$14,773	$14,441
Procurement cost (PEMA only) (millions)	$60.8	$158.8	$171.6	$175.6	$196.2
Number of vehicles	9,000	13,050	[1] 12,516	[1] 12,516	14,275
Program unit cost	$6,756	$12,169	$13,710	$14,030	$13,744

[1] The difference between 12,530 vehicles (columns 3 and 4, program acquisition cost) and 12,516 vehicles (columns 3 and 4, procurement cost) represents 14 R. & D. prototype vehicles.

Mr. DANIEL. The target weight for the vehicle was originally 2,500 pounds, is that correct, General?

General ELLIS. I don't think that is correct.

Colonel BERGQUIST. No; that is the cargo-carrying capacity.

Mr. DANIEL. What is the cargo capacity now, after the design changes?

General ELLIS. 2,500, a ton and a quarter, still.

Mr. DANIEL. All right. Let's talk about the 4,400 vehicles in storage. who is going to pay for those?

General ELLIS. I am, sir. The Army will pay for those.

Mr. DANIEL. Are they included in the $15,000 cost per vehicle?

General ELLIS. Yes.

Mr. DANIEL. What will you be able to salvage from those vehicles? Or will you be able to use them after the corrections are made?

General ELLIS. Absolutely. They will be modified to the current configuration being issued in Europe, the acceptable configuration, by addition, or replacement, of components which we have replaced during the course of production on those now being successfully reproduced.

Mr. DANIEL. Who pays for the cost of that?

General ELLIS. The Army.

Mr. DANIEL. Why shouldn't the contractor pay for them?

General ELLIS. Because of deficiencies in the drawings and specifications we gave the contractor and said, "Make the vehicle like that." He did, the vehicle was not sufficiently durable.

Mr. DANIEL. In other words, these vehicles were made to your specification, then you changed the specification. Is that what you are saying?

General ELLIS. That is correct, sir.

Mr. DANIEL. Mr. Chairman, will you please excuse me? I have to leave. I appreciate the opportunity to ask those questions.

Mr. PIKE. You owe your thanks to Dr. Hall.

Before you start, Dr. Hall—what you are telling the committee in response to Mr. Daniel's request is that the Army did not require the contractor to provide a vehicle that would perform in a certain manner; it merely required the contractor to produce a vehicle which would comply with some drawings the Army provided; is that correct?

General ELLIS. That is correct, sir; absolutely.

Mr. PIKE. So if the vehicle does not perform, then it is the Army's fault, not the contractor's?

General ELLIS. Absolutely, sir.

Mr. PIKE. And the payment to which you refer as coming from the Army, which I would refer to as coming from the taxpayer——

General ELLIS. Yes, sir.

Mr. PIKE (continuing). Will continue to come from the taxpayer, and there will be no recourse whatsoever against the contractor?

General ELLIS. That is correct, sir, on the 4,400 vehicles.

However, had we taken any other course of action the taxpayer would have been $21.3 million out at the start. So we feel a $6.3 million retrofit program, as part of our continuing effort to save the biggest part we could possibly save of that $21 million—the difference between the low bid and the next low bid—is still a guaranteed saving to the taxpayer on this procurement of, at the very least, $9 million.

Mr. HALL. General, how long since you have paid troops on payday?

General ELLIS. Sir, it has been a good 25 years.

Mr. HALL. Does the service still require that a company or platoon commander, when he pays his men, have a military escort and sit there with his sidearm up on the table and pay the troops? Or is it done by computer and a checkwriter these days?

General ELLIS. Sir, I don't know. I will have to consult one of the younger officers.

Mr. PIKE. You won't find a younger officer in here, General. [Laughter.]

General ELLIS. I don't know. I will be glad to attempt to find out.

Mr. HALL. It is not worthwhile finding out. I am setting the stage for a question.

In the days when the Army used to do that, there was a regulation that said, if you did not come out even after you paid the troops in cash, you made the balance up out of your pocket. If you were over, God help you, unless you could redline it out on the payroll. This was based on the doctrine of the accountable officer being responsible.

Is there any such doctrine we make in the services nowadays, after your 25 years of not paying the troops?

General ELLIS. There is, indeed, sir. There is indeed.

The professionalism, the integrity, and the honesty of the present Army is the equal of anything we have ever had, sir.

Mr. HALL. Have you ever known in the last 25 years—whether you have been involved in paying troops or not—of any officer being required to dig down in his own pocket and be responsible for that which he is held accountable?

General ELLIS. Specifically, I cannot recall a case.

Mr. HALL. Well, I can, General. And those cases are relieved by what is known in the Congress as the private bill technique, after manipulation through the Judge Advocate General's office. But that is neither here nor there.

You sat here and heard the chairman of this committee's opening statement.

General ELLIS. Yes, sir; I did.

Mr. HALL. As he says, your statement is at such variance with it that it makes us wonder why we are here. I know why we are here. I don't want to belabor that.

Is it a fair assumption that you disagree with the point-by-point emphasis contained in the chairman's opening statement as to the history of the delivery of the Gama Goat to the using troops in the field?

General ELLIS. No, sir. I find no point of fact on which to disagree with the chairman's statement.

Mr. HALL. There must be a difference in semantics or rhetoric as to how you present the case, then. Is that the difference?

General ELLIS. The difference, sir, is one of scale of values.

I have been associated with trying to get vehicle programs, artillery programs, moved from development into production, since 1958. It is a very difficult and complex process. It is always fraught with problems.

Mr. HALL. Oh, I agree, General. I think this entire committee agrees with you. And I would like to interrupt right at this point to say that

I hope the House Committee on Armed Services is the best friend that you, or at least your consuming troops, have.

General ELLIS. This is true, sir.

Mr. HALL. We certainly want to continue that way.

Actually, my concern through the years has evolved into how in the world you ever get anything into the hands of the using troops, in view of all these technical evaluations, cross-command utilizations, feasibility tests, and approval by higher and lower authority.

As a matter of fact, I had the Secretary of the Army provide me earlier this year with a list of steps that any concept must go through before it becomes a productive item utilizable by troops; and it is almost unbelievable that you ever get anything done. Of course, your record is not very good, whether you are talking about the M–1 or the M–16, or types of explosives, or ballistic efforts, and so forth. We have become so surfeited and bound down with technology and the interplay of the suppliers with the using service that it is remarkable if we ever get anything done.

There has been a 10-year slippage, as I understand it, or will be a 10-year slippage, in actual expected delivery of the Gama Goat to the troops. Now, I am speaking very generally. Originally, I understand, it was planned in 1965 and 1966 to replace the quarter-ton truck and ambulance and jeep, and so forth and so on, with this type of concept—speaking very generally. It slipped, so now you will be lucky if you get it produced and delivered in the quantity you have decided you need, before 1975. That is what I mean by a 10-year slippage.

Meantime, it must have been necessary for you to refram—excuse me, that is a Navy expression for destroyers, I guess—modernize, update, retrofit, make available and usable, all the M–37's you have. Have you placed a reorder for any M–37's in this timelag?

General ELLIS No, sir. No M–37's have been procured. But a vehicle known as the M–715, a 1¼-ton truck, has been procured during this interim.

Mr. HALL. What was the total cost of that procurement?

General ELLIS. Sir, I do not know the total cost of that procurement.

Mr. HALL. Could you even round off a figure?

General ELLIS. I don't have that information. I can obtain it.

Mr. HALL. If you don't have that figure, anyway, is it not included in the increased cost of the Gama Goat?

General ELLIS. No, sir. It would not be proper to do so.

Mr. HALL. Even though it was used to shore up the needs of the service while we were doing all this slipping?

General ELLIS. Two vehicles were to have been developed to replace the ¾-ton—the high-mobility Gama Goat to operate in front of the brigade rear boundary, and the XM–705, a low-mobility vehicle to operate behind the brigade rear boundary.

Mr. HALL. What is a GOER?

General ELLIS. That is an 8-ton cargo carrier built sort of like a scoop piece of construction equipment. It has oversized construction-industry tires, a wagon steer that gives it unusual mobility, and a very high carrying-to-tare weight ratio.

Mr. HALL. Not comparable in any way to the Goat, not for the same purpose?

General ELLIS. No, sir. No way.

Mr. HALL. As it came up in the description I thought they were more or less concomitant developments.

General ELLIS. Only similar in that both are high-mobility-type vehicles and both have the PPE provision in the contract; and that provision is working to our advantage.

Mr. HALL. Mr. Chairman, I think my general, probably poorly developed but basic, point stands, that we have had a lot of slippage, we have had to reorder something for the troops to use in the meantime, while we were changing our specs, improving our engineering design. Is this a fair statement, General? A lot was done after type classification standard A was permitted?

General ELLIS. A lot of the design changes to the Gama Goat for replacement of the small quantity of M–37's used in front of the brigade rear boundary was done after type classification.

The large dollar value of the procurement of the M–715 vehicle has to be spread over the entire Army requirement and could in no way be thought of as an additional cost resulting from slippage in the Gama Goat program.

Mr. HALL. The point remains, beyond all of this, you still have a hard, firm requirement for this type of vehicle, which you took the committee out to Fort Belvoir and demonstrated, by using troops at the earliest practical date.

Is that a fair statement?

General ELLIS. It is a fair statement.

Mr. HALL. Mr. Chairman, this gets us into exactly the same position we have been in with slippages and/or cost overruns in recent years. With high costs, cost overruns, we get between a rock and a hard place because we want to see that the troops are supplied, and we do not believe it is the function of a centralized or Federal Government to eliminate the supplier.

But with the different contracts and different procurement methods with which we must be concerned as supervisors with surveillance, oversight, and review, we reach the point that we have to say, at one end of the stick, our troops need it regardless of the cost, regardless of errors, regardless of accountability, regardless of responsibility; we cannot leave them naked before the enemy and the aggressor. On the other hand, we come up against a situation where, in at least other areas, it has been demonstrated there has been gross neglect of accountability and responsibility.

What is the function of CONDEC under the current contract you have?

General ELLIS. The function of the contractor is to produce the vehicle precisely to the drawings and specifications that have been provided him in the technical data package.

Mr. HALL. And that technical data package, I believe you testified or told us the other day in the field, does not include the Detroit diesel engine?

General ELLIS. That is correct, sir.

It does include the Detroit diesel engine, I am sorry.

Mr. HALL. I thought you said that was Government-furnished.

General ELLIS. That is correct. The contract price with CONDEC does not include the value of the Government-furnished engine. I misunderstood the question.

Mr. HALL. Well, let's be sure we get that clearly in the record, now.

As I understand it, the existing production contract with CONDEC is purely and simply for an assembly of the vehicle, and it is done in two different places. What I am getting at is how you ever arrived at this kind of contract. Because in addition to the Government-furnished equipment, including the basic engine, which is pretty important to any moving vehicle to move people, equipment, or anything else, turns the wheels, there are also many other things, including the wheels which are bought offshore, and the brakes which were part of the retrofitting and updating or improved engineering design.

Is it not true that all CONDEC does is to assemble these trucks at two different plants, and their contract is not really a production contract in the sense that they cast iron or mold metal or anything, but they simply bring together at assembly points these things, assemble them, produce them, and deliver them to you?

General ELLIS. No, sir; they are not just as assembler. The other companies who bid on the program aimed mainly at being an assembler.

The reason for the $21.3 million lower bid by the present contractor was that he was willing to help us try to avoid a sole-source situation on actual assemblies that would have cost us about half of the $21 million had we gone to another producer; tried to help us avoid a sole-source position on the sealed wheel end brakes and was willing to undertake the manufacture himself of the difficult part of the body structure.

All other offerors were going to subs on those three difficult parts.

The present contractor, responding to the competition that we provided for, undertook to do a much more difficult job of manufacturing in an attempt to save us money than did other bidders. That is why he won.

Mr. HALL. That is a pretty straightforward statement in favor of CONDEC. And you are obviously impressed by their cooperation and willingness and their original submission of bid.

I believe you said there was a blue ribbon senior committee, or words to that effect, that, because the bid was so much lower, investigated and checked out their capability. Were you on that committee?

General ELLIS. No, sir; I used the term "blue ribbon committee" in connection with the final scrubbing of the tech data package prior to its being given to the bidders.

The evaluation I spoke of was done by the evaluation board which was headed by a supergrade at the Tank Automotive Command.

Mr. HALL. Can you identify that supergrade civilian for us?

General ELLIS. Yes, sir; Mr. Henry Jones.

Mr. PIKE. Is he in the room today?

General ELLIS. No, sir.

Mr. HALL. He is at the Tank Command, and where is that?

General ELLIS. Detroit, sir.

Mr. HALL. Do you have any of the other procurement officers here with you as backup witnesses today, who are in the armed services, that had to do with the letting of this contract to Consolidated Diesel?

General ELLIS. No, sir.

Mr. HALL. Is there anyone who is knowledgeable about the actual signing off of that contract?

General ELLIS. Not here with me today. I don't think.

Is John Bruce back there?

(Calls of "Yes, sir.")

General ELLIS. Great scott, John. Welcome aboard.

Mr. Bruce was the contracting officer.

Mr. HALL. Mr. Bruce, did you ever meet with Consolidated Diesel at the Market Inn during the process of signing this contract?

TESTIMONY OF JOHN BRUCE, CHIEF, SYSTEMS PROCUREMENT DIVISION, PROCUREMENT AND PRODUCTION DIRECTORATE, U.S. ARMY TANK-AUTOMOTIVE COMMAND, WARREN, MICH.

Mr. BRUCE. No, sir. I don't know where the Market Inn is. But I did not.

Mr. HALL. Did you ever have any other informal meetings with Consolidated Diesel about, or pertaining to, the award of this contract at any place outside of your place and office of business?

Mr. BRUCE. No. sir. This was an invitation for bid, so there was no negotiation as such.

Mr. HALL. Oh, but there often can be, Mr. Bruce and General, after an invitation to bid is ordered. This committee is an old hand at how these things come into being.

Mr. BRUCE. I can unequivocally state that I have had no contact, social or otherwise, other than a visit to their plant on a business review of the production, or——

Mr. HALL. Can you tell us, and furnish to the committee, who actually did submit the bid to you and/or your procurement office from Consolidated Diesel?

Mr. BRUCE. I believe it was mailed, sir, in a sealed envelope. I know it was in a sealed envelope, because the award was a result of a formally advertised invitation for bid.

Mr. HALL. You were not contacted by their Washington representative or counsel at any time concerning this bid or the right to revise the bid?

Mr. BRUCE. No, sir.

Mr. HALL. Who is your immediate superior, Mr. Bruce?

Mr. BRUCE. Mr. Jones is my immediate superior, sir.

Mr. HALL. Who is the Army officer in charge of your division?

TESTIMONY OF MAJ. GEN. JOSEPH E. PIEKLIK, COMMANDING GENERAL, U.S. ARMY TANK-AUTOMOTIVE COMMAND, WARREN, MICH.

General PIEKLIK. I am. I am the commanding general of the Tank-Automotive Command.

Mr. HALL. And all the bids went through you, through your office, General?

General PIEKLIK. It went through the command, yes.

Mr. HALL. I know you evaluated it. That has been well testified to. I am trying to get to the place of who and what office—I understand it might be Army Materiel instead of TACOM, or something like that—actually was responsible for signing the contract. Was that you?

General PIEKLIK. No, sir.

Mr. HALL. It was you, Mr. Bruce?

Mr. BRUCE. I personally signed the contract after the necessary approvals.

General PIEKLIK. The source selection was outside the Tank-Automotive Command.

Mr. BRUCE. General Besson was the source selection authority.

General PIEKLIK. General Besson was then the commanding general of the AMC.

Mr. HALL. That is your ultimate superior officer as far as awarding contracts is concerned.

General PIEKLIK. In this particular case he was the source selection authority, Mr. Hall.

Mr. HALL. I am not talking about source selection, who is the one who signs the final contract?

General PIEKLIK. The source selection authority is the one who approved the selection of the contractor and the ASA (I. & L.) noted the award and authorized the contracting officer to sign the contract.

Mr. HALL. You have been very helpful. There certainly has been no personal inference. I am speaking only from past experience in trying to evolve this situation or any other similar one.

Thank you for rising to the occasion.

Mr. Chairman, may I ask General Ellis if all of the prior development and prototypes that were done by LTV, as we try to arrive at the cost of one of the Gama Goats and amortize or distribute or prorate, whatever the proper term is, all of the R. & D., all of the prototypes, of the developer before it was let to other producers, is that included in the final total cost of these beasts?

General ELLIS. It is included in the $15,000-odd figure I mentioned, yes, sir. All of the program cost.

Mr. HALL. Still, in spite of the obvious advantage LTV would have had, having all these original development engineering and prototype contracts, it was more advantageous to the taxpayer to let it to another assemblyman, supplier, manufacturer, whatever you want to call Consolidated Diesel?

General ELLIS. By about $30 million.

Mr. HALL. Good.

General ELLIS. One point I think we did not get across well: This was a two-step formally advertised procurement. It was a sealed public bid opening at which this contract was won. Each contractor brought or mailed the bids in a sealed envelope, and these were publicly opened.

Mr. HALL. We appreciate that. And I read that in your statement.

General ELLIS. Yes, sir.

Mr. HALL. But we have also had that in other situations where, to be the very kindest, influence has been exerted thereafter for changes or modification, or I believe you used the term "getting well."

General ELLIS. Yes, indeed, sir. We are painfully aware of that.

Mr. HALL. What else do you furnish prior to final assembly in the so-called GFE areas?

General ELLIS. I am not prepared to answer that.

TESTIMONY OF COL. DONALD M. BABERS, PROJECT MANAGER, GAMA GOAT, U.S. ARMY TANK-AUTOMOTIVE COMMAND, WARREN, MICH.

Colonel BABERS. The engine is the only GFE item.

Mr. HALL. Then it is simply a subcontract on the part of the supplier, Consolidated Diesel, that enables them to go offshore or out of continental United States to purchase the equipment used in the Gama Goat?

General ELLIS. That is correct.

Mr. HALL. That is a subcontract.

General ELLIS. That is right. That is a subcontract.

Mr. HALL. And your invitation for bids allows that under the Buy American Act, and so on, so they can get the best price and make the most honest profit prior to delivery of the unit for acceptance?

General ELLIS. That is correct, sir.

Mr. HALL. I believe you said the Army is going to do the retrofitting, to be completed during the next 12 months. Is that correct?

General ELLIS. That is correct, sir.

Mr. HALL. What has been the principal problem of the, oh, say, 1,600 vehicles that have not been accepted in recent months? At the bottom of page 18 of your statement you say "As of May 9, 1972, CONDEC has produced 9,526 vehicles," which of course is way short of the final order, but that you have accepted only 7,980, including—and we understand about the 4,400; I think that has been adequately exercised. But as to the others you have not accepted recently, what has been the primary problem?

General ELLIS. I think just a matter of final inspection.

Colonel BABERS. I am Col. Donald Babers, project manager.

This goes back to a strike in England by the supplier of the drive shafts. The English firm was on strike from September through November. As a result, CONDEC ran out of several of the different drive shafts. In order to keep the production line running they continued to build vehicles minus the shafts. Thus, those trucks are in their storage area now, awaiting delivery of drive shafts. There are approximately 1,000 vehicles in this category.

The remaining 600 vehicles which have been built but not accepted, are working stock that they continue to work on and ship as they bring them up to acceptable standards.

General ELLIS. Thank you, Don.

Mr. HALL. How about the supplier's own in-house quality control? I presume the project officer, or whoever is on the spot, or whoever Army Materiel Command has on the spot—has this been satisfactory?

I understand you did send a team overseas to visit some of the overseas suppliers, for example the supplier of these shafts, gears, and I believe even the wheels, you said the other day, came from overseas.

Colonel BABERS. Yes, sir.

Mr. HALL. Anyway, I want to know if CONDEC's own quality control has satisfied the responsible person in the Army?

Colonel BABERS. Yes, on balance I would say their performance has been satisfactory.

Mr. HALL. That "on balance" bothers me a little. I have great respect for you, but not for qualifying rhetoric.

Let's be specific. Where have they been off balance?

Colonel BABERS. They have been satisfactory, sir.

Mr. HALL. In no case have you found they or their subs have tried to cut corners in order to live within their low-price bid?

Colonel BABERS. We can find no case where anybody at any time deliberately attempted to give an inferior quality product in order to make money.

We know the first vehicles delivered to the Test and Evaluation Command were below acceptable standard, because of an excessive number of quality problems. Those were returned and through a series of visits by the Tank-Automotive Command and the Contract Administration Services, and three in-depth inspections have shown progressive improvement in the quality level.

Mr. PIKE. That is sort of like the General's statement; it is mighty reassuring.

But you did send back the first 11.

Colonel BABERS. That is correct.

Mr. HALL. Were those the 11 prototypes, or the first 11 that came from CONDEC?

Colonel BABERS. First 11 from CONDEC.

Mr. HALL. But you got that all worked out, and they were cooperative and worked with you?

Colonel BABERS. That is correct.

Mr. HALL. And they did not furnish you credit cards, pick up your motel bill, or anything like that, while you were up there with them?

Colonel BABERS. No, sir.

Mr. PIKE. You are suspicious, Dr. Hall.

Mr. HALL. I am a suspicious character, in view of what I have been through before, Mr. Chairman.

You think you are clear, as Mr. Bruce indicated he was, a while ago, in that regard?

Colonel BABERS. Yes, sir.

Mr. HALL. Thank God.

Mr. Chairman, I am sure I will want to ask other questions.

In fact, I would like very much to ask some about your opening statement; for example, how the Army evaluates the fact that upon completion of the test by the Technical Command concluded in March 1966 that, as tested, the Gama Goat would not be suitable for Army use until modification and further testing was accomplished, and then in June of the same year they moved to have the Gama Goat classified as standard type A.

That seems to me as though if the General concurs in your opening statement, as he said he did, that there would be at least an asymmetry of the line of thought on the part of the dear old Army as far as their procedures are concerned.

As I understand it, all that type classifying standard A means is that for a sum you grant to those with whom you have been dealing the authority to complete the blueprints, the drawings, maybe the prototypes, as in this case, deliver them, and then those become the property of the Army so that you can develop them, shelve them, pick them off the shelf, start up production again, any time you want to, and so forth and so on.

But I cannot understand why in one month early in 1966 you said it was no good for Army procurement, then 2½ months later you classify it as standard A.

General Ellis. I will be delighted to answer that question, Mr. Hall.

This is part of the problem we face in scale of values.

In all my years of experience in dealing with the Test and Evaluation Command I have never seen a test report that was a completely unqualified "This vehicle is suitable." Never.

Mr. Hall. It is their job to find defects, is it not?

General Ellis. That is correct. It always has to be so, because no matter how long we struggle with the development, there will be 1, 2, 5, a minor number of deficiencies that yet remain, when it is obvious the vehicle has matured enough to risk putting it into production.

And the Test and Evaluation Command, almost without exception—I have never seen an exception—makes the recommendation that when all the deficiencies and as many of the shortcomings as possible are corrected, the vehicle will be suitable.

Mr. Hall. Are you telling us you ordinarily override the TECOM recommendations and go ahead and recommend to type classify standard A or B, as you desire?

General Ellis. Not always. In the instances when the appropriate authorities up the line from the Test and Evaluation Command, Combat Developments Command, Army Materiel Command, examine all the inputs—testing is only one input to the decision process——

Mr. Hall. The CDC, the user, also disagreed, did it not?

General Ellis. CDC disagreed as a result of a slight time lag in providing the test results.

At the initial IPR, CDC did not feel it had sufficient of the current test results to go ahead.

Mr. Hall. You have not answered the question, still.

Why within 2 or 2½ months did you change your mind, or override, as the case may be, your decision and decide to go ahead and type classify standard A?

General Ellis. Referring to the CDC change of position?

Mr. Hall. No. I am referring to what is stated here. You concluded in March 1966 that, as tested, it would not be suitable for Army use unless modification and further testing were done. Then in June 1966 the project manager concluded to have the Gama Goat type classified as standard A. Perhaps it would be best pursued with the project managers.

General Ellis. They would be the best ones.

Mr. Hall. I apologize for taking so much time. I hope it has been of value to the committee.

Mr. Pike. It has been of great value.

I would state what I should have mentioned earlier, that it was through Dr. Hall's initiative and insistence that this matter be looked into that this investigation is taking place.

Now, General, you state in rather broad terms, early in your statement here, that you feel that management at all levels has been effective, and that all in all the Gama Goat program has been a successful one.

I want to read at this point a report which comes out of the—what is this, Richmond?

Mr. REDDAN. Yes.

Mr. PIKE. The Richmond Depot, regarding the attempted use of some Gama Goats at the time of the flood emergency in West Virginia. It reads like this:

At approximately 0515 hours, 21 February 1972 Staff Sergeant John Castellano was driving GOAT NO. 22524783C north on Highway I 95 approximately 32 miles from the Richmond Depot when he heard noises. He was accompanied by a mechanic, Mr. Neverson. Suddenly the shift and handbrake handle began to vibrate strongly. Mr. Neverson advised slowing down as it sounded like driveshaft problems. Staff Sergeant Castellano immediately complied. When pressure was released on the accelerator a thumping was heard which sounded to Mr. Neverson like the driveshaft coming free of its mounting. A strong rumbling was heard. Sergeant Castellano brought the vehicle to a stop with 4 of 6 wheels to the right of the right driving lane. Driver and mechanic investigated for cause of difficulty and ascertained that the driveshaft had come loose. Employing 6-wheel drive, Mr. Neverson slowly pulled the vehicle forward an additional 15 to 20 feet to remove it completely from the driving lane.

The vehicle was participating in a Civil Defense Emergency Relief action at the time of the incident. Assigned driver and mechanic were returned to the depot and departed with another vehicle. After the damaged vehicle had been evacuated to the depot, the following details were developed: Driveshaft apparently disengaged when the bolts came out of the spider and bearing assembly. The following items were damaged: Driveshaft, universal joint, hydraulic brake-line, air line, transmission shifting shaft, transmission linkage arm, and hull hole.

Now, this is only one isolated instance. But what I am interested in is, it seems to me that your statement regarding reliability is a very general statement.

Did you not have, when you went into this procurement, certain requirements as to reliability? Is it not the fact that the vehicle was supposed to go for 10,000 miles without a breakdown? And would you just tell us what the statistics are on your reliability? What was your reliability requirement on the vehicle.

General ELLIS. Sir, I need Colonel Babers to handle that for me. The reliability is rather a difficult item to define and measure. The early attempts at stating them, 10,000 miles without organizational work and 20,000 without direct support, have never been met by any vehicle in our inventory.

Mr. PIKE. Yes, but weren't these a requirement?

General ELLIS. Sir, they are a requirement that was unattainable. They were stated as a requirement and determined to be unattainable.

Mr. PIKE. But were they not a stated requirement for the vehicle?

General ELLIS. They were a stated requirement at the outset.

Mr. PIKE. All right. Now, when did you decide this was no longer a requirement?

General ELLIS. Can you help me, Don?

Colonel BABERS. If I may.

Sir, there has been no formal change in the requirement. But there has been a recognition at all levels that this requirement was unattainable, too stringent, not attainable by this truck or any other series of vehicles we have ever tested at TECOM.

Mr. PIKE. How do you measure the reliability of a vehicle for which you have established an unattainable requirement?

Colonel BABERS. We chose, sir, to go to the more conventional means of measuring reliability that has been in use in the tank-automotive field for the last couple of years. Under this criteria, reliability is

assessed against performance of a typical mission. In the case of the M561, the typical mission is 75 miles in length. The 10,000-mile-test cycle is divided into 75-mile missions. One mission is aborted for each disabling deficiency experienced by the vehicle during the test. The truck's reliability is then computed on the basis of the number of 75-mile missions successfully completed when compared to the total missions run during the test.

Mr. PIKE. So you have gone from a 90-percent probability of completing in a military environment 10,000 miles to a 95-percent requirement of going 75 miles, is that it?

General ELLIS. Seventy-five miles in any increment throughout the first 10,000, yes.

Mr. PIKE. Really, you can come up with any reliability statistic you want to come up with, as long as you change the requirements, can you not, General Ellis?

General ELLIS. I don't think I am qualified, really, to answer that question.

Mr. PIKE. If you put a requirement that it go 1 mile when it comes off and say a 90-percent chance of doing it, you are going to have 100-percent capability, 100-percent availability, are you not?

General ELLIS. If one went to that low a reliability requirement, yes, I believe you could.

Mr. PIKE. You have gone from a requirement of 10,000 miles, have you not?

General ELLIS. No, sir.

Don?

Colonel BABERS. Sir, if we just take the 10,000 mile requirement and say no organizational maintenance, we have a "go-no-go" gage.

Mr. PIKE. You are saying because the vehicle could not do what you said it had to do, you did not change the vehicle and require it do it, but you lowered the standard, isn't that correct?

General ELLIS. That is correct, yes. We lowered the standard to something that was more meaningful and more nearly attainable. It would have cost—well, nobody knows.

Mr. PIKE. General, I want to go now from the little specific example I cited to your statement on user acceptance.

On page 15 you talk about the Fort Carson experience in Colorado. You quote two portions or clauses out of a document, and I would ask you to provide the whole document for the record.

General ELLIS. We will.

(The following Army inquiry and responses from Fort Bliss, Tex., Fort Bragg, N.C., Fort Campbell, Ky., Fort Carson, Colo., Fort Hood, Tex., and Fort Riley, Kans., were subsequently furnished for the record.)

MESSAGE FROM THE DEPARTMENT OF THE ARMY STAFF TO THE USING UNITS

Subject: User evaluation of the Gama Goat (M561).

1. House Armed Services Committee has scheduled public hearings on procurement of Gama Goat (M561). Target date to begin such hearings is 16 or 23 May 1972.

2. To assist DA Staff in preparation for hearings, request addressees submit command evaluation of the Gama Goat's performance (operations and maintenance) based on use to date.

3. Comments to be provided DAFD-SDS not later than May 9, 1972.

MESSAGE RECEIVED FROM FORT BLISS, TEX.

Subject: User evaluation of the Gama Goat

1. This installation presently has 153 truck M561 on hand. Eighty have been in the hands of one unit for approximately 8 months and have cumulatively logged over 110,000 miles, averaging approximately 1,500 miles each. The remaining 73 vehicles have averaged less than 100 miles per vehicle, however, the faults noted below apply to all vehicles.

2. The operational characteristics of the vehicle in the desert environment at Fort Bliss have proven excellent. The overall usefulness of the vehicle has been extremely limited due to maintenance and design problems.

3. Maintenance problems:

(*a*) Improper wheel bearing adjustments. All vehicles required correction prior to use.

(*b*) High failure of alternators. Approximately 26 have been replaced on the 153 vehicles.

(*c*) Faulty U-joints. No particular U-joint has broken excessively, however, a total of 17 have required replacement. The metal in the U-joint appears to be porous and not conducive to long wear in an area of high strain.

(*d*) Transfer case breaking at drain plug hole has occurred on two occasions.

(*e*) Faulty master cylinder push rod and connecting hardware has broken and caused one accident. This was explained in Equipment Improvement Report T874–1204–04.

4. Design/quality control problems.

(*a*) Driver compartment is too small. A fully equipped soldier can only enter and depart the vehicle with great difficulty. In the event of an emergency or accident he could not respond rapidly.

(*b*) The body design does not allow quick and easy maintenance or troubleshooting. Engine, transmission, and transfer leaks cannot be easily detected as they are enclosed in watertight body; the only openings available are those for draining (3'' holes).

(*c*) Light fiberglass battery covers and consoles are impractical in a tactical vehicle. The "no step" lettering does not prevent a soldier from using the cover as a step in an emergency. Many of these have been replaced even in a training environment.

(*d*) To date approximately 54 hood assemblies have been cracked. The tear starts at the rear cover and rips away the hinges. The present policy of two men opening the hood has partially alleviated the situation, however, the ultimate solution appears to be replacement of the thin aluminum braces.

(*e*) The lack of a spare tire requires the lock out kit to be used when a flat occurs. This requires approximately 70 minutes if a flat occurs on other than the center wheels. The "locked out" vehicle must return to its maintenance facility to repair the tire since it can no longer be used in a tactical situation as a prime mover.

(*f*) In operation the communications with the rear compartment are not effective. The emergency signal light on the cab dash is practically useless in the bright sunlight.

(*g*) The vehicle commander sitting in right front cannot hear the radio due to noise. Frequencies cannot be changed without stopping for another soldier riding in rear compartment. A remote is required.

(*h*) Preservative used in fuel tank is dissolving and clogging fuel filters.

(*i*) Console must be removed to check transmission. Vehicle should have access doors.

(*j*) Brake line rubs against fitting under carrier.

(*k*) The tire valve stem does not make a tight seal after movement resulting in loss of pressure.

(*l*) The authorized jacks have not yet been received. This was due to contractual and production problems.

(*m*) Body access plugs cannot be screwed fully in without threads grabbing and seizing up.

(*n*) Water can strap hooks are breaking. Material is not heavy enough.

(*o*) Fuel leaks from vent located in line over tailpipe at left rear corner of engine compartment.

(*p*) Windshields have been received with acid pitting from factory.

MESSAGE RECEIVED FROM FORT BRAGG, N.C.

1. This command's evaluation of the M561 Gama Goat is presented in three major areas of concern: Maintenance, supply, and operations.

2. Maintenance:

(*a*) To date 850 Gama Goats have been received at Fort Bragg. The following maintenance problems have been observed:

(1) Thirty-eight engine starters have failed.

(2) Ten engine failures; 90 percent of these failures were caused by engine overheating.

(3) Twelve transmission failures.

(4) Nine transfer assembly failures.

(5) Nine differential failures.

(*b*) Several factors affect maintenance on the vehicle:

(1) Location of the universal joints does not provide for easy access for lubrication.

(2) An excessive amount of dirt and metal, detected when performing the first semiannual services on the fuel filter, indicates that fuel and tank lines may not have been properly cleaned at time of manufacture or assembly.

(3) The engine cover and seats are constructed of fiberglass and tend to crack when being removed.

(*c*) The thin wall aluminum body is easily punctured and light tailgate construction is evidenced by tendency for the tailgate to become dented, cracked, or warped. Cracks and warping of the tailgate cause the loss of flotation capability.

(*d*) Several electrical problems, although not extensive, have been encountered:

(1) Shorting of windshield wipers.

(2) Electrical ring harness incorrectly installed by manufactuer.

(3) On/off switches not functioning properly.

3. Supply:

(*a*) Jack, jack handle, life preservers, and fire extinguishers were not included in the BILI (basic item list issue).

(*b*) Repair parts support has been extremely slow. Order ship time for most items averages 4 to 6 months.

(c) Many of the parts problems experienced during the early use of this vehicle could have been precluded by use of a push package prior to or at the time of issue of the vehicle.

(*d*) The immediate nonavailability of the following items has resulted in some deadlines:

(1) Starter.

(2) U-joints.

(3) Accelerator cables.

(4) Stoplight switches.

4. Operations:

(*a*) The driver and assistant driver space in the cab is very limited. This condition is aggravated when wearing the full field uniform and life preserver.

(*b*) The loud noise caused by the proximity of the engine to the driver's seat causes extreme difficulty in voice communication.

(*c*) When the canvas top is used on the cab and cargo compartment, communication between the two respective areas is limited to the warning light on the dashboard.

(*d*) When making sharp turns, water and mud are thrown into the cab compartment and against the windshield by the front and center wheels. This constitutes a safety hazard for the driver and passengers.

(*e*) When canvas is installed, rear view mirrors to be effective protrude outside the vehicle dimensions subjecting the mirrors to damage by trees, bushes, or other vehicles.

(*f*) Some of the advantages of the vehicle are:

(1) The small turning radius.

(2) The advanced ability of the vehicle to maneuver over rough terrain and climb steep slopes.

(3) Increased carrying capacity.
(4) Flotation (swim) capability.
(5) Greater carrying capacity per linear foot of aircraft space required for deployment by air.
(6) Additional flexibility for utilization of the ¾-ton trailer for additional carrying capacity.

5. Summary: Although some problems have been encountered with the Gama Goat vehicle, they are insignificant when compared to the total number of vehicles placed in service. The consensus of commanders authorized the Gama Goat indicates that the vehicle is a significant improvement over the M–37 ¾-ton truck and M–715.

MESSAGE RECEIVED FROM FORT CAMPBELL, KY.

1. Evaluation of M561 is submitted.
2. This post received its first four M561's during November 1971. Presently there are 16 M561's on hand. Priority of issue was 3D 8N which is the only unit with user experience in field environment.

There has been limited experience at the installation maintenance level due to low density and usage.

3. Comments from using unit and maintenance facilities are:

A. Unit: Vehicle will accomplish mission for which designed, however, there are many small faults which operational usage has pointed up. Among these problems are:

(1) Some metal surfaces are too thin, such as the engine cover and battery cover. Can be damaged with a hand.
(2) Bilge pump will not remove all water in driver compartment and no drain plug is provided.
(3) Side mirrors will not extend far enough to allow unrestricted vision when canvas is in place.
(4) Canvas must be fully installed or completely removed. No provisions for rolling up sides.
(5) Lack of a spare tire causes lost time in changing flats.
(6) Driver compartment is difficult to enter due to size of seats.
(7) When used as prime mover for light howitzers, it is more difficult to maneuver than the ¾-ton truck it replaced.
(8) There is no place to mount twin antennas such as are required for fire direction trucks with more than one radio. One area in which an improvement was noted was the bar system for securing the tail gate. This system is superior to the chain and hook system on other cargo vehicles.

B. Installation maintenance: To date, there have been two major work orders submitted:

(1) Vehicle 03D14771 experienced damage to rear differential and body due to rear propeller shaft coming loose during normal operation. Mileage was 130 miles.
(2) Vehicle 03D18771 experienced transmission failure due to all teeth being sheared off the 2D gear during normal operation. Total mileage was 233. Few conclusions can be drawn from the low usage factor at this installation except that, based on the low mileage of the two failures, the rate appears high.

4. It is difficult to evaluate this vehicle under the circumstances listed above. Another limiting factor is the restriction on using the M561 for administrative purposes. Until further experience is gained under a variety of field conditions with a larger sample no real command evaluation is possible.

MESSAGE RECEIVED FROM FORT CARSON, COLO.

1. The following information is provided:

A. Fort Carson received 48 Gama Goats initially in March 1971 for troop evaluation. To date, an additional 346 have been received and currently 354 are issued to troop units.

B. Extensive deprocessing at director of industrial operations and operator/organizational maintenance instruction which has been accomplished prior to issue to troop units has significantly contributed to a minimum of maintenance problems.

C. The cross country capability of the Gama Goat is unparalleled. During a recent snowstorm which paralyzed entire communities in this area with drifts up to 4 feet, Gama Goats were used extensively as the primary rescue vehicle. During winter training conducted at Camp Hale, Colo., the Gama Goat provided mobility not attainable with other vehicles.

D. The performance of the Gama Goat on a day-to-day basis exceeds that of the previously issued M715 vehicle.

E. Training within each unit averages 16 hours per individual as before, during, and after operations checks on the M561 require a more extensive effort due to the complexity of the vehicle.

F. The most prevalent driver complaints are:

(1) Difficulty in entering and exiting the drivers compartment, especially if the vehicle has an installed winterization kit.

(2) Inability of the driver/assistant driver to communicate with passengers in the cargo compartment.

G. Minimum maintenance problems have been experienced. The most serious problems were:

(1) During cold weather when troop units experienced difficulty in starting the M561 in temperatures below 20 degrees fahrenheit. Basically, this problem revolved around personnel excessively grinding the starter thus burning it out. From a design standpoint, the problem was discovered to be that the engine did not receive sufficient air at this altitude and temperatures below 20 degrees fahrenheit. Project managers office has provided a field fix designed to pass air to the engine preheater. Evaluation of the fix at this installation will not be attempted until next winter.

(2) Snapping of universal joints when operators release the clutch pedal too fast. Project managers office had advised that through attrition an improved universal joint will alleviate this problem.

2. Based on 14 months of experience with M561 vehicles in the hands of troops at this installation, the following conclusions can be drawn:

A. The M561 has proven to be an exceptional vehicle in overall performance.

B. Operational availability of the M561 has been outstanding.

C. Minimal direct support/general support maintenance has been required.

MESSAGE RECEIVED FROM FORT HOOD, TEX.

1. The following comments of the performance of the Gama Goat (M561) were compiled on short notice in response to the request for evaluation of the vehicle's performance. Additional time would have permitted a more detailed evaluation of problem areas.

2. The comments are divided into three areas:

A. Operations:

(1) It is difficult for the operator to see to the right rear of the vehicle while backing up.

(2) The driver and passenger compartment is cramped and difficult to get into and out of.

(3) There is no provision for draining excess water from the driver and passenger compartment.

(4) The noise and vibration level is too high for sustained operations. In accordance with TB Med 251, hearing conservation measures must be instituted to prevent hearing loss.

(5) The tailgate is not strong enough to withstand normal use. When it is bent the vehicle loses its swim capability.

(6) There is no area provided for storage creating a problem with both security, and proper maintenance of these items.

B. Maintenance:

(1) The hydraulic brake system develops leaks too easily.

(2) The inner brake line is made of steel and rubs the drum as it turns, wearing a hole in the brake line.

(3) Servicing of the power train is difficult. In order to service components (wiring, brakes, fuel, and steering systems), other components must be removed (master cylinder, throttle linkage, and fuel lines).

(4) The universal joints break too easily.

(5) The vehicle is extremely difficult and time consuming to lubricate.

C. Supply: Starter and throttle cables and U-joints are difficult to obtain.

3. Listed below are some of the most prevalent faults found during deprocessing of 566 new Gama Goats by the installation maintenance division:

Problem area:	No. of vehicles with faults
A. Defective brake drums, seals, "O" rings	25
B. Water in differentials	35
C. Wheel brake cylinder leaking	41
D. Defective signal lights	20
E. Gear boxes low on oil	354
F. Transmission leaking at dowel pins top cover	19
G. Loose wheel bearing	356
H. Transfer case oil pump inoperational (no prime—some with Teflon tape in ball checks)	188
I. Transfer case jumps out of high range (improper manufacture of main shaft splines)	10
J. Vent pipe missing on rear differential	11
K. Defective seat, tube, spindle assembly (brass brake line seat)	42
L. Hood hinge broken	10

4. This vehicle has not been operated sufficiently to render a sound judgment on its performance, a representative sampling of units revealed an average of 211 miles per vehicle. The consensus of opinion is that it is an outstanding vehicle under field conditions and can operate over almost any terrain.

MESSAGE RECEIVED FROM FORT RILEY, KANS.

1. Ft. Riley, Kans., has received only 16 of the 252 Gama Goats (M561) programed for this installation. Eight have been issued to the 1st Infantry Division, the remaining vehicles are in post supply.

2. Due to the small number of Gama Goats (M561) available, adequate testing, comparison, and evaluation of the vehicle's performance and operational capabilities cannot be realistically accomplished.

3. The eight Gama Goats (M561) assigned to the 1st Infantry Division are being used for driver training. The following is provided for these vehicles:

(*a*) Total vehicle mileage to date, 3,530.

(*b*) One vehicle has been on deadline since February 16, 1972, for kit, universal joint.

(*c*) One vehicle has been on deadline since March 1, 1972, for kit, universal joint, and two each yokes.

(*d*) One vehicle was deadlined February 2, 1972, to February 29, 1972, for a starter.

4. Due to the low usage and vehicle density, valid maintenance indicators or trends cannot be provided.

Mr. PIKE. I am going to quote from another document which came out of Fort Carson. This is from the U.S. Army Audit Agency, Audit Report WE 72-42, dated May 19, 1972. It says this:

The Gama Goat is a new 6-wheel drive, diesel-powered vehicle. In March 1971, 44 of these vehicles were issued to 5 Fort Carson units to be field-tested for a 6-month period. Subsequently, starting around September, an additional 257 vehicles were received for use by Fort Carson units.

So far everyone is in agreement.

During the 7-month period June-December 1971, the units experienced at least 180 separate failures. Many of the failures were repetitive or were otherwise serious enough to warrant submission of Equipment Improvement Recommendations to the national maintenance points but only 5 EIRs were submitted.

There were numerous failures related to problems of operating the Goat in cold weather. The Army has two cold weather kits for the Goat—a 'winterization' kit and an 'Arctic' kit. Fort Carson's Goats were authorized the winterization kit because the mean temperature was not considered low enough to warrant the other.

Fort Carson's winter weather was sufficiently cold to cause drivers considerable difficulty starting the Goat's diesel engine. Repeated unsuccessful efforts to start the engine placed a severe strain on the starter and at least 30 starters burned out, but only 2 EIRs were submitted.

The Goat has about 14 universal joints, increasing the chances of a U–Joint failure whenever the clutch is let out suddenly after the vehicle is coasted with the clutch disengaged. This happened when the vehicle was towed in an effort to get the engine started, but it also happened during driving. The units experienced at least 35 U–Joint failures, but only two EIRs were submitted.

The winterization kit defroster directs a blast of hot air against the windshield. In cold weather, this hot air blast caused the windshield glass to crack. There were at least 18 instances of cracked windshields as a result of the defroster, but no EIRs were submitted.

* * * * * * *

The Goat's tailgate is made of light metal and bends rather easily. Sometimes the tailgate bent when the operator inadvertently backed the vehicle against an object. Other times, the tailgate bent when dropped while being opened and striking the towing pintle protruding below. Bent tailgates do not close securely, causing the vehicle to lose its water-tight integrity and, thus, its swimming capability. There were about 15 tailgate failures, but no EIRs were submitted.

I am not going to read the rest of this, General. But would you really say you are being fair with the committee when you present the views which you presented there from Fort Carson as to this vehicle, and sort of omitted all the failures they had?

General Ellis. Sir, I do think I am being entirely fair. I will make a covering answer and toss this one to Don Babers, because he was intimately involved in this.

The AAA in the preparation of that report in what they were terming a "maintenance audit" was getting hard-nosed with the 4th Infantry Division for not following procedures in the submission of equipment improvement reports. The reason they were not doing so is that all those deficiencies were provided by our people to the AAA in the course of our following the results of this initial fielding of the vehicle.

Those 180 deficiencies spoken to were found by our technical representative and our project manager, people who were out there trying to make this initial fielding of the phase II vehicle as good as possible for the troops at Fort Carson. The AAA did not find any of those things. They were just looking at the record and saying they should have been reported on an EIR. We had already reported them, had them in the proper channel for correction, and they were being properly handled.

The job the EIR was set up to do was getting done faster.

The difficulty with the vehicle at Fort Carson was determined to be the result of the altitude, not the cold weather.

Colonel Babers, will you take it from there?

Mr. PIKE. What is the altitude at Fort Carson?

Colonel BABERS. 5,000-plus, sir.

Mr. PIKE. Are you saying we will always have difficulty with this vehicle at 5,000-plus?

Colonel BABERS. No, sir, Mr. Chairman. It was a combination of the altitude, over 5,000 feet, plus the weather below 25° F. We have tested previously at higher altitudes and lower temperatures, but never the combination of the two. So the first time we saw that combination was at Fort Carson, 1 mile high, plus the cold weather.

Mr. PIKE. And cold is 25° F?

Colonel BABERS. I am talking now of the starting capability of the engine.

Upon learning this, we immediately met with the engine manufacturer and engineered a correction for the problem. The correction consisted of putting a slug in the airblock box heater. This correction requires 2½ to 5 minutes per vehicle and has been applied on all vehicles at Fort Carson.

Mr. PIKE. General Ellis, what is the document that you are quoting in your quote of the 4th Infantry Division (Mechanized)?

General ELLIS. I am quoting from the final report that the 4th Infantry Division submitted, that has been submitted to the committee.

Mr. REDDAN. Is that a report dated November 9, 1971?

General ELLIS. 1971.

Mr. PIKE. Can you tell me where in that report the language is that you are quoting?

General ELLIS. Not without referring to a copy.

Mr. PIKE. Here is a copy.

General ELLIS. Paragraph 4, page 2, conclusions:

Based upon the limited use of the M561 at Fort Carson the following conclusions are drawn:

The M561 has proven to be an exceptional vehicle in overall performance. Maintenance problems to date have been minimal.

Mr. PIKE. Neither of those quotes is in your statement.

General ELLIS. Well, let me see.

Mr. PIKE. "The cross-country capability of the Gama Goat is unparalleled," and "The Gama Goat provides mobility not attainable with other wheeled vehicles."

Those are the two quotes you gave us.

General ELLIS. Sir, this was partly an extract from a report from Fort Carson.

Mr. PIKE. Has that report been made available to this committee?

General ELLIS. I am not certain.

Has it?

It was not requested sir.

Mr. PIKE. It was not requested?

General ELLIS. We can certainly make it available.

Mr. PIKE. Counsel tells me we did request all reports out of Fort Carson.

What you have quoted in your statement, then, does not come from this report which was the final report of the evaluation at Fort Carson.

General ELLIS. You are correct, sir. I was misinformed on that point.

Mr. PIKE. That final report did also say:

Tailgates are extremely fragile and are easily bent. Warping of the tailgates will preclude flotation of the vehicle, due to water leakage.

The ride in the cargo compartment is extremely rough. Seat belts are recommended for the transportation of troops over rough terrain.

Is that correct?

General ELLIS. That is what the report says; yes, sir.

Mr. PIKE. There is no sense in going through these items, General. My point is, you have extracted from a document which has not been made available to the committee certain flattering comments about the Gama Goat and you have obviously not used the unflattering comments about the evaluation.

In my own judgment, in doing this you are not really being fair with the committee and you are not really giving us the information in an objective mode.

General ELLIS. I do apologize, sir. I was not aware that I was quoting from a document that had not been provided. It is my error in editing of my presentation. I apologize.

It was not in any attempt to deliberately mislead, but to again attempt to create a scale of values, to compare this vehicle with the possible rather than with the perfect.

This sort of thing is routine in the fielding of new vehicles.

Mr. PIKE. General, did you write to this committee on March 15 and say that you were enclosing certain documents relative to the M561, and then say this, that is, "No other written reports on the field use of the M561 are available."

General ELLIS. What was the date of that letter, sir?

Mr. PIKE. March 15, 1972.

General ELLIS. Yes, sir; I think I did that.

Mr. PIKE. In January the GAO put out a report on the Gama Goat. And I am sure you are familiar with that report.

General ELLIS. Yes; I am familiar with it.

Mr. PIKE. The GAO said that the not only normal but the legally required procedure for a procurement requires that after a product has been determined to be operationally feasible a piece of paper is prepared called a qualitative materiel requirement, whose purpose is to identify the essential and desired characteristics for the end item vehicle.

Would you tell us what the qualitative materiel requirement for the Gama Goat said for the essential and required characteristics for the end item vehicle?

General ELLIS. I am not capable of quoting that from memory, sir. But I think Col. Bob Bergquist, the former project manager, is able to do it.

TESTIMONY OF COL. R. L. BERGQUIST, FORMER PROJECT MANAGER, GAMA GOAT PROGRAM

Colonel BERGQUIST. There was no QRM, a single document describing all characteristics as we know them today.

The military characteristics were stated in the original document published in 1961 and did list the requirements of the vehicle in order of descending importance.

Mr. PIKE. So the document which was required by law and which General Ellis says he doesn't recall, you tell us was in fact never prepared. Is that the case?

Colonel BERGQUIST. To the best of my knowledge there was not a QMR fully describing the technical characteristics of the vehicle as we know it today.

Mr. PIKE. Your statement on page 2, General, says, "The qualitative materiel requirement was approved in May 1961."

General ELLIS. I will call on Colonel Shelton, my backup witness from the Office of the Chief of Research and Development, to address that for me.

TESTIMONY OF COL. HENRY R. SHELTON, CHIEF, COMBAT MATERIEL DIVISION, OFFICE, CHIEF, RESEARCH AND DEVELOPMENT

Colonel SHELTON. I am Colonel Shelton, Mr. Chairman.

Prior to 1962 the methods of determining the technical requirements for military equipment were contained in a document known as military characteristics, which Col. Bob Bergquist has referred to.

Starting in 1962 the terminology of basically this same document—we started calling it the QMR, qualitative materiel requirement.

We have used, during the transfer from one system to another, interchangeably this terminology. For this vehicle we had an approved QMR but it was the military characteristics that guided the project manager.

Mr. PIKE. Colonel, it is 10 years ago that the new terminology came along. Was it not really a legal requirement at the time that this vehicle was being procured?

Colonel SHELTON. The legal requirement was that we continue to work under the military characteristics, the document Bob Bergquist described.

Mr. PIKE. You are saying that the GAO report is wrong? Is that what you are saying?

Colonel SHELTON. I am saying there is a misinterpretation of the nomenclature of the same basic legal requirement.

Mr. PIKE. And the Army is still operating, then, in this procurement under a document which became obsolete 10 years ago; is that correct?

Colonel SHELTON. Once that document was approved, it does not become obsolete, but becomes the basis from which the development is to proceed until type classification of that particular item of equipment.

Mr. PIKE. And this document was approved?

Colonel SHELTON. The military characteristic.

Mr. PIKE. Do we have a copy of that document?

Is it that document which sets forth requirements as to what this vehicle should do and should be? Is that not correct?

Colonel SHELTON. That document establishes the requirement which becomes the goal toward which the development is oriented. As part of the other policy matters and management system, at significant points in the development there will be held in-process reviews, at which time the individuals associated with this equipment, from the Army Staff, the developer, and the user, may evaluate the status at that particular time and make the decisions, or make the recommenda-

tions which are ultimately made as a decision by the Department of the Army, as to whether to continue.

Mr. PIKE. Are you familiar with this GAO report, Colonel?

Colonel SHELTON. I am not personally familiar with it, sir.

Mr. PIKE. I will read you a chunk out of it.

The essential characteristics originally expressed by the user included decreased weight, increased cargo space, improved reliability, and ease in loading and unloading of personnel, as compared with characteristics of the M37 ¾-ton truck which it was to replace. These characteristics were not met.

Now, let's talk about the weight. What did the document require that the weight should be?

Colonel SHELTON. I have given testimony regarding the policies that were in effect. I am not—I do not——

Mr. PIKE. Who can tell us what the weight of this Gama Goat was supposed to be when the requirements were set up?

General ELLIS. A practical minimum equivalent to the other essential characteristics.

Mr. PIKE. Was not the number 2,500?

Colonel BERGQUIST. That would be the carrying capacity of the vehicle, a ton and a quarter, sir.

Mr. P'æ5. I read to you from the document: "The curb weight shall approximate the payload capacity, 2,500 pounds."

Colonel BERGQUIST. Yes, sir.

Mr. PIKE. What does "curb weight" mean?

Colonel BERGQUIST. The weight of the vehicle without the payload, sir.

Mr. PIKE. So it shall approximate the weight of the payload.

Colonel BERGQUIST. Yes, sir.

Gross weight would be 5,000 pounds.

Mr. PIKE. What is the weight of the vehicle today?

Colonel BABERS. The curb weight is approximately 7,400 pounds, sir.

Mr. PIKE. Fifty percent over the requirement; is that correct?

Colonel ELLIS. More than that.

Colonel BABERS. In the original requirements document, 2,500 pounds is the curb weight mentioned. The actual curb weight is 7,400 pounds.

Mr. PIKE. Three times.

General ELLIS. Three times, yes, sir.

Mr. PIKE. I think the thing we had better do at this point, Mr. Reddan, is to put this GAO report as it pertains to the Gama Goat in the record. And I think we better also put in this military characteristics document, whether or not it is a qualitative materiel requirement, just so we can show what has happened to the program in the meantime.

(The following are excerpts from the General Accounting Office report, "Need to Improve Management of the Army's Tactical Vehicles Development Program" (B–133256), dated Jan. 27, 1971.)

M561 1¼-TON CARGO TRUCK

The need for a 1¼-ton cargo truck was determined by a motor vehicle requirements study approved by the Army in 1961. Although the preparation and approval of a Qualitative Materiel Requirement was required, it

was never prepared for this development project. The essential characteristics originally expressed by the user included decreased weight, increased cargo space, improved reliability, and ease in loading and unloading of personnel as compared with characteristics of the M37 ¾-ton truck which it was to replace.

These characteristics were not met, however, and possibly were not realistically achievable. For example, the M561 weighs 7,445 pounds (the user desired a curb weight of 2,500 pounds) compared with 5,700 pounds for the M37. The cargo space is only slightly increased over the M37, and, in our opinion, the M561 could hardly provide the capacity needed to carry light, bulky loads which the M37 was also unable to carry. Loading and unloading of cargo and personnel are more difficult in the M561 because of its hull-type design. Reliability, durability, and maintainability, although somewhat improved over the M37, are still far from meeting user requirements despite a waiver of some requirements after tests showed that the vehicle was incapable of meeting them.

In addition, since various special purpose kits—such as weapon, winterization and heater, winch, and ambulance—are necessary for the vehicle to perform its mission, it was considered essential that such kits be developed concurrently with the vehicle. We found, however, that, because in some cases firm kit requirements were not established on a timely basis, development of some of the kits was not completed concurrently with the vehicle. As a result, such kits could not be tested with the vehicle and modifications to the current production contract will have to be made to procure such kits. Any delay in delivery of kits to the user might impair accomplishment of vehicle missions.

Conclusions

We believe that the M561 development, costing at least $9 million, is another example of how, in the absence of a Qualitative Materiel Requirement, development efforts can be expended on requirements that are not technically feasible and can result in materiel which, although eventually accepted by the user, substantially deviates from the user's expressed needs. We believe that, had the M561 development been preceded by an approved Qualitative Materiel Requirement, it is more likely that the development effort would have been directed to satisfying user needs or that the analysis leading to such approval would have indicated that some of the requirements established by the user were unrealistic or not feasible. In addition, adequate review of the Qualitative Materiel Requirement, we believe, would have resulted in the initiation of more timely and firm determinations involving kit requirements.

* * * * * * *

The M561 1¼-ton truck was made Standard A in June 1966 and authorized for mass production on the basis of assurances that numerous defects would be corrected prior to award of a production contract. The technical data package, although incomplete, was initially released in September 1966. However, the production contract, normally awarded about 6 months after type classification, was delayed for nearly 2 years. We found that numerous design changes, made to correct defects found during engineering and service tests and included in the technical data package, had not been validated by test when the type classification action was approved. During preproduction testing, many of these changes proved inadequate and necessitated additional revisions to the technical data package in January and again in September 1967.

As late as September 1967, major equipment defects found during engineering and service tests remained unresolved and many of the modifications made to correct preproduction defects had not been tested sufficiently to validate their adequacy. Nevertheless, the revised technical data package was used in the September 1967 solicitation of bids for production of the vehicle. Tests were then initiated to test the adequacy of modifications, some of which constituted completely new components, such as sealed brakes. As a result of the continued testing, numerous additional changes were made to the technical data package. Contractors, in the middle of bid preparation, experienced considerable difficulty because of the vacillating design and nearly all of them requested an extension of the bid opening date because of problems encountered with the technical data package. Tests were not completed until after award of the production contract

in June 1968 and necessary design changes resulting from the tests were incorporated by contract modification.

Agency comments and our evaluation

The Assistant Secretary of the Army (Research and Development) said that the technical data package was not incomplete or inadequate for competitive procurement and that seven firms competed for the procurement without submitting a protest for any reason. He said that the Army believed that the intensity of the competition and the requirement for bidders to thoroughly evaluate the technical data in accordance with the pre-production-evaluation clause were responsible for requests for extension of the bid preparation period.

As shown above, unresolved major equipment defects existed when the bids were solicited which indicated that the technical data package was incomplete. In addition, testing continued after bids were solicited and numerous changes were subsequently made to the technical data package. Although we have no evidence of any formal protests by the seven firms that competed for the procurement, the record shows that a 30-day extension for bid submission was recommended in view of complaints by four of the contractors that the technical data package was inadequate or required changes.

The Assistant Secretary also stated that there were relatively few cost-type engineering change orders processed during the life of the contract and that the time spent between type classification (June 1966) and issuance of the solicitation (September 1967) was well spent in generating product improvements. We recognize that the time interval of more than a year from the standardization action to the request for bids permitted correction of many of the known deficiencies. Nevertheless, the classification as Standard A denotes that the item is ready for mass production and issuance to the troops, and it is evident that such classification of this vehicle in June 1966 was premature.

Conclusions

We believe that this case illustrates how the Army's emphasis on leadtime reduction can cause management to orient decisions toward Standard A-type classification irrespective of known vehicle defects and the incompleteness of the technical data package. In our opinion, both the approval of Standard A-type classification and the initial release of the technical data package were premature. Revisions to the data package during and after preproduction testing indicate, we believe, that the technical data package was obviously incomplete and inadequate when initially released in September 1966 and was still incomplete when released in September 1967 and used for bid solicitation and contract award.

* * * * * * *

For the in-process review on the M561 held in April 1966 to decide on type classification of the M561, we found participants were furnished data on the results of tests completed only through November 1965 on which to establish their agency positions for the meeting. Tests, however, continued until June 1966. At the April meeting, results of testing since November 1965 were summarized and other data were presented which the decisionmaking agencies had not had a chance to consider prior to the meeting. Because of the data not previously considered, the Combat Developments Command, the user representative, nonconcurred in type classification of the M561 as Standard A. Later, in June, the Combat Developments Command concurred in type classifying the vehicle as Standard A on the condition that an in-process review meeting be held after completion of the pre-production test and before the award of a production contract.

Again, at the M561 in-process review held early in April 1968 to consider whether to award a production contract, the Combat Developments Command would not concur because of unsatisfactory pre-production-test results furnished to them for the meeting. Subsequent to the meeting, however, results of additional tests, begun after the pre-production tests, were furnished to the Command officials that had not been previously provided to or considered by them when developing the Command's position. We were told that these data, although available, were not provided to decisionmakers prior to the meeting because it was not thought necessary. On the basis of the additional data, however, the Combat Developments Command later in April concurred in awarding the M561 contract.

(The following sets forth the Army's military characteristics developed for the Gama Goat.)

HEADQUARTERS, U.S. CONTINENTAL ARMY COMMAND,
Fort Monroe, Va., July 25, 1961.

Re: USCONARC-Approved Military Characteristics for Truck, Utility, High Mobility, Light Duty.

CHIEF OF RESEARCH AND DEVELOPMENT,
Department of the Army,
Washington, D.C.

1. Reference is made to:

(*a*) Letter, ATSWD–CS 451, HQ USCONARC, 25 October 1960, subject: "Mover, Motor Vehicle Requirements, Army in the Field, 1965–1970," with 1st endorsement from CRD to CofOrd, 29 April 1961.

(*b*) Letter, ATSWD–CS 451.2(C), HQ USCONARC, 3 May 1961, subject: "Approved Qualitative Materiel Requirement for Truck, Utility, High Mobility, Light Duty (U)."

2. Enclosed are USCONARC-Approved Military Characteristics for Truck, Utility, High Mobility, Light Duty. This vehicle is intended to fulfill the requirement indicated in the Mover Study, reference 1*b* above, for a 1¼-ton capacity vehicle.

3. This headquarters recommends that the enclosed USCONARC-Approved Military Characteristics be approved.

4. The current USCONARC materiel priority number for this item is Priority I in the functional group 4.

5. Human Engineering Factors to be considered in the development of this vehicle are at inclosure 1 to the USCONARC-Approved Military Characteristics. Human engineering considerations should be directed to accommodate the 95th percentile man dressed in the cold weather uniform provided the design is not unnecessarily complicated.

6. Comments of the Canadian Army and of the Marine Corps on the draft Military Characteristics are at inclosure 2 to the USCONARC-Approved Military Characteristics. British Army comments have not been received and will be forwarded at a later date.

7. The subject military characteristics are not considered adequate for the development of either the front line or field ambulance conversion kits. Separate military characteristics will be prepared for these kits in conjunction with the Office of The Surgeon General, Department of the Army, and submitted at a later date as a separate action.

8. In accordance with subparagraph 25a(2)(a), AR 1–70, copies of this correspondence have been released to the British and Canadian Liaison Officers at Headquarters, United States Continental Army Command.

For the Commander:

T. J. MARNAME,
Colonel, AGC, Adjutant General.

USCONARC-APPROVED MILITARY CHARACTERISTICS FOR TRUCK, UTILITY, HIGH MOBILITY, LIGHT DUTY

SECTION I—GENERAL

1. Statement of requirement

A cargo, personnel, and weapons carrier with a rated payload of 1¼-tons. Its payload tonnage/mile per gallon fuel consumption must be improved over that of current-light-duty wheeled tactical use vehicles. It must have a minimum cruising range of 300 miles of travel without refueling. An inherent swimming capability, within the limitations of a nominal increase in cost, is essential. It must be air-transportable in Phase I (aerial delivered with payload) of airborne operations without sacrifice of durability or reliability. This vehicle will replace the Truck, Ambulance, Frontline, ¼-Ton, 4x4, M170; Truck, Cargo, ¾-Ton, 4x4, M37 and Truck, Ambulance, ¾-Ton, 4x4, M43. It will reduce the requirements for, and may replace some Truck, Utility, ¼-Ton, 4x4, M38, M38A1, M38A1C, and M151, Carrier, Light Weapons, Infantry, ½ Ton, 4x4, M274 for Army use (Marine Corps intends to retain); and general purpose trailers towed by these vehicles in forward combat areas. It will satisfy the

qualitative material requirements for Truck, Utility, Lightweight, ¾-Ton; Truck, Utility, 1-Ton; and Ambulance, Frontline. It will be used on and off roads, throughout the theatre of operations, in close support of fighting vehicles and troops as a command and communication vehicle; as a carrier for personnel weapons, and cargo; as a frontline and field ambulnce; as an emergency carrier of wounded casulties on litters; and as a prime mover for towed loads. (MR) Tentative CDOG subparagraph is 1636c(8).

2. Operational concept

Although this vehicle will be used in both combat and service units, its adaptability to tactical utilization should receive primary consideration. It is intended to improve the mobility of tactical and logistical support elements commensurate with the future concept of dispersed operations. This quality will permit support units to operate across the same type terrain as the units supported and will permit greater dispersion and inland water crossings on a wide front without the necessity of grouping at bridges, ferries, and other bottlenecks. It will be employed in Phase I of airborne operations. With the addition of kits this vehicle will be used as a weapon platform, as a military police vehicle, as a light-duty repair truck, as an ambulance, and as a resupply vehicle in close support of units. This vehicle will also be used as a prime mover for direct support artillery.

3. Organizational concept

This vehicle will be organic to Infantry, Artillery, Engineer, Signal, Airborne and Armor units, their support elements, and most types of administrative and logistic units.

4. Maintenance concept

(*a*) Means should be incorporated that will assure a minimum of down time for the removal and replacement of components and assemblies. The vehicle must incorporate all major advancements in construction and design which can be profitably employed, and its components will make maximum use of sealed assemblies requiring no, or limited, lubrication. It must be free of complex mechanical arrangements and components requiring highly skilled maintenance, tools, equipment, or manpower.

(*b*) This vehicle must have a 90 percent probability of completing in a military environment 10,000 miles with organizational maintenance only, and 20,000 miles without the need to evacuate the vehicle beyond the direct support maintenance echelon.

5. Canadian and Marine Corps comments are at enclosure 2

6. Feasibility of development

If, during the development phase, it appears to the developing agency that the characteristics listed herein require the incorporation of certain impracticable features and/or unnecessarily expensive and complicated components or devices, costly manufacturing methods and processes, critical materials, or restrictive specifications which serve as a detriment to the military value of the item, such matters should be brought to the immediate attention of the Chief of Research and Development, Department of the Army, and Headquarters, United States Continental Army Command for consideration before incorporation into a final design.

7. Background

(*a*) In July 1960, CRO advised USCONARC that the then approved Army development program for wheeled vehicles had not been fully implemented and was not fully compatible with future operational concepts. Reappraisal of the Army's requirements was directed. In October 1960, USCONARC forwarded the results of this study. Development of a fleet of wheeled vehicles in 6 payload categories was recommended. These military characteristics are for the 1¼-ton vehicle of this fleet.

(*b*) No difficulty is anticipated in the technical feasibility of developing or producing the vehicle in the applicable time frame.

(*c*) While there is no existing counterpart, the vehicle will be superior to the items to be replaced, which are indicated in the MCV's.

(*d*) This vehicle can be produced in quantity, but quantitative requirements cannot be established at this time, particularly as the extent of replacement in

the ¼-ton and trailer area is indeterminate. Attention is also invited to the existing usage of 2½-ton trucks to carry light but bulky loads for which the ¾-ton M37 does not have sufficient cargo space.

(*e*) Office, Chief of Ordnance knows of no implication involving AR 705–30 (which has been superseded by AR 705–35) or AR 700–105 (superseded by AR 700–2300–1).

8. Personnel implications

Wheeled vehicle mechanics, MOS 631.0, assigned to units equipped with this vehicle will require additional training.

SECTION II—OPERATIONAL CHARACTERISTICS

Military Characteristics common to various tactical-type wheeled transport vehicles, MCV 200, 18 Jun 53, applies, supplemented, modified, or emphasized as follows:

1. Performance

(*a*) It is essential that the vehicle possess:

(1) The capability of operating off roads with a payload of 2,500 lb, in addition to weight of a two-man crew and their equipment.

(2) Improved cross-country mobility characteristics over current wheeled tactical vehicles in the light-duty series.

(3) Better fuel economy than that of current wheeled tactical vehicles in the light-duty series, based on actual miles per gallon.

(4) A minimum cruising range of 300 miles off roads with payload, without refueling, over a course including various longitudinal and side slopes, hills, open and rolling terrain, heavy brush, wooded trails, clay, rocks, sand, and inland waters.

(5) An inherent swimming capability in inland waters under all load conditions.

(6) The capability of transporting Signal Corps shelters and accompanying on-vehicle power units of sizes and weights appropriate to the vehicle's rated load.

(7) The capability of towing trailers or trailer-like equipment weighing up to 50% of the gross weight of the towing vehicle. It is not contemplated that a companion trailer will be required.

(8) The vehicle with maximum load and towed load shall be capable of being efficiently operated on dry, level, hard-surface roads at a sustained speed of 50 mph and at a minimum sustained speed of 2½ mph.

(*b*) It is desirable that the vehicle possess:

(1) A cruising range of 400 miles off road with payload without refueling under conditions specified in par 1a(4), above.

(2) The capability of towing trailer or trailer-like equipment weighing up to 60 percent of the gross weight of the towing vehicle.

2. Definition of materiel

(*a*) Weight:

(1) *Essential.*—

(a) The curb weight shall be the practicable minimum consistent with other essential characteristics. Performance, durability, reliability and ease of maintenance will not be compromised to achieve weight reductions.

(b) The curb weight to payload ratio must be a significant improvement over the ¾-ton truck.

(2) *Desirable.*—The curb weight shall approximate the payload capacity (2,500 lb.).

(*b*) Configuration:

(1) *Essential.*—

(a) The vehicle shall be a wheeled vehicle.

(b) The vehicle design shall provide for transporting at least 10 personnel (including driver) and their individual combat equipment and arms.

(c) The vehicle shall be capable of accepting kits to mount the flexible version of the current standard 7.62-mm and caliber .50 machine guns, the Vehicle Rapid Fire Weapon System, the antitank guided missile, the current standard heavy recoilless rifle, and the Davy Crockett XM28 and XM29 Systems.

(d) The vehicle shall be capable of accepting a litter adapter kit (3 litter patient capacity) for its frontline ambulance role, a field ambulance body (4 litter patient berths) for its field ambulance role, and a lightweight multipurpose shelter kit for its command post, communications, and fire direction center roles.

(e) The vehicle shall be capable of accepting and mounting a separate on-vehicle power unit. It is anticipated that a 5 or 10 KW engine generator set will be mounted. Anticipated weight of these sets varies from 400 to 750 lbs.; anticipated bulk varies from 28 to 30 cubic feet.

(f) The vehicular electrical power source, when the vehicle engine is idling, will provide 50 per cent of its maximum power output.

(g) With respect to both cargo and personnel the vehicle shall be provided with means for rapid loading and unloading which will constitute an improvement over the means found in those vehicles it is designed to replace.

(h) The vehicle shall be designed to permit the easy installation of a front-mounted winch.

(i) Provision shall be made for installation of a heater for the vehicle's ambulance role.

(j) The vehicle shall be capable of accepting fuel at a rate not less than 50 GPM.

(k) Provision shall be made for stowage of vehicular tools and equipment, and the individual weapons of the two-man crew.

(l) Provision shall be made for the stowage of a spare tire or other device which will give the vehicle a get-home capabiilty in the event of its suffering a tire disablement.

(m) The vehicle shall be designed in conformity with human factors engineering principles contained in inclosure 1.

(n) Provision shall be made for lifting and tie down for rail, air and marine transport.

(o) A turn signal for use with the standard stop light shall be provided.

(p) Sufficient clearance shall be provided to permit the use of tire chains or traction devices.

(q) A means shall be provided to adequately secure payload in cargo compartment during air delivery and air transport operations.

(2) *Desirable.*—

(a) Advanced engine design shall be utilized. In this connection, multifuel or diesel engines shall be given strong consideration, with preference for the former; turbine engines should not be ignored. If a conventional, spark ignition engine is used, consideration shall be given to a design that will permit possible later exchange with an engine of advanced design.

(b) The configuration shall provide the most efficient use of the space available within the normal confines of the vehicles.

(c) A cargo area of approximately 56 sq. ft. shall be provided when the vehicle is employed as a cargo carrier.

(d) Access to the full length of the cargo bed shall be provided to insure more efficient loading and unloading.

(e) Suspension points, for aerial delivery, shall be located at the uppermost portions of the four corners of the vehicle.

(*c*) Transportability:

(1) (Essential) The vehicle with payload shall be air-transportable and capable of aerial delivery, including parachute delivery, in Phase I of airborne operations.

(2) (Essential) The vehicle shall be capable of overseas transport and landing over beaches in service ready condition. Particular attention shall be given to the avoidance of materials which suffer rapid deterioration as a result of exposure to salt-laden atmosphere and to salt water.

(3) (Essential) The vehicle, fully loaded, shall be capable of both internal and external transport by transport helicopter of the time period.

(*d*) Durability and reliability:

(1) *Essential.*—

(a) Durability.—The vehicle shall be capable of operating in a military environment for 10,000 miles with organizational maintenance only and 20,000 miles without evacuation beyond the direct support maintenance echelon.

(b) Reliability.—During the first 10,000 miles of operation the unscheduled maintenance hours required shall not exceed the scheduled maintenance hours.

(c) Durability and reliability of the vehicle shall not be compromised in order to achieve an approximate ratio of one-to-one in payload to curb weight.

(2) *Desirable.*—The vehicle shall be capable of operating in a military environment for 15,000 miles with organizational maintenance only and 25,000 miles without evacuation beyond the direct support maintenance echelon.

(e) Vulnerability:

(1) (Essential) Protection from inclement weather shall be provided for personnel and cargo.

(2) (Desirable) Means shall be provided in the weather canopy for protection against small arms fire and shell fragments. In this connection, the use of a lightweight, body-armor type of material or other materials should be investigated.

(3) (Desirable) Means shall be provided to protect personnel and cargo inside the vehicle from the ionizing effects of residual radiation. A radiation transmission factor of 0.1 is desirable.

3. Special regulations

(a) (Essential) The vehicle shall be suitable for use in Phase I airborne operations as defined in AR 705–35, Criteria for Air Transportability and Air Delivery of Materiel, 26 Feb. 60.

(b) (Essential) The vehicle shall be designed to conform to the requirements of AR 705–15, Operation of Materiel Under Extreme Conditions of Environment, 14 Aug. 57. The equipment shall be capable of operation in air temperature ranges of −65° F to 125° F and of storage in temperature ranges of −65° F to 155° F.

(c) (Essential) The vehicle shall have an inherent swimming capability in inland water as defined in SR 705–2300–8, Water-Crossing Requirements for Future Combat and Tactical Vehicles, 11 Aug. 60.

4. Maintenance requirements

(a) Essential:

(1) Vehicle maintenance in the field at all echelons shall be accomplished easily in the minimum practicable time. To this end, the following should be considered: skill of average driver and mechanic in the field, maximum practicable use of sealed assemblies and modules, minimum practicable use of moving parts requiring servicing, no interference to accessibility for servicing and repair, fewest practicable essential organizational maintenance tasks, and no need for special tools or complex maintenance equipment.

(2) Maximum design effort shall be made to keep to a reasonable minimum the variety and quantity of repair parts required for stockage at organizational level.

(b) (Desirable) Design shall incorporate permanently lubricated assemblies and equipments to the maximum extent practical.

SECTION III—ASSOCIATE CONSIDERATIONS

1. Associated equipment—Kits

(a) (Essential) Development of special purpose kits shall be concurrent with development of the vehicle. All kits required shall have the following features.

(1) Be designed for installation by organizational means.

(2) If any kit requires power, provisions must be made for conversion of power available from the vehicle to a suitable form for use by the particular kit. Power outlets only shall be provided on the vehicle.

(b) (Essential) If demanded by design of the vehicle, a winterization kit shall be provided to permit attainment of the requirements established by MCV 200 and AR 705–15.

(c) (Essential) If demanded by design of the vehicle, a desert kit shall be provided.

(d) (Essential) Kits for mounting the flexible version of the current standard 7.62–mm and caliber .50 machine guns, the Vehicle Rapid Fire Weapon System, the antitank guided missile, the current standard heavy recoilless rifle, and the Davy Crocket XM28 and XM29 Systems.

(*e*) (Essential) A litter adapter kit shall be provided for conversion of the vehicle to perform a frontline ambulance role.

(*f*) (Essential) A front mounted winch kit shall be provided; it must be of sufficient size and strength to permit self-extrication with straight line pull in difficult terrain.

(*g*) (Essential) A lightweight multipurpose shelter kit shall be provided to permit the vehicle to be used as a command post, communications, and fire direction center vehicle. It is desirable that this shelter provide protection against small arms fire, shell fragments, and ionizing effects of residual radiation, similar to the objectives as stated in paragraphs 2e(2) and 2e(3) of section II. It is also desirable that a collective protective system and personnel heater be provided for this kit.

(*h*) There are no requirements known at this time for special training aids or devices requiring separate development.

2. Atomic energy commission considerations—None

3. Safety criteria

(Essential) Particular attention shall be given to the prevention of noxious fumes in crew and passenger areas resulting from exhaust system and vehicle design.

4. Priority of development

Recommended priority for this development is 1–A.

5. Special time considerations

This vehicle should be in the hands of troops as soon as possible.

6. Other items or systems that may be affected

(a) This vehicle will permit elimination of the following vehicles from the supply system:

(1) Truck, Ambulance, Frontline, ¼-Ton, 4 x 4, M170.

(2) Carrier, Light Weapons, Infantry, ½-Ton, 4 x 4, M274 (in the Army only).

(3) Truck, Cargo, ¾-Ton, 4 x 4, M37.

(4) Truck, Ambulance, ¾-Ton, 4 x 4, M43.

(*b*) This vehicle will reduce the requirements for, and may replace, some of the following vehicles and general-purpose trailers towed by them in forward combat areas:

(1) Truck, Utility, ¼-Ton, 4 x 4, M38, M38A1, M38A1C.

(2) Truck, Utility, ¼-Ton, 4 x 4, M151.

(*c*) This vehicle cancels the following CDOG qualitative materiel requirements:

(1) Subparagraph 1436a(1)—Ambulance, Frontline.

(2) Subparagraph 1636c(2)—Truck, Utility, 1-Ton.

(3) Subparagraph 1636c(6)—Truck, Utility, Lightweight, ¾-Ton.

7. Coordination

Comments received as a result of coordination of these military characteristics which would require revision of the military characteristics if agreed to are listed below with the headquarter's reason for nonconcurrence:

Chief of Ordnance

(a)(1) *Comment (para 2b(1)(j)).*—Change from essential to desirable the statement that the vehicle shall be capable of accepting fuel at a rate not less than 50 GPM.

(2) *Basis of nonconcurrence.*—The requirement is stated in the QMR.

(*b*)(*1*) *Comment (para 2, section III).*—In view of para 2e(3) of section II, it appears that there might be Atomic Energy Commission consideration involved.

(2) *Basis of nonconcurrence.*—Requirement for shielding from ionizing effects of residual radiation does not require Atomic Energy Commission coordination.

SECTION IV

1. Order of priority of major characteristics

If any of the required characteristics are incompatible with each other to the extent that significant compromises are required, the Commanding General,

USCONARC, shall be consulted as to the degree of compromise acceptable and the merits of reviewing the relative priority which otherwise will be as here listed.

(*a*) Performance.
(*b*) Durability and reliability.
(*c*) Maintenance.
(*d*) Transportability.
(*e*) Configuration and weight.
(*f*) Vulnerability.

2. Unit cost

(*a*) Prototype cost is estimated at $150,000 each.
(*b*) In reasonably large production volume, cost of the vehicle should be less than $5,000.

Enclosure 1—Human Engineering Factors

VEHICLE DESIGN

1. Seats

Driver and passenger seats are adjustable for tall and short men and are contoured to fit the back and buttocks of the average man.

2. Controls

(*a*) The steering control-operator seat relationship shall permit safe, easy, and comfortable driving.
(*b*) The control requires as few movements as possible.
(*c*) Successive control movements are interrelated, i.e., one movement passes easily into the next.
(*d*) Controls used in rapid sequence have uniform direction of motion.
(*e*) Control movements are consistent for all equipments which one operator uses.
(*f*) The method used to prevent accidental activation of the control, if any, does not increase the time required to operate the control to such an extent that it is unacceptable.
(*g*) Activation of the control does not obscure visual display or control markings.
(*h*) Controls such as clutches and foot throttles are located in such a manner that they can be operated easily without the driver having to assume uncomfortable body angles. Controls of this type are also capable of being operated easily when the driver is equipped with thermal boots (Mickey Mouse boots).
(*i*) Foot throttles are so located that the driver, with minimum amount of movement and effort, can remove his foot from the throttle and apply the foot brake.
(*j*) The driver has the capability of applying the brakes easily when thermal boots are worn.
(*k*) The instrument panel is so located that it can be observed from the normal driving position.
(*l*) A master warning light is provided for notification when engine temperature, oil pressure, etc., are above or below safe operating ranges.

3. Displays

(*a*) Information presented will be the minimum necessary for the basic decisions or actions required of the operator in regard to safety and maintenance.
(*b*) Displays will be simple in design and will present information in the most immediately meaningful form i.e., no interpretation or decoding is required.
(*c*) Information is displayed to the accuracy required by the decisions or actions of the operator, and preferably no more accurately than required.
(*d*) If scale interpolation is required, it does not introduce a probability for operator errors which are greater than the operator's task permits.
(*e*) Information for different types of activities, e.g., operation and maintenance, is not combined unless the activities require the same information.
(*f*) Information is current, i.e., lag is minimized.
(*g*) Failure in the unit is clearly shown or the operator is otherwise warned.

4. Ease and safety of operation

(*a*) Adequate means are provided for the driver to get in and out of the cab when wearing cold-weather clothing.

(*b*) Adequate means are provided for troops to mount the rear of trucks with maximum ease.

(*c*) Nonskid decking is provided for safety.

(*d*) OVE tools are located where they are easily accessible to drivers.

(*e*) A warning device is provided to indicate when the emergency brake is on.

(*f*) Tail gates on trucks incorporate an equilibrator that slow their movement to the down position and assist their movement to the closed position.

(*g*) Safety straps are placed in vehicles that do not have doors on the driver or passenger side. They are also required for the safety of passengers in the cargo compartment.

(*h*) Whenever possible, trucks have drop sides for ease of loading. Means should be provided to permit ease of lowering and raising.

MAINTAINABILITY DESIGN

1. Handles

(*a*) When possible, handles are provided on covers, drawers and components to facilitate handling.

(*b*) When handles cannot be provided, hoist and lift points are clearly marked.

(*c*) When possible, handles are located over the center of gravity to prevent the object from tipping while being lifted or carried.

(*d*) Handles are positioned so that they cannot catch on other units, wiring, protrusions, or structural members.

(*e*) The following dimensions are minimum for handles to be used by the ungloved hand:

(1) Weight to be lifted or moved is under 25 pounds:
Handles diameter: ¼ to ½ inch
Finger clear: 2 inches
Handle width: 4½ inches

(2) Weight to be lifted or moved is over 25 pounds:
Handle diameter: ½ to ¾ inch
Finger clear: 2 inches
Handle width: 4½ inches

2. Covers, cases, and access doors

(*a*) Method of opening a cover is evident from the construction of the cover itself. If not, an instruction plate is permanently attached to the outside of the cover.

(*b*) Hinges are used, where possible, to reduce the number of fasteners required.

(*c*) When a hinged cover is used, a space equal to the swept volume of the cover is provided, e.g., opening of the cover is not obstructed by bulkheads, brackets, etc.

(*d*) Structural members, other components, etc., do not interfere with removal of a cover.

(*e*) Provision has been made for adequate bonding of plastic or rubber stripping and seals, so that if a cover comes into contact with, or must slide over such material, the seal will not be damaged or the cover jammed.

(*f*) It is evident when the cover is in place but not secured.

(*g*) Where feasible, guides, tracks, and stops are provided to facilitate handling and to prevent damage to components.

(*h*) Access doors are hinged at the bottom if possible.

(*i*) When access doors must be hinged at the top, a support rod is provided to hold the cover open.

(*j*) Hinged doors or covers are provided with captive, quick-opening fasteners.

(*k*) If instructions applying to a covered unit are lettered on a hinged door, the lettering is properly oriented for reading when the door is open.

(*l*) A minimum number and type of fasteners are used, commensurate with requirements for stress, bonding, etc.

(*m*) When possible, the same size and type of fasteners are used for all covers, cases and access doors.

(*n*) Maximum use is made of tongue-and-slot catches to minimize the number of fasteners required.

(*o*) Hand-operated fasteners requiring no tools are preferred; those requiring standard hand tools are acceptable; those requiring nonstandard tools should not be used.

(*p*) Captive nuts and bolts are used where feasible.

3. Accessibility

Information placed at each access included the following:

(*a*) Nomenclature of items accessible through it.

(*b*) Warnings of hazardous or critical operations.

(*c*) Edges of accesses have internal fillets or other protection if they might otherwise cause injury to hands or arms.

(*d*) Access provisions are located on easily accessible surfaces.

(*e*) Components are not placed in recesses or located behind or under stress members, floor boards, seats, hoses, pipes, or other items which are difficult to remove.

4. Reaching

Smallest allowable openings for one-hand tasks are as follows:

(*a*) Inserting empty hand held flat: 2½ by 4½ inches.

(*b*) Smallest square hole through which empty hand can be inserted: 3¼ by 3¼ inches.

(*c*) Using 8-inch screwdriver with a 1-inch diameter handle: 4 by 4 inches.

(*d*) Inserting drawer or electronic assembly grasped by handles on front, into opening: ½ inch clearance on each side of assembly.

(*e*) Reaching through opening with both hands to depth of 6 to 25 inches: width, three-quarters the depth of reach; height, 4 inches.

(*f*) Reaching in to full arm length (to shoulders), straight ahead, with both arms: width, 20 inches; height, 4¼ inches.

5. Location of replaceable components

(*a*) Large components which are difficult to remove are mounted so that they do not prevent access to other components.

(*b*) Components are located so that each replacement unit can be removed through a single access panel.

(*c*) Components are placed to allow sufficient space for use of test equipment and other required tools without difficulty or hazard.

(*d*) *All* throwaway components are accessible without removal of other components.

(*e*) Structural members of the chassis do not prevent access to components.

(*f*) Delicate components are so located or guarded that they will not be damaged while the unit is being handled or worked on.

(*g*) Components are located so that blind adjustments are not necessary.

(*h*) Components of the same or similar form, such as seals, are mounted with a standard orientation throughout, but are readily identifiable and distinguishable.

(i) Equipment is modularized so that rapid and easy removal and replacement of malfunctioning modules or components can be accomplished by one technician.

(*j*) Components can be checked and adjusted separately and then connected together into the system with minimum adjustment.

6. Component mounting

(*a*) Whenever possible, components are so located that no other equipment must be removed to gain access or to remove them.

(*b*) If it becomes *necessary* to place one component behind another, the component requiring less frequent access is in the rear.

(*c*) Components frequently removed for checking from their normal installed position are mounted on roll-out racks, slides, or hinges.

(*d*) Limit stops are provided on roll-out racks and drawers; override of these limit stops is easily accomplished.

(*e*) Field removable components are replaceable with common handtools.

(*f*) Components are mounted to the housing rather than attached to each other so only the component to be replaced has to be removed.

(*g*) Removal of any replaceable component requires opening or removal of a minimum number of covers or panels (preferably one).

(*h*) Components are laid out so that a minimum of place-to-place movement by the operator is required during the checkout.

(*i*) Components are located and mounted so that access to them may be achieved without danger to personnel, e.g., from electrical charge, heat, sharp edges and points, moving parts, chemical contamination.

(*j*) Access to units maintained by one operator do not require removal of equipment by a second higher-skilled operator.

7. Conductors, cables, and conduits

(*a*) Long conductors, cables, and conduits internal to equipment, are secured to the chassis by cable clamps.

(*b*) Cables are long enough so that each functioning component can be checked in a convenient place or, if this is not feasible, extension cables are provided.

(*c*) Cables are long enough to permit jockeying or movement of components when it is difficult to connect or disconnect other cables.

(*d*) If it is necessary to route cables, wires, and conduits through holes in metal partitions, protection from mechanical damage is provided by grommets or other acceptable means.

(*e*) Cables and conduits cannot be pinched by doors, lids, etc.

(*f*) Cables and conduits are routed so they cannot be walked on or used for hand holds.

(*g*) Cables and conduits are easily accessible for inspection and repair.

(*h*) Cables and conduits are so routed that they need not be bent or twisted sharply or repeatedly.

(*i*) If feasible, individual conductors of all cables, either single- or multi-conductor, are color-coded their entire length.

8. Connectors

(*a*) One-turn or other quick-disconnect plugs are used.

(*b*) When dirt and moisture are a problem, plugs have an attached cover.

(*c*) Connectors are located far enough apart so that they can be grasped firmly for connection and disconnection.

(*d*) Rear of plug connectors is accessible for test and service, except where this is precluded by potting, sealing, etc.

(*e*) Plugs or receptacles are provided with aligning pins or other alignment devices.

(*f*) Plugs are designed so that it is impossible to insert the wrong plug in a receptacle.

(*g*) Socket rather than plug contacts are "hot".

(*h*) Connectors and their associated labels are positioned for full view by maintenance personnel.

(*i*) Connecting plugs and receptacles are identified by color or shape or other acceptable means.

(*j*) Plugs and receptacles have painted stripes, arrows, or other indications to indicate proper insertion of aligning pins.

9. Test points

(*a*) Test points to determine that a unit is malfunctioning are provided.

(*b*) Appropriate test points are provided when a component is not completely self-checking.

(*c*) Second echelon test points are so located and coded that they are readily distinguished from higher echelon test points.

10. Fuzes and circuit breakers

(*a*) Fuzes and circuit breakers are so located that they can be easily seen and quickly replaced or reactivated.

(*b*) Fuze replacement is not hampered by other components.

(*c*) No special tools are required for fuze replacement.

11. Tools

(*a*) Variety of tools is held to a minimum.

(*b*) As few special tools as possible are required.

(*c*) Tools are of dull finish to avoid glare in strong light.

(*d*) Speed and ratchet-type tools are provided when necessary.

(*e*) Nonsparking tools are provided for use in an explosive atmosphere.

12. Lubrication

(*a*) Equipment containing mechanical components either has provision for lubrication without disassembly or does not require lubrication.

(*b*) When lubrication is required, the type of lubricant to be used and the frequency of lubrication is specified by a label at or near the lubrication point.

ENCLOSURE 2—CANADIAN ARMY AND MARINE CORPS COMMENTS

1. Canadian Army

"The Canadian Army has no comments on the subject Draft Military Characteristics."

2. U.S. Marine Corps

(*a*) The Marine Corps is interested in a vehicle of this design and capacity. It is anticipated that a vehicle of this type will replace a portion of the Trucks, 2½-ton, 6x6, used for logistical support and as a prime mover for direct support artillery within the Marine Division.

(*b*) Specific comments pertaining to the subject Draft Military Characteristics are as follows:

(1) Section I, paragraph 1—Comment: An inherent swimming capability is not required for Marine Corps use. Add—(prior to last sentence, after "letter"), and as a prime mover for towed loads.

(2) Section I, paragraph 2—Add sentence—This vehicle will be used as prime mover for direct support artillery (Marine Corps).

(3) Section II, paragraph 1a(3)—Add—after "series", based on actual miles per gallon.

(4) Section II, paragraph 1a(5)—Comment: An inherent swimming capability is not required for Marine Corps use.

(5) Section II, paragraph 1a(7)—Comment: A 3500 pound tow capability is mandatory for the Marine Corps.

(6) Section II, paragraph 1a(8)—Comment: A maximum speed of 45 miles per hour will meet Marine Corps requirements.

(7) Section II, paragraph 2a(1)—Substitute: Essential—The curb weight will permit the vehicle to be lifted by HRB–1 helicopter in helicopter-borne assault with radius of operation of 100 miles.

(8) Section II, paragraph 3c.—Comment: An inherent swimming capability is not required for Marine Corps use.

(*c*) The comments contained in 3a, d and h above are based upon the opinion that the Marine Corps does not require an inherent swimming capability for ground motor transport vehicles for anticipated amphibious warfare operation. Although unlisted, it is considered that this capability might prove to be a handicap when disembarking vehicles from landing craft in heavy surf.

3. USCONARC comments on Marine Corps comments

(*a*) Nonconcur with comments 2b(1), (4) and (8) above as pertains to the swimming capability of the vehicle. For U.S. Army use, an inherent swimming capability in inland waterways is essential.

(*b*) Concur with comment 2b(1) above as pertains to use of vehicle as a prime mover for towed loads.

(*c*) Concur with comment 2b(2) above.

(*d*) Concur with comment 2b(3) above.

(*e*) Nonconcur with comment 2b(5) above. Office, Chief of Ordnance has informed this headquarters that under guaranteed performance contracts, 50% of the gross vehicle weight for towed loads is the maximum obtainable. 50% of the gross vehicle weight will meet the Army requirement for towed loads. 60% of the gross vehicle weight has been added as a desirable characteristic.

(*f*) Nonconcur with comment 2b(6) above. A 50 mph capability on dry, level, hard surface roads is required for U.S. Army use.

(*g*) Nonconcur with comment 2b(7) above. Vehicle weight will be minimum consistent with other requirements and should be less than weight lifting capability of the HRB–1 helicopter. As stated in Section II, subparagraph 2c, it is essential that the vehicle, fully loaded, shall be capable of both internal and external transport by medium transport helicopter.

Mr. PIKE. Do you have any questions, Mr. Reddan?

Mr. REDDAN. No, sir.

Mr. PIKE. Mr. Lally?

Mr. LALLY. No, sir.

Mr. PIKE. General, I am going to recess the hearing at this point.

I realize that you have a busy schedule. We will hear other witnesses this afternoon. You need not come back this afternoon, but we may want you back at a later date.

General ELLIS. May I come back, sir? I am not so busy that I am not able to.

Mr. PIKE. I thought the whole purpose of our putting you on first without the opportunity to really study your statement was so you could go off and do something else?

General ELLIS. Sir, I was not a party to that arrangement, and I don't——

Mr. PIKE. Sir, I was not a party to that arrangement either. We would be delighted to have you come back.

We will recess until 2 o'clock this afternoon.

(Whereupon, at 12:10 p.m., the special subcommittee was recessed, to reconvene at 2 p.m., the same day.)

AFTERNOON SESSION

Mr. PIKE. The hearing will come to order.

Frankly, we covered so much ground this morning that I do not anticipate that it will be necessary to make this hearing last more than the remainder of today. We got so much of what we were after from General Ellis and the supporting documents which we have that I think with the completion of the testimony of only about two more witnesses, we will be able to wrap this up today.

Who is the next witness?

Mr. REDDAN. Colonel Boyd.

Mr. PIKE. Colonel Boyd, please.

Colonel BOYD. Good afternoon, sir.

Mr. PIKE. Would you give your name and address to the reporter, please?

TESTIMONY OF COL. CLARENCE W. BOYD, JR., G–4 DIVISION, HEADQUARTERS, U.S. MARINE CORPS; ACCOMPANIED BY MAJ. BILLY M. FLOYD, MOTOR TRANSPORT SECTION, EQUIPMENT BRANCH, G–4 DIVISION, HEADQUARTERS, U.S. MARINE CORPS

Colonel BOYD. Col. Clarence W. Boyd, Jr., G4 Division, Headquarters, Marine Corps.

Mr. PIKE. It is my understanding you do not have a prepared statement, Colonel Boyd. Is that correct?

Colonel BOYD. That is correct, Mr. Chairman.

Mr. PIKE. Go ahead, Mr. Reddan.

Mr. REDDAN. You are accompanied by Major Billy Floyd?

Major FLOYD. Yes, sir.

Mr. REDDAN. Would you please introduce yourself, for the record?

Major FLOYD. I am Maj. Billy M. Floyd. I am the head of the Motor Transport Section of the Equipment Branch, G4 Division, Headquarters, Marine Corps.

Mr. REDDAN. Colonel, could you briefly, for the record, give the Committee the nature of your position and responsibilities, particularly with reference to Gama Goat?

Colonel BOYD. At the present time I am executive officer of the G4 Division, supervising operations and activities of the various branches, and have been closely associated with the Motor Transport Section. Prior to that I was involved with research and development, directly, and testing of Gama Goat.

Mr. REDDAN. How long have you been associated with the project?

Colonel BOYD. When it was an experimental model, in about 1965, was my first contact.

Mr. REDDAN. What were the Marine Corps requirements for a mobile vehicle of this nature, at that time?

Colonel BOYD. We stated in our SOR, our Special Operational Requirement, in 1965, only that we required a truck of 1½-ton capacity, a utility vehicle, to replace an aging M37 vehicle in our operational units. I guess that is about the requirement.

Mr. REDDAN. You required an over-the-road, across-the-country capability?

Colonel BOYD. Yes. We required a capability, at least in mobility, equal to the M37, and hoped for better. We stated the normal statements relative to mobility of ascent, descent, across-slope capability that we desired in our SOR.

Mr. REDDAN. Did you require a swimming capability?

Colonel BOYD. No, sir. We required capability to get from a beach-landing craft on to dry land.

Mr. REDDAN. In such a beach-landing craft are the wheels normally in contact with the ground when you come off the ramp?

Colonel BOYD. The answer should be "Yes," sir. If not, very shortly afterward they would be, because hopefully you would be in water less than 5 feet in depth.

Mr. REDDAN. How about an airdrop capability? Did you require that?

Colonel BOYD. We did not, sir.

Mr. REDDAN. Did you require a vehicle of the size of the Gama Goat?

Colonel BOYD. We asked for one that would carry a larger capacity in weight; yes, sir.

Mr. REDDAN. At the time you became associated with the program, what was the Marine Corps thinking with respect to the probable cost of the vehicle to meet your requirements?

Colonel BOYD. I think the original cost that we were hoping for would be no more than the M37.

Mr. REDDAN. Which was what, sir?

Colonel BOYD. Something around $7,000.

I am sorry. I am informed the cost was around $5,000.

Mr. REDDAN. Do you know how many M37's the Marines have in inventory at the present time?

Colonel BOYD. Right now we have approximately 3,800.

Mr. PIKE. Just to ease our procedure here, Major Floyd, if there is any information which you have which the colonel does not have, don't you hesitate to answer the question yourself. It is perfectly all right. You need not go through channels, to that extent.

Major FLOYD. Sir, I might say our allowance for the M37 is greater than that.

Mr. REDDAN. Was the Gama Goat going to replace the M37 on a one-for-one basis?

Major FLOYD. Yes, sir.

Mr. REDDAN. Were you going to use anything in combination with the Goat? How about the XM705?

Colonel BOYD. We were going to replace the M37's in units of the regiment and forward with the Gama Goat, and replace these vehicles that did not require such close proximity to the combat zone with a lesser capability vehicle.

Mr. REDDAN. You are using the M715. Is that a modified commercial vehicle?

Colonel BOYD. We have the M715 only in a very limited number which we have with Marine Aviation, sir.

Mr. REDDAN. As I understand it, when you first went into this program you determined your needs to be about 3,300 vehicles. Is that correct?

Colonel BOYD. Yes, sir.

Mr. REDDAN. What is your present requirement?

Colonel BOYD. We have presently contracted for 1,758 vehicles of the two types, 159 of the ambulance configuration, the rest of the M561.

Mr. REDDAN. Could you tell the committee the reason or rationale for the reduction of the number of vehicles?

Colonel BOYD. Basically, funding problems, sir, the increased price. We are forced to look for a less expensive vehicle.

Mr. REDDAN. Have you run any studies to determine the increased cost of the Gama Goat by reason of its alleged swimming capability and airdrop ability?

Colonel BOYD. No, sir; we have not.

Mr. REDDAN. At the time of your original request, or your original entrance into this program, and your desire to get the vehicle, what sort of priority did you have on it?

Colonel BOYD. It was an operational priority that was quite high. But it was not of an absolutely urgent nature at that time.

Mr. REDDAN. Did you have a requirement for it in Vietnam?

Colonel BOYD. We stated at one time that we had a requirement for it in Vietnam.

Mr. REDDAN. Have you ever gotten any over there?

Colonel BOYD. No; we have not deployed them.

Mr. REDDAN. Do you still have a high priority requirement for this type of vehicle?

Colonel BOYD. Yes. Our M37 fleet is aging very badly, and we have no other military vehicle we can substitute at this time.

Mr. REDDAN. The Army was the procuring authority for you in this, the procuring agency?

Colonel BOYD. Yes.

Mr. REDDAN. You might explain for the record why that is.

Colonel BOYD. The Marine Corps only attempts to develop the items peculiar to amphibious operations or which are unique, for which no one else has a requirement. Other than that we attempt to use development agencies or branches of the other branches of the Armed Forces, and in particular rely very heavily on the Army in support of development of our requirements which are similiar to theirs.

Mr. REDDAN. By going with the other service, does a quantity buy reduce the price?

Colonel BOYD. Normally that will benefit us, also.

Mr. REDDAN. Has the Marine Corps received any Gama Goats as yet?

Colonel BOYD. Yes. We have taken delivery of 66 Gama Goats. These were used in our training in preparation for the introduction of the vehicle.

Mr. REDDAN. Did you run tests of the Gama Goat down at Quantico?

Colonel BOYD. In the earlier period, yes, sir; 1967–68 time frame.

Mr. REDDAN. Would you tell us whether or not the test you ran at that time would still be valid with respect to the Goat's capability today?

Colonel BOYD. To the best of my knowledge; yes, sir.

Mr. REDDAN. For what were you testing at that time?

Colonel BOYD. Basically, testing operational capabilities.

Mr. REDDAN. How did it come out?

Colonel BOYD. On cross-country mobility, it did quite well. It performed many of the functions we were looking for, without any problem at all.

Mr. REDDAN. Could you give us an example, sir, of that?

Colonel BOYD. Yes. It was run in competition with other vehicles, at our rather primitive test track there, and did very well in time and carrying its prescribed load.

Mr. PIKE. Were the other vehicles new?

Colonel BOYD. One set was—yes, two of them were, sir. The other was the old M37, but it was in comparable operating condition.

Mr. REDDAN. What other vehicle did you test, along with the Goat?

Colonel BOYD. We ran the XM571 at the same time over the same track, and also ran a vehicle procured in limited quantities for Marine Aviation, called a Cerlist Diesel, which was more of a van-type vehicle designed for airfield and not unimproved operating terrain use.

Mr. REDDAN. In determining cross-country mobility how did the Goat compare with the M37 in getting from point A to point B?

Colonel BOYD. Generally speaking the Gama Goat would get there faster.

Mr. REDDAN. Both got there, but the Goat would get there faster?

Colonel BOYD. Yes, sir.

Mr. REDDAN. Do you have a copy of your 1966 report from Quantico?

Colonel BOYD. Yes, sir.

Mr. REDDAN. That is dated May 2, 1966?

Colonel BOYD. Yes, sir; I have that.

Mr. REDDAN. I wanted to make sure that we were talking about the same document. We have this in our files.

Mr. Chairman, I see no point in going into the performance characteristics at this time.

Mr. PIKE. We have established the validity of the document; at least we are all talking about the same thing.

Mr. REDDAN. You might describe for us briefly, Colonel, how you tested the Goat's ability to move through swampy areas or waterlogged areas. How did you do that?

Colonel BOYD. We built, in one of the tests, a large mud puddle, an area of deep mud, drove the vehicle into it, towed the artillery piece

behind it. When it got stuck we retrieved it and tried it again from both directions.

Mr. PIKE. Colonel, do you mean the Marines don't have a mud puddle, they had to build a mud puddle?

Colonel BOYD. No, Mr. Pike. We just had to improve the one that existed.

Mr. PIKE. Had to get a good one.

Colonel BOYD. Make it a little deeper, sir.

Mr. PIKE. I see.

Mr. REDDAN. How did the Goat do in those tests?

Colonel BOYD. Nothing went through the mud puddle. So it, like the other vehicles, was rendered immobile as it got into the middle of the mud puddle. However, it was capable of winching itself out.

Mr. REDDAN. How did the winch work?

Major FLOYD. There were two failures of winch components during the extraction.

Mr. PIKE. How many vehicles were you testing?

Major FLOYD. Two vehicles were associated with this test, sir.

Mr. PIKE. Did the winches on both vehicles fail, or did one winch fail on one vehicle, you replaced it, and it failed again?

Major FLOYD. Sir, I don't recall.

Yes; it was the same winch. They repaired the winch, and then they had difficulties with it after it was repaired.

Mr. PIKE. So it really could not winch itself out of the mud puddle?

Colonel BOYD. That is correct.

Mr. PIKE. Eventually something else came along and winched the Gama Goat out of the puddle?

Colonel BOYD. No, sir. Eventually we repaired the winch and it was able to winch itself out.

Major FLOYD. Yes, sir.

Mr. REDDAN. I understand the Goat is supposed also to be a mobile prime mover. What artillery pieces was it supposed to handle?

Colonel BOYD. We were trying to replace the prime mover, the 105-millimeter M101, for our artillery, tried to tow it behind the Goat.

Mr. REDDAN. What happened?

Colonel BOYD. The Gama Goat was a fine prime mover, could tow it in most environments. It was limited by its ability to carry the crew and ammunition. It was very, very difficult to back the vehicle with the artillery piece attached.

Mr. REDDAN. Is that the——

Colonel BOYD. That is the standard 105-millimeter artillery, which are direct support artillery.

Mr. PIKE. Why was it difficult to back the vehicle with the artillery piece attached?

Colonel BOYD. It restricts the ability of the driver to see to the rear. In addition, there was a tendency of the vehicle to jackknife, bend sharply. As you know, there are the two parts to the Gama Goat, and in addition the artillery piece behind it, and it takes quite a high level of skill to do this in confined areas.

Mr. PIKE. Marines don't ever go backward, anyway, do they?

Colonel BOYD. We try not to.

Mr. REDDAN. I notice on page 2 of enclosure 1 of the report, to which we have referred, a statement with respect to the towing of howitzers. Would you read to us Colonel and tell us precisely what took place there?

Colonel BOYD (reading).

In relation to control vehicle M–37, truck, cargo, three-quarter ton, four by four, towing the M98, 107-millimeter Howtar the articulated movements of the cargo bed of the XM561 in cross-country movement caused difficulty for the Howtar. (See enclosure (3) photos numbers 4, 5, 13) The nature of this difficulty seemed to stem from excessive up and down movement of the bed plus the unhesitating power of the XM561 in most situations of rough terrain movement. In two instances during tests conducted this coupling of "movement/power" caused the Howtar to be tipped over. The Howtar was "flipped" on a soft sand surface at Onslow Beach and tipped completely over once while the XM561 was recovering out of a mud hole in swamp-travel. In the former case damage was done to the tailgate to the extent to render it no longer water-tight.

Would you like more, sir?

Mr. REDDAN. The next two paragraphs, please.

Colonel BOYD (reading further.)

In both cases where the Howtar was up-ended it appeared that the XM561 was simply "too much truck for the Gun."

It should be noted, however, that the XM561 was able to tow the Howtar into many areas through sand, mud and water, where the M–37 could not penetrate. In most cases where speed was kept to an absolute minimum and good judgment was exercised on the part of the driver the Howtar remained stabilized.

The movement of the XM561 in the role of prime mover during march column exercises was satisfactory. The XM561 was utilized in an ambush-reaction demonstartion, towing a 105 millimeter Howitzer, M2A2. At that time it was required to maintain speed and interval with ten M–35's, to react to the ambush by deploying the gun to the convoy flank as part of a "V" formation, and come to an immediate halt. The performance of the XM561 during this exercise was satisfactory.

Mr. REDDAN. Am I wrong in thinking perhaps the speed of the Goat might be an undesirable condition when towing across-country? You might get from A to B quicker than with the M–37, but to tow your equipment safely you would really have to reduce the speed of the Goat, is that correct?

Colonel BOYD. In fairness, I would say the "Howtar" referenced in this report is no longer an item in our inventory, and we have not experienced the same difficulty towing the M–101, the 105-millimeter howitzer.

Mr. REDDAN. That remains stable?

Colonel BOYD. Yes, sir.

Mr. PIKE. In general, Colonel, the Marine Corps is satisfied, then, with the performance of the Gama Goat? Is that essentially correct?

Colonel BOYD. Yes, sir.

Mr. PIKE. Are you satisfied with the cost of the Gama Goat?

Colonel BOYD. Of course we would like to have a much less expensive vehicle, sir.

Mr. PIKE. You said earlier you had to cut down your procurement because of the cost. Would you rather have the lesser number in lieu of a greater number of the M–37's that you are replacing?

Colonel BOYD. I think we would prefer to have the greater number, sir.

Mr. PIKE. In other words—well, that is an adequate answer.

As to the availability of the Goat, what is your status at the present time?

Colonel BOYD. At the present time our Gama Goats are in the hands of the Army, awaiting retrofit to bring them up to what we have expressed as our desired configuration at phase III, plus the front differential modification.

Mr. PIKE. Why are your Gama Goats in the hands of the Army, instead of the Army's Gama Goats in the hands of the Army? Why aren't you getting any coming off the production lines that don't have to be retrofitted?

Colonel BOYD. As I understand it, sir, the contract, or the production, was phased so a certain number of vehicles would be assigned to certain units, and there were priorities established. Our priorities were quite high, and we got some of the early vehicles. These, of course——

Mr. PIKE. You have them in a warehouse?

Colonel BOYD. Yes, sir.

Mr. PIKE. Because you had a high priority you got the vehicles which are in the warehouse, which are awaiting retrofit, is that the fact?

Colonel BOYD. That was the production schedule, yes, sir.

Mr. PIKE. So the fact of the matter is that aside from the 66 you have not gotten any, isn't that the case?

Colonel BOYD. That is correct, sir.

Mr. PIKE. The retrofit, according to General Ellis, started in August 1971 and will be resumed in June 1972. Why did it stop in the middle?

Colonel BOYD. I cannot answer that factually, sir. I don't know.

Mr. PIKE. When you first entered into this arrangement when were you supposed to get your vehicles?

Major FLOYD. We were supposed to introduce them late in fiscal year 1970–71.

Colonel BOYD. Fiscal year 1970 and 1971, sir.

Mr. PIKE. We now are 2 months short of fiscal year 1973. Do you know when you are going to get your vehicles?

Colonel BOYD. Yes, sir. The latest information from the Army indicates our vehicles will start going through modification in June of this year.

Mr. PIKE. "Start going through modification." That is not what I asked you.

When are you going to get your vehicles?

Colonel BOYD. The modifications will be complete in March 1973. Our vehicles will be delivered, I am pretty sure, on a phased basis as they are modified.

Mr. PIKE. Do you have any other questions?

Mr. REDDAN. One question, Mr. Chairman.

Colonel, what is the problem with the Goats that you now have in storage? What will the retrofit program correct?

Colonel BOYD. There are a number of small items. Basically, it is the correction of the two differential units. There are also Pitman arms, and a number of seals. I have a list here. It is a list we received from the Army, therefore I am sure you already have it.

Mr. REDDAN. Are these developments being placed on the vehicles that are presently coming off the assembly line?

Colonel BOYD. To the best of my knowledge the phase III vehicles, those now being produced, do have these modifications incorporated.

Mr. REDDAN. What is the holdup of the retrofit program, then? Why can't they send some of these components over to the warehouses and fix your vehicles?

Colonel BOYD. I do not know, sir.

Mr. PIKE. Mr. Lally?

Mr. LALLY. Colonel, in the interim, between the time you intended to introduce the Gama Goats into the Marine Corps inventory and today, what have you used to fill the gap?

Colonel BOYD. The old tired M37's or in some cases M35 2½-ton trucks.

Mr. LALLY. Have you had to rebuild any of the M37's?

Colonel BOYD. Not since 1971, sir.

Mr. LALLY. What was the cost of rebuilding those?

Colonel BOYD. Around $500,000 for the 80 vehicles we rebuilt, is what we estimated, sir.

Mr. LALLY. I have no further questions, Mr. Chairman.

Mr. PIKE. That is all, Colonel. Thank you.

General Ellis, would you answer just one question I asked, if you are able to?

Why did the retrofit program stop?

General ELLIS. The lack of availability of sufficient parts to keep the production line going and do the retrofit at the same time.

Colonel Babers is intimately familiar with the details of that.

Mr. PIKE. Does that have to do with the parts that are coming from England?

Colonel BABERS. No, sir.

Mr. PIKE. For the record, will you tell us why the retrofit program stopped?

Colonel BABERS. Sir, it was stopped for the lack of availability of the gears that are used in retrofit for the center and the front differential. We procured the retrofit gears from a CONUS source, CONDEC. The CONDEC supplier, at Salisbury, in England, did not have the capacity, we were told, of producing enough gears to keep the CONDEC production line going and at the same time provide gears to the Army for retrofit.

Although the lack of retrofit gears was the primary reason for the delay, there were other reasons. We wanted the results of the product improvement test we ran, to insure that we had the Pitman arm problem under control, that we had a modification that would work, and that we had a more durable accelerator rod.

Mr. PIKE. Is any part of the retrofit program addressed to this tailgate problem and the fact that the tailgates tend to get bent and therefore destroy the swim capability?

Colonel BABERS. No, sir. We are not modifying the tailgate. We are inspecting the seal to make sure we have a good seal.

Mr. PIKE. A good seal prior to being used?

Colonel BABERS. That is correct; making a double check to insure there is not a faulty seal.

Mr. REDDAN. Do you have any special decals you put on the vehicle to tell the troops how to operate it in the water?

Colonel BABERS. Yes, sir.

Mr. REDDAN. Such as what?

Colonel BABERS. The decal states the precautions that should be taken in swimming operations under certain load conditions. For instance, swimming should not be attempted when the carrier is empty and two or more kits, such as the winch and machinegun kits, are installed on the tractor. Under these conditions, the free board is marginal.

Mr. REDDAN. What is marginal, sir?

Colonel BABERS. There is no specific definition of the condition described as marginal free board, but we are talking of 3 to 4 inches of free board.

Mr. REDDAN. Would we be talking of 0 to 1 inch, with an unloaded truck?

Colonel BABERS. I have swum in it under all conditions, and have never seen it that low, sir.

Mr. REDDAN. As to the tailgate, is there any requirement for inspection of the tailgate, and treatment in the field, to insure watertightness?

Colonel BABERS. Yes, sir. That is part of the before, during and after operation service to insure that the tailgate is properly sealed.

Mr. REDDAN. If you damage it in the field, what do you do?

Colonel BABERS. Direct support maintenance would have to repair it.

Mr. REDDAN. Is there any direction in the maintenance manual with respect to putting a waterproof grease on the tailgate?

Colonel BABERS. No, sir; during the Test and Evaluation Command's assessment of the vehicles we had at one time two tailgates battered rather badly, distorted more than I have seen in the field. TECOM was able to get a satisfactory seal, and swim for 20 minutes, by applying a coat of grease to it. But no, it is not in the manual.

Mr. REDDAN. I see.

I have no further questions.

Mr. PIKE. Mr. Lally.

Mr. LALLY. I have nothing further.

Mr. PIKE. Before closing this hearing—and we are about finished—I simply want to say that we have been asked by the CONDEC Corp. to put a statement from them in the record. We will put the statement in the record, together with the covering letter.

With that, this hearing is concluded.

(The letter and statement from the Consolidated Diesel Electric Co. follow:)

CONSOLIDATED DIESEL ELECTRIC CO.,
Old Greenwich, Conn., May 23, 1972.

Hon. OTIS G. PIKE,
Chairman, Armed Services Investigating Subcommittee, Committee on Armed Services, House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: In connection with the Subcommittee's forthcoming hearings on the M561 Gama Goat program, Consolidated Diesel Electric Company is pleased to offer the attached information for your use. We would appreciate your making it a part of the record.

Should the Subcommittee desire, I am available to provide any further information the Subcommittee might require.

Sincerely,

JEROME I. DAVIS,
President.

STATEMENT OF JEROME I. DAVIS, PRESIDENT, CONSOLIDATED DIESEL ELECTRIC CO.

Mr. Chairman and Members of the Subcommittee, I am Jerome I. Davis, President of Consolidated Diesel Electric Company of Old Greenwich, Connecticut. I am pleased to have this opportunity to appear to discuss briefly with you the production program for the M561 1¼-ton rough terrain amphibious cargo truck, the Gama Goat. After telling you something about the company I head, I would like to talk about the manufacturer's role in the Gama Goat program.

Let me begin with a thumbnail description of our company. Consolidated Diesel has its headquarters in Old Greenwich, Connecticut. We have manufacturing facilities at Old Greenwich and also at Schenectady, New York, and Charlotte, North Carolina. Consolidated Diesel is one of the principal operating divisions of Condec Corporation, a New York corporation with principal offices in Connecticut. Consolidated Diesel was founded in 1942 by Mr. Norman Schafler, who is president of Condec today and still active in the business. The corporation has grown to fourteen operating divisions located in ten states. As it has expanded, the proportion of defense sales has dropped over the past ten years from 67% in 1962 to 47% in 1972. Total sales of all kinds in 1971 were $162,800,000.

I am a licensed professional engineer, and hold two degrees in engineering. I have been with this company for twenty-one years, nearly all my professional life. Most of the principal officers and managers of Consolidated Diesel hold initial or advanced degrees in engineering, and most have extensive experience in motor vehicle, particularly truck, production. As a group, we are professionals who take pride in our ability to build advanced land and water vehicle systems.

With that background, let me turn to the company's role in producing the Gama Goat.

Our association with this project began in 1968, after the Army had completed several years of research and design for a new amphibious land vehicle designed to operate on rough terrain. Specifications and drawings for the vehicle, based on test programs, were submitted by the Army to a number of vehicle manufacturers late in 1967 in a formally advertised procurement. Manufacturers who had demonstrated acceptable technical capability were invited to submit sealed bids for a fixed-price three-year contract to produce 15,274 of the vehicles according to the Army's drawings and specifications. Six bids were submitted. Consolidated Diesel's, at slightly over $132,000,000, was $21,000,000 less than that of the next lowest bidder.

The Army for three months reviewed and surveyed Consolidated Diesel's production facilities and capabilities. Approximately thirty individuals of the U.S. Army Tank-Automotive Command and other federal agencies participated. They examined every aspect of the company's bid and backup material in order to ensure that Consolidated Diesel had thoroughly analyzed and planned for meeting the requirements of the contract.

My company passed this exacting scrutiny. In June 1968 the Army awarded the fixed-price contract to Consolidated Diesel at the bid amount. The contract provided for no price increase other than a maximum of 3% per year for two of the contract's three years if the Bureau of Labor statistics Index for Tactical Vehicles rose that much. However, if the price level were to fall, it provided for an unlimited proportional drop in the contract price. In fact, that two-year period turned out to be one of great inflation, and the Index over the two-year period rose 11%. The total 6% allowed by the contract did not keep up with the cost of production. Consolidated Diesel thus had to absorb about half the increased cost of inflation.

In spite of the fact that the Gama Goat had never been produced before, there have been very few changes in the design. By terms of the contract, it was up to Consolidated Diesel to take the drawings it received from the Army and correct drawing errors at its own expense. The company, in fact, has corrected over 1,300 such errors to date, at no additional cost to the Government.

There have been, in addition, changes by the Army in the original contract specifications for the vehicle. These have totalled $1,427,155. Some of the additional cost of these was reduced by fourteen Value Engineering changes suggested by Consolidated Diesel's engineers, which reduced manufacturing costs and saved the Government $364,311. Thus the net cost to the Government for engineering changes on the first production run of this unique vehicle has been only $1,062,844. Miscellaneous other Government-directed items, such as surf kits and technical manuals, have amounted to $365,492. So the total "cost growth" of this $132 million three-year contract, apart from the limited inflation allow-

ance referred to earlier, has been 1.1%. We will stack up that cost-control record with that of any major defense contract in the past ten years—in particular, any initial production contract. Other changes in the vehicle are under consideration by the Army, but even in the unlikely event that all were made, they would amount to only somewhat over 2%.

Unit cost under the contract, then, has remained almost steady since 1968. Nor is this a contract which grew through addition of more items to the original buy. All the hardware that the Government has added to the contract amount is $2.81 million for several years' supply of spare parts, and $1.68 million to build 1,246 of the Gama Goats to a special front-line ambulance configuration.

In short, the Government has kept exceptionally close to its original order. Consolidated Diesel is doing the job it undertook to do.

Now, what is the Army buying? The Gama Goat is a vehicle of novel design. It was designed by the Army to be a wheeled vehicle which could maintain highway speeds of 55 miles per hour and yet cover rough terrain which only tracked vehicles had previously attempted. This was to be a truck which could operate at the front lines, carrying heavy loads of supplies over roughest ground, and providing an ambulance which could go where only stretcher bearers had been able to go previously. Moreover, it had to be easily air-dropped and to be able to swim rivers where there were no bridges.

To perform this way, the Army designed a machine with features never before seen in a land vehicle. The M561 has six-wheel drive, and steers with four of its six independently suspended wheels. The vehicle is two articulated hulls, rather than one straight body. It can transmit power to the rear section of the vehicle as well as the front while it turns or climbs. This means that the power train must withstand unusual stresses, with the drive shafts exposed to severe cramp angles resulting from the pitch and twist of rough terrain. Its bodies are of aluminum and extremely light, yet it can carry ten fully equipped troops, including the driver. Besides a payload of 2,900 pounds, it can tow 9,000 pounds more. The two sections have the flotation design of boat hulls, permitting the vehicle to cross deep streams propelled by its wheels.

I understand that two members of the Subcommittee have seen the Gama Goat perform. Therefore I shall not describe at greater length what it can do. Suffice it to say that this is a truck with performance capabilities not approached by any other truck ever built.

Although Consolidated Diesel had no role in designing or testing the Gama Goat, and although it is not a giant of the automotive industry, we were, nevertheless, in a good position to compete for the production contract. First of all, the production quantity was large enough to require imaginative tooling—long a strength of Consolidated Diesel's engineers and tool designers—but not so large that large competitors would have a mass production advantage. Also, since no vehicle like the Gama Goat had ever been produced before, no competitor had permanent tooling for it. Moreover, each Gama Goat requires a large amount of aluminum welding. The company's know-how in thin-gauge aluminum welding makes it a leader in the United States.

The Government's specifications were derived from a few prototypes built earlier by another contractor for research and development. When production for the Gama Goat was ordered, it was recognized by all concerned that these drawings probably were not completely appropriate for production and might have to be corrected in the manufacturing process. Similarly, not all aspects of the vehicle were completely described in the specifications, requiring definition as production proceeded. Such refinements are common in the first production run of any piece of complex equipment, whether it be a new aircraft or a family automobile. They are particularly to be expected when a vehicle represents a major breakthrough in the state of the engineering art and has no close forerunners. Although a land vehicle, the Gama Goat in many respects, is as revolutionary a departure as a new generation of aircraft.

Many initial corrections represented simply small errors in the drawings furnished Consolidated Diesel by the Government. The drawings for a major vehicle system like the Gama Goat, as I am sure you know, are extensive and detailed. There are over 6,000 separate engineering drawings, plus 7,600 other technical data documents, and beyond that a library of technical specifications. The Government recognized that while most errors in the drawings would be caught by the contractor before production, some would not be caught until production was well underway. As I mentioned, to date over 1,300 preproduction drawing errors have been corrected by the company.

Since this was a completely new vehicle, the Army planned a testing and evaluation program to continue with the production stage. It was recognized that the Government might want to direct changes in the contract design in light of that test experience. For instance, an initial group of eleven vehicles was selected. These were minutely examined by Government inspectors from the Defense Contract Administration Services (DCAS) to see that they conformed with the contract design. The inspectors gave them full approval, and the vehicles were shipped for field testing to the U.S. Army Test and Evaluation Command at Aberdeen Proving Ground, Maryland. The Army's Test and Evaluation staff recommended numerous minor changes which were not included in the original specifications. We at Consolidated Diesel agreed to incorporate these changes in the production process, in most instances at no cost to the Government.

The only substantial problems in the tests of production Gama Goats resulted from an inadequacy in the design—that of the center and front differentials and the drive shafts. As specified in the contract drawings, these components would not perform at the level the Army desired. The drive train did not have the endurance to withstand the stresses of severe field testing for the 20,000-mile test program. The problem had been noted by the Army in testing research prototypes built by the design contractor, from which the Army drew its specifications; however, these had been assumed to be special random problems of those vehicles, and not inherent in the design.

While this problem was being studied by the Army, Consolidated Diesel on its own, at no cost to the Government, set out to find a way to improve the design. We instrumented a vehicle to obtain a histogram to find out the exact torque each differential component was subjected to during Aberdeen tests. Our engineers analyzed the whole drive train system, particularly the differentials and drive shafts. I personally visited and consulted with some of the world's leading automotive differential experts. We came up with a method by designing and building a dynamometer with a four-foot flywheel, to put differentials in the laboratory to shock stresses equal to or greater than those at Aberdeen, and at the same time to attach instruments so that we could get precise measurement and analysis.

The tests showed that the drive train was in fact subject to stresses greater than those it had been designed to bear. Then, using new metallurgical techniques, Consolidated Diesel found a way to strengthen the drive train without reducing the capabilities of the vehicle. We selected new stress resistant materials for the differential gears. We designed an experimental device to regulate the torque reaching the differential. We redesigned the drive shafts. We then showed the Army these changes, which our tests indicated would solve the problem and make the Gama Goat work.

These changes were successful. We did not contract to be designers. We had no obligation to do this. We suggested these improvements to make sure we were building a product that worked. I am proud that I was able to help in this respect. I think the Army agrees that our help contributed to solving this problem.

During the period these changes were being developed, the Army desired that production be slowed until the design improvements were completed. The drive train improvements were put into production after 4,400 vehicles had been produced. The Army has decided to incorporate the improved drive trains developed by Consolidated Diesel in those 4,400 through a retrofit program. This program is being carried out entirely by the Army. Consolidated Diesel, although it came up with the improvements in design which made it possible, is not participating in nor profiting from the retrofit in any way.

As of Monday, 9,831 Gama Goats of the 15,274 called for in the contract had been manufactured. The delivery period has slipped a total of eight months. Seven weeks of this resulted from a strike at the main Consolidated Diesel facility, eight weeks from strikes at suppliers' facilities. The balance of the delay, slightly over four months, is attributable to program changes. Considering the length of the program and the complexity of the product, I think this is a good record.

Let me close with a word about production quality control. As you know, the Government did not ask Consolidated Diesel to build a vehicle able to perform certain tasks. Instead, its contract called for a piece of hardware which conformed to the Army's drawings. As I told you before, Consolidated Diesel, of course, wants the product to do the job, and we have helped in every way we can. We think it is a good product.

To make sure our production models meet contract specifications, Consolidated Diesel has an independent Quality Assurance staff of company inspectors, tech-

nicians, and engineers, who constantly check all activities along the production line. Our inspectors also test drive each vehicle as it comes off the line, taking it over a special seven-mile test track, including sharp irregular drops and 60% slopes. Only if a vehicle passes every test is it turned over to the Government inspectors as a candidate for Government acceptance. The entire Quality Assurance staff is organized separately from the plant manager and production staff. The Quality Assurance staff reports directly to my office. It is headed at our assembly plant by an engineer whose background inculdes over twenty years of experience in quality control.

Because it is built to such exacting standards, the Gama Goat's acceptance record with Government quality inspectors is extremely high. The figures speak for themselves. The overall acceptance rate is about 96% since production began—and for the past ten months has been perfect. Not one vehicle of the past 2,650 produced has been rejected. Earlier this month we received an opinion from an independent consultant in motor vehicle quality control, who for many years was a top quality control expert with the Army's Tank-Automotive Command. In closing, I will quote just one part of it. He said:

"Considering the magnitude of the program, I doubt that many companies would favorably compare with this record. Take advantage of reflecting this fine performance in any future communications on this subject. I would recommend the gathering of some simple statistics, such as the number of components, the number of operations, the number of processes, the number of vehicles, etc., in comparison with the number of deficiencies found. I would predict that if this data is equated, you would have a .999 performance record."

I offer this letter for the record.

HOWARD W. SPRENGEL ASSOCIATES,
Almont, Mich., May 9, 1972.

CONSOLIDATED DIESEL ELECTRIC CO.,
Old Greenwich, Conn.
Attention: Mr. H. E. Morse, Vice President-Purchasing.

DEAR MR. MORSE: As requested, I have thoroughly reviewed the results of the Selected Product Quality Review Audit conducted during the period of 13th through the 28th September 1971 and the Re-Audit conducted during the period of 17th through the 19th January 1972.

There are several situations that must be considered prior to reaching any conclusions relative to these audits. These situations are unique with your company and have a great effect upon the measurement of performance or comparisons with other systems or producers.

1. The audit covers four distinct locations.
(*a*) Toms River.
(*b*) Scotia/Schenectady.
(*c*) Old Greenwich.
(*d*) Charlotte.

From a mathematical standpoint, it can be expected that the per cent of deficiencies would increase depending upon the number of facilities involved. This is especially true considering the fact that the vehicles are totally produced at two distinct locations. Consequently, when measuring or comparing performance, this must be taken into consideration.

2. The establishment of management programs at different locations must be subjected to differences of opinion, i.e., the inspection and management techniques directed by the Government in one location may differ in other locations. This is caused by the fact that many inspection and management techniques are a matter of opinion and not clearly defined as measurable to a specific standard.

Many of the deficiencies represented in the initial audit fall within this category and are debatable as being truly deficiencies or an individual opinion.

I will not further address the initial audit since many actions have taken place to make the audit now obsolete.

If you must have my opinion of the original audit, I would say that considering the minute detail that the team approached and the locations and number of parts involved, that the performance of your company is above average.

The re-audit is what I am interested in since it represents that situation as it exists today. The report states, "The contractor had improved since the September SPQR. Evidence of much corrective effort was manifested, in both records

and operations." In conclusion they stated, "The significant quality improvements have appreciably improved confidence that the product meets contractual requirements."

I consider these statements to be extremely complimentary and completely justifiable in view of the results of the re-audit, which I will summarize as follows.

Of the forty-three (43) re-audit areas involving approximately 3,000 different components in mass quantities, there were only three areas that showed any deficiencies. They are as follows:

(*1*) Documentation and identification.

(*2*) Material handling.

(*3*) Product deficiencies.

In the area of documentation and identification there were four instances reported. None of these were serious and involved marking of parts and filing of data, not affecting product performance.

Material handling involved three instances, the most serious being a possible in-plant safety hazard, involving stacking of pallets, that can be easily corrected.

The third area involves product deficiencies. There were four instances reported. Only one could be categorized as a system failure. This involved a single incident of hydraulic brake leak. I would not consider this catastrophic in view of the redundancy design in the brake system.

In view of the small number of deficiencies found on the re-audit and the insignificance of these deficiencies, I would consider that Condec should be proud of their record. Considering the magnitude of the program, I doubt that many companies would favorably compare with this record. Take advantage of reflecting this fine performance in any future communications on this subject. I would recommend the gathering of some simple statistics, such as the number of components, the number of operations, the number of processes, the number of vehicles, etc., in comparison with the number of deficiencies found. I would predict that if this data is equated that you would have a .999% performance record. Your mathematicians can work this out, I am sure, considering the fact that the audit shows only one area that could be defined as a system failure.

I would certainly use this re-audit to my advantage in expressing proficiency of product.

Don't hesitate to call on me if I can be of any further assistance.

Sincerely,

HOWARD W. SPRENGEL.

In summary:

The Gama Goat is a new departure in land vehicle technology. Nothing like it has been manufactured before.

Consolidated Diesel, after receiving a fixed-price contract to build the Gama Goat to the Army's specifications, was able to hold cost growth from engineering changes to 1% to date.

The principal design changes, involving strengthening the drive train, were developed by Consolidated Diesel at no cost to the Government even though Consolidated Diesel's contract called for production and not design.

Consolidated Diesel is not involved in, and in no way profiting from, retrofit of early production vehicles to incorporate design changes.

There are no current production problems, production quality is outstanding, and the program is proceeding smoothly.

We are a proud company, and proud of the job we are doing.

Thank you for this opportunity to present our views.

(Whereupon, at 2:30 p.m., the hearing was adjourned.)