

SECTION 1

1. Military Service/Command: United States Marine Corps, Marine Corps Logistics Command (MARCORLOGCOM)
2. Specific major depot maintenance facility responsible for nominated program: Maintenance Center Albany
3. Identification of nominated program: Design and Manufacture Vehicle Armor Protective Kits in Support of Operation Iraqi Freedom II (OIF II), Operation Enduring Freedom (OEF) and Global War on Terrorism
4. Depot Facility Commander's name and nominee's mailing address:

Maintenance Center Albany
Colonel Peter T. Underwood
814 Radford Blvd Ste 20325
Albany, GA 31704-0325

5. Point of Contact (POC) at nominated units:

Primary

Name: Col Peter T Underwood
Program role: Commander
E-mail: peter.underwood@usmc.mil
Phone (Coml): 229 639-5301
DSN: 567-5301
Facsimile: 639-5386

Alternate

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Program Role: Deputy Commander
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Phone (Coml): 229 639-5301
DSN: 567-5301
Facsimile: 639-5386

6. Complete message address (Standard Subject Identification Code) of the nominated program, the depot facility and the responsible headquarters: 1650 CG
MARCORLOGCOM ALBANY GA// MAINT CTR
7. Background information for nominated program: Maintenance Center Albany was tasked to design and manufacture vehicle Armor Protective Kits for Department of Defense components deploying to OIF II, OEF and the Global War on Terrorism.
8. Program size: Government Civilian, 875; Contractor, 16; and Military, 5.
9. Mission statement for program: The mission of Maintenance Center Albany is to provide armor protection to Department of Defense components meeting their needs in cost, quality, and schedule.

SECTION 2; MISSION ACCOMPLISHMENTS

Maintenance Center Albany, Marine Corps' "**911 for Maintenance**" responded to Marine Corps, Navy, and Army requests to **provide armor protection** for Marines, Sailors and Soldiers in harms way.

The first of many 911 calls from Marine Corps Systems Command (MARCORSYSCOM) and I Marine Expeditionary Force (IMEF) to the Maintenance Center Albany, Georgia for armor protection was received on 26 January 2004.

Caller: Marine Corps I MEF is deploying back to Iraq in support of OIF II. Marine Corps policy is no vehicle will enter into Iraq without zonal armor protection. IMEF has identified 1,837 tactical wheeled vehicles requiring armor. Commercial vendors are unable to respond to the requirement in a timely manner.

911 Operator: Maintenance Center Albany's previous armor experience has been limited to developing a tractor protective kit for the D7G bull dozer prior to the first Gulf War and repairs to the armor on Light Armored Vehicle and Assault Amphibious Vehicles. What are your requirements?

Caller: The requirement is for 1,837 armor door kits to protect Marines from small arms fire and improvised explosive devices. The armor door sets need to be simple in design, easily installed with no welding or drilling required, and include an opening to allow for offensive fire. The armor door kits will be mounted on High Mobility Multi-purpose Wheel Vehicle (HMMWV), Medium Tactical Vehicle Replacement (MTVR), Logistics Vehicle System (LVS), and 5-ton trucks.

911 Operator: Roger that! Armor **protection** will be delivered **on schedule** and **under budget**.

Maintenance Center Albany immediately **surged**. Mission was **accomplished** with the first of 1,837 L-shape armor door kits installed in Kuwait 28 days from receipt of the first call and production of 1,837 L-shaped armor doors and 635 armor cargo flank kits completed on 8 March 2004, 42 days from the receipt of requirement.

"The Marines had **engaged** the enemy and the armor kits had **saved lives**, no doubt about it." -Major General Keith Stalder, Deputy CG I MEF.

Additional armor applications were **developed** by Maintenance Center Albany for the HMMWV, MTVR, LVS, and 5-ton trucks. These efforts include **underbody protection** for each of the vehicles, tailgates for the MTVR and cargo HMMWV, and rear cab plates for the 4-door HMMWV. There was also a **joint collaborative effort** with MARCORSYSCOM, Nevada Automotive Test Center, and Maintenance Center Albany for **all encompassing gunner shields** for the HMMWV, MTVR and LVS. A total of 18,190 armor kits providing interim zonal armor protection for 4,293 vehicles consisting of 5,453,394 pounds of armor plate was cut into 46,962 armor components, painted with

35,850 pounds of powder coat; assembled using 367,303 machined parts, 2,554,473 nuts, bolts and washers and covering sharp edges with 33 miles of vinyl ribbing were delivered to Marines, Sailors, and Soldiers worldwide in support of the OIF II, OEF, and the Global War on Terrorism.

A **second generation** integrated Marine Armor Kit (MAK) was **jointly developed** for HMMWVs by MARCORSSYSCOM, Maintenance Center Albany and Army Research Lab as an integrated solution, concurrently with the interim zonal armor production.



“As you can see from the photo, people should have died here. That armor we had put on these vehicles saved lives that day.”

s/f

1stSgt Theakston. (2nd Amphibious Assault Battalion)

The Meritorious Unit Commendation (page 3) was presented to the Marine Corps Logistics Command from the Secretary of the Navy:



THE SECRETARY OF THE NAVY
WASHINGTON, D.C. 20350-1000

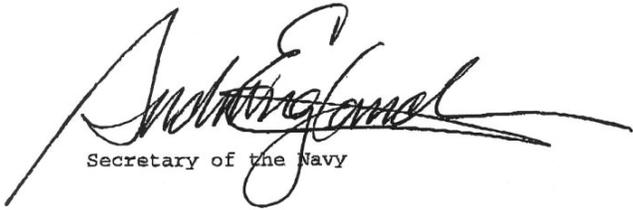
The Secretary of the Navy takes pleasure in presenting the
MERITORIOUS UNIT COMMENDATION to

MARINE CORPS LOGISTICS COMMAND, ALBANY, GEORGIA

for service as set forth in the following

CITATION:

For meritorious service from 26 January to 8 March 2004. The personnel of the Marine Corps Logistics Command Albany, Georgia demonstrated a unique strategic capability for the Navy and Marine Corps by completing an urgent priority, high intensity program in record time. Responding to an Urgent Needs Statement submitted by I Marine Expeditionary Force (I MEF) which required improved armor protection for a variety of vehicles deploying in support of Operation IRAQI FREEDOM II, the Marine Corps Logistics Command, working with the Defense Distribution Depot, commenced work immediately to design the interim armor kits. After surmounting the challenge of locating the needed quantities of ballistic steel, kit production began on a 24 hour/7 days a week basis. The first of 1,837 armor kits arrived in Kuwait less than 28 days after the tasking was received. Production of all kits was completed on March 8, 2004 at 33 percent less than the estimated cost. This production initiative required the coordination of the entire logistics supply-chain to process and cut 1,000,000 pounds of armor plate into 7,898 panels, to be painted and further assembled using machined parts and related hardware. They were then kitted and shipped with 85,241 ancillary items to aid deployed personnel in the assembly of the armor kits on tactical wheeled vehicles. When I MEF convoys were attacked during their first week in Iraq, these armor kits directly contributed to the safety of U.S. Marines and saved lives. By their unrelenting perseverance distinctive contributions, and steadfast devotion to duty, the Marine Corps Logistics Command, Albany, Georgia reflected great credit upon themselves and upheld the highest traditions of the United States Naval Service.



Secretary of the Navy

SECTION 2; (1) EFFECTIVE SUPPORT TO WARFIGHTERS AND (2)
EXTRAORDINARY SUPPORT TO OPERATIONAL FORCES

26 January 2004 - Maintenance Center Albany engineers began **design/prototyping** of L-shape armor door kits for the HMMWV, MTVR, LVS and 5-ton truck. The L-shape armor door kits were to be **simple in design, easily installed** with no welding or drilling required, and include an opening to allow for offensive fire.

02 February 2004 - First mild steel L-shape door prototypes were completed. MARCORSYSCOM staff performs functional review and safety evaluation of L-shape doors.

03 February 2004 – I MEF representatives arrived to perform operational and functional assessment of the L-shape doors. With the L-shape door design established, troop protection for the cargo areas of the MTVR and HMMWV became I MEF's next priority. Guidance for the cargo flank armor kits was limited, simple in design, easily installed with no welding or drilling required.

05 February 2004 - Basic design of the L-shape armor doors established. The L-shape armor doors were physically moved to Marine Corps Logistics Command (MARCORLOGCOM) Operations Center to allow video transmission of the design to General Stalder, I MEF Deputy Commander, via video teleconference. L-shape armor door design and level of protection was discussed at length. General Stalder then contacted General Conway, I MEF Commander, on his cellular phone and described the L-shape armor doors and the protection level. From the description provided via the cellular phone, General Conway adjusted the height of the L-shape armor doors upward for maximum protection to a six foot tall Marine.

06 February 2004 - Armor, hardware, and fabricated parts placed on order for 1,837 L-shape armor door and 635 armor cargo flank kits.

10 February 2004 - First armor components for L-shape armor doors were received at Maintenance Center Albany for processing.

11 February 2004 - First 185 L-shape armor doors kits **completed** and **released** to Defense Logistics Agency (DLA) for shipment. The kits were individually packed in specially built wooden crates. Packed inside the wooden crates were painted doors ready for installation, installation instructions, hardware and tool kits consisting of common hand tools, handling slings, spare hardware, torque wrenches, gloves, and a tool bag.

18 February 2004 - Requirements were received for 243 L-shape armor door and 138 armor cargo flank armor kits for 22 Marine Expeditionary Unit (MEU) deploying to Afghanistan and 66 L-shape armor door and 38 armor cargo flank kits for Navy deploying in support of I MEF.

21 February 2004 - First 50 cargo flank armor kits for I MEF released to DLA for shipment.

24 February 2004 - Marine assigned to Maintenance Center Albany deployed to Kuwait to meet the first shipment of armor and assist in the installation of the L-shape armor door and cargo flank kits.

26 February 2004 - First shipment of armor door kits arrives in Kuwait. **Installation time** of armor doors is **less than 20 minutes per kit**.

6 March 2004 – I MEF initial requirement for 1,837 armor door and 635 armor cargo flank kits is complete.

11 March 2004 - 22 MEU requirements for 243 armor door sets and 103 armor flank kits and Navy requirement for 66 armor door sets and 38 armor cargo flank kits is complete.

The L-shaped armor door kits were **well received** by the Marines and **provided increased protection** over the commercial off the shelf armor panels and half doors already installed on their vehicles. I MEF Commander requested an additional 1,187 L-shaped armor door kits to replace the existing commercial panels and half doors. Marine Corps had received additional information and had a better understanding of the threat. The available stock of armor had also increased. The Marine Corps made the **decision to change** the armor from high hard armor (Mil-A-46100), 3/16-inch thick used mainly for small arms protection to rolled homogenous armor (Mil-A-12560), 3/8-inch thick which provides **equal small arms protection** and **better improvised explosive device protection**.

Once the armor doors and armor cargo flanks were in production, Maintenance Center Albany engineers began **designing, developing, and prototyping** additional armor protection for the HMMWV, MTRV, LVS and 5-ton Truck in anticipation of additional requirements. The next design effort, underbody armor for mine blast protection was **completed just in time**. The 22 MEU had developed their own underbody armor and used a non-ballistic, non-armor, hard and brittle steel. Ballistic testing identified this steel would fragment/spall when hit by a projectile or blast, sending secondary projectiles into the vehicle. MARCORSYSCOM and IIMEF representatives were on hand and provided input to the final configuration for HMMWV, MTRV, LVS and 5-ton truck underbody designs. Production immediately started as the 22 MEU had already deployed to Afghanistan.

As the threat was further **identified and evolved** so did the requirement for **additional protection**. Maintenance Center personnel were in constant contact with MARCORSYSCOM Watch Officer, MARCORLOGCOM Liaison Officer in Iraq and used feedback from the contact teams **installing** armor. As new designs/prototypes were completed, digital pictures were passed to MARCORSYSCOM Watch Officer and MARCORLOGCOM Liaison Officer in Iraq for review by the operating forces.

Requirements for additional armor protection continued as the **threat intensified** in the theater of operation. Maintenance Center Albany engineers **developed** armor tailgates for the HMMWV and MTRV, rear cab plates for the four door HMMWV and **jointly designed** a gunner shield for the HMMWV, MTRV and LVS with MARCORSSCOM and Nevada Automotive Test Center. These designs were **welcomed** by the operating forces and were **produced ahead of schedule and within budget**. Sufficient armor kits were produced to protect each of the Marine Corps vehicles in OIF II, OEF, and the Global War on Terrorism including I MEF operations in Iraq, 4 MEUs, and other units deploying around the world.

The Army's Third Infantry Division was preparing for return deployment to Iraq and was unable to obtain sufficient quantities of armor protective kits for their HMMWV fleet. Maintenance Center Albany **responded** to their request for information and **provided** five armor kits and **installed them** at Fort Stewart, Georgia, for their evaluation and review. The Commanding General **approved** the design and **ordered** 2,928 armor kits to **provide** armor protection to 855 HMMWVs.



Army, 3rd Infantry Division up armored HMMWV including L-shape doors, underbody, and rear cab plates produced at Maintenance Center Albany and installed at Fort Stewart, Georgia.

SECTION 2; IMPACT ON OPERATIONAL FORCE AVAILABILITY, MATERIAL READINESS, AND SUSTAINABILITY METRICS

Maintenance Center Albany **sustained** 24-hour operations, seven days a week for extended periods to ensure **expeditious delivery** of 18,190 armor kits to deployed forces fighting the OIF II, OEF, and the Global War on Terrorism. The personnel worked 12-plus hour shifts for a total of 168,748 direct labor hours from 26 January to 30 September 2004.

Services Components Supported: Marine Corps, Army, and Navy



HMMWV underbody armor kits staged for shipment to 22 MEU in Afghanistan
Kit Breakdown:

| <u>Nomenclature</u> | <u>Quantities</u> | <u>Nomenclature</u> | <u>Quantities</u> |
|---------------------------|-------------------|-----------------------------|-------------------|
| HMMWV Door Kits | 5466 | MTVR Underbody Kits | 192 |
| HMMWV Cargo Flank Kits | 1559 | LVS Door Kits | 356 |
| HMMWV Tailgates Kits | 1494 | LVS Underbody Kits | 8 |
| HMMWV Rear Cab Plate Kits | 1844 | 5-Ton Door Kits | 317 |
| HMMWV Underbody Kits | 1726 | 5-Ton Underbody Kits | 5 |
| MTVR Door Kits | 1828 | Gunner shields | 1857 |
| MTVR Cargo Flank Kits | 884 | Army Research Lab HMMWV Kit | 1 |
| MTVR Tailgates Kits | 854 | MAK | 11 |

Installation of Armor: Maintenance Center Albany **responded** to numerous requests to **install** armor throughout the world. The armor kits were designed for installation by the using units. Operational tempo and remote areas dictated otherwise. The approach taken was dependent on location and manpower available. In the mountains and far reaches of Afghanistan, Maintenance Center Albany Marines teamed with Marines from the Reserve Technical Assistant teams located at Marine Corps Logistics Bases Albany, Georgia and Barstow, California. For the MEUs offloading in Kuwait, Maintenance Center Albany used its long **established partnership** with Oshkosh Truck Corporation to **jointly install** armor. Maintenance Center Albany Marines provided the training and technical support and Oshkosh Truck Corporation **provided** the facilities and laborers to **install** the armor. The Maintenance Center Civilian Marine workforce provided stateside installation assistance at the using units locations. Other units sent Marines to Maintenance Center Albany for armor kit installation training prior to deployment.

Locations: Maintenance Center Albany teams supported armor installation:

Kuwait: IMEF, 31 MEU, 24 MEU, 11 MEU

Afghanistan and Qatar: 22 MEU

Camp Pendleton, California: 15 MEU

Fort Benning and Fort Stewart, Georgia: Army, 3rd Infantry Division

Horn of Africa, Djibouti: Anti Terrorism Task Force, Marine Central Command

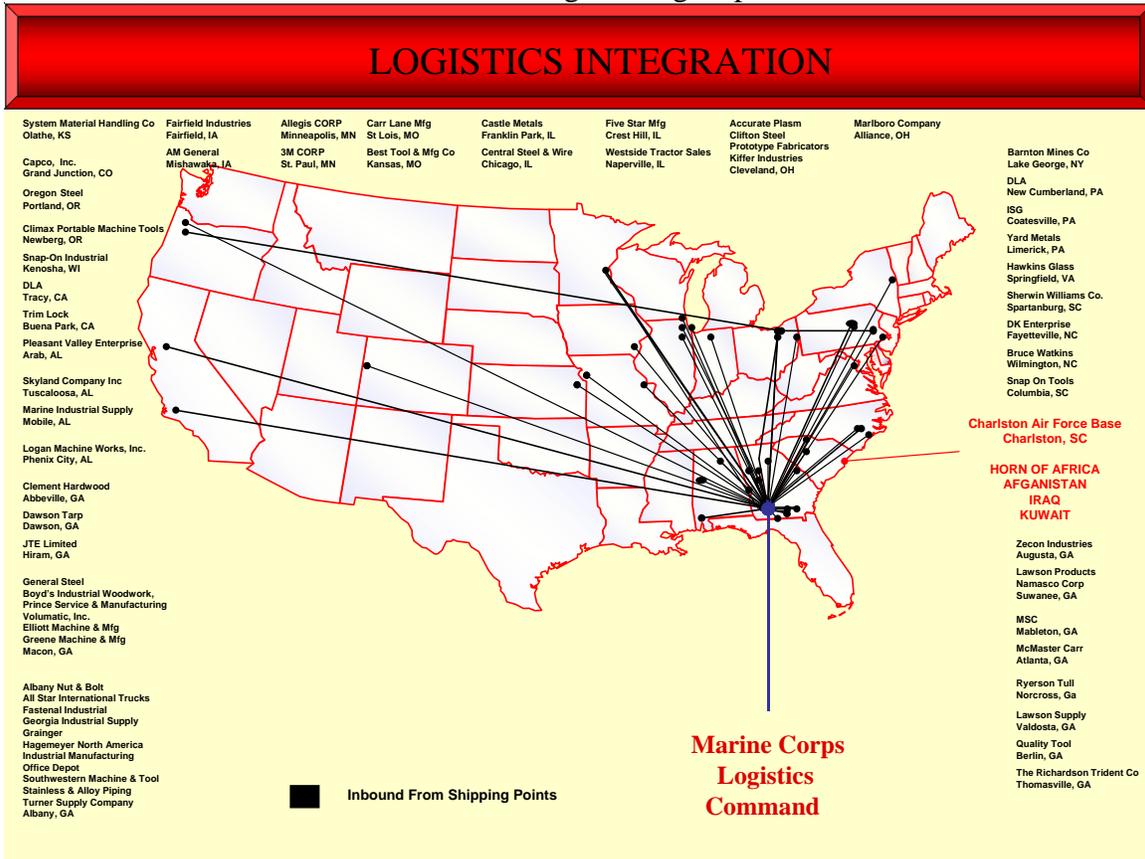


Armor installation for 22 MEU in a maintenance tent at a remote Base in Afghanistan

SECTION 2; (1) RESPONSE TO UNFORESEEN DEMANDS AND
(2) INNOVATIVE SOLUTIONS

Due to the nature of our mission, Maintenance Center Albany is staffed with a workforce to execute scheduled workload and had the **ability to surge** for short periods of time for **unforeseen requirements**. Maintenance Center Albany was not staffed for the initial requirement of 1,837 L-shape armor door kits and the long-term armor program that followed. To meet the initial requirements for the L-shape armor door kits, two 12-hour shifts were established seven days a week. Volunteers were solicited from the Maintenance Center Albany workforce. An overwhelming number of personnel volunteered, including those from non-traditional trades to include office automation clerks, supply technicians, and materiel handlers.

As additional armor requirements were received, Maintenance Center Albany took **traditional** and **non-traditional approaches** to **increase** its workforce. Local and regional radio and television stations were used as a means of advertising. Maintenance Center Albany advertised in a 200-mile radius versus the normal 50-mile radius specifically targeting areas where former military personnel may have interest. Additionally, our local Human Resources Office obtained temporary direct hiring authority, which **streamlined** the hiring process resulting in personnel **reporting** to work in less than 90 days versus the normal 120 to 180 days. To further supplement the workforce, contract welders were hired using existing Department of Defense contracts.



Maintenance Centers Albany's board based contractor/sub contractor network

Further **enhancing capabilities and capacity**, Maintenance Center Albany **outsourced** using Contracts Department. For the initial effort 1,837 L-shaped armor door kits, Maintenance Center Albany used 20 different vendors in seven states to provide required new and fabricated parts. There were a total of 33 contractual actions issued with a total dollar value of \$2,724,372.51. All totaled, from 27 January 2004 to 30 September 2004, there were **277 contractual actions issued** to 52 contractors in 16 states obligating \$40,174,629.90 for **material, parts, and services**.

Establishing and maintaining a source for armor: It was established within hours from the first request to produce armor door kits that armor plate was in high demand and short supply. Due to a previously weak market, the number of ballistic steel manufacturers in North America, which are the required sources for the Department of Defense, had dropped from three to two. International Steel Group had all of its production committed to supporting other services requirements. Clifton Steel in Cleveland Ohio, a distributor of domestic ballistic steel, was the only United States distributor for Algoma, a Canadian steel manufacturer. The last of the third manufacturers' production, Oregon Steel, Portland, Oregon, had been loaded on to four railcars and was en route from Oregon to Clifton Steel. In order to meet production requirements, the Contracts Department **aggressively accepted** the task of **expediting** the railcars to the Cleveland Ohio railhead. Conversations between the Contracting Officer and a Vice-President of the railroad resulted in timely delivery of the steel. Additionally, Clifton Steel had a limited supply of armor available. **Ongoing negotiations** for armor plate were **conducted** with Mike Cooper, Vice-President of Clifton Steel. At one point, negotiations were temporarily suspended while Mr. Cooper underwent surgery. Negotiations continued hours after surgery during his recovery. This was the start for a long-term **commitment** to the Marine Corps. Mike Cooper provided his office, home and cellular phone numbers and encouraged us to contact him 24 hours a day, seven days a week. To demonstrate the Marine Corps' appreciation, the Commander and Deputy Commander of Maintenance Center Albany traveled to Cleveland, Ohio, to personally thank Mike Cooper and all the employees of Clifton Steel.

On Friday, 7 May 2004, concerns arose that unless a commitment was made for the purchase of ballistic steel for a rapidly emerging requirement, the lead-time for the armor could be as much as 16 to 20 weeks thus preventing immediate production of armor kits. The Deputy Commander, Marine Corps Logistics Command, determined and made a decision that funding would be made available to make the required material purchase. The Contracting Officer and the Director, Contracts Department were 12 miles out in the Gulf of Mexico deep-sea fishing. Maintenance Center Albany contacted the Coast Guard and had them hail down the Contracting Officer with a message that a call to Maintenance Center Albany was required. A commitment was made for the armor via a four-way conference call, which included Maintenance Center Albany, Contracting Office, Clifton Steel and Contracting Officer who was on a speakerphone in the boat.

Establishing a method to cut armor and maintain schedule: With a source of armor established, the next hurdle was cutting the armor plate into armor components. Maintenance Center Albany's method was limited to a water jet cutter. Water jet cutter

average cycle time per armor component is 50 minutes. With a requirement to cut hundreds of components a day, an alternative had to be established. Maintenance Center Albany immediately engaged Clifton Steel and learned that the industry standard was a high definition plasma cutter for cutting armor timely and economically. Clifton Steel offered the services of their subsidiary, Accurate Plasma, to cut the armor plate and subcontracted with two additional companies with high definition plasma cutters.

To meet **increasing demands** for armor kits, Maintenance Center Albany **located** an additional high definition plasma cutter at Namasco Corporation, located in Suwanne, Georgia. In order to immediately **increase production** of cut armor plate, the Contracting Officer had Clifton Steel negotiate with Namasco to become a sub contractor. Armor plate was moved to the Namasco location within two days. Maintenance Center Albany engineers went to the Namasco facilities and completed a first article evaluation upon receipt of the first armor shipment. As **demands** for armor kits continued to increase, Namasco enlisted services of their Charlotte, North Carolina, and Pompano Beach, Florida, facilities and subcontracted to a local facility to **increase capacity** of cutting armor plate.

Working together to achieve a common goal: To handle the high volume of fabricated parts, the Contracting Officer contacted all machine shops in a 50-mile radius of Albany. They were requested to assemble at Maintenance Center Albany. The machine shop representatives were informed as to the importance of the requirement, given drawing packages and schedules and requested to return with prices and scheduled production. The use of commercial contracts for **competition ensured lowest price and aggressive delivery schedules**. To support these aggressive schedules, several of the machine shops would in turn subcontract a portion of the requirement to a competitor to whom they had just outbid. This was the beginning of a mutually beneficial business relationship with multiple machine shops in the local community. The machine shops were all family owned businesses with workforces of five to 50 employees. Companies that had 40-hour workweeks went into extended periods of 24 hours, seven days a week production. Maintenance Center Albany personnel developed business relationships with the machine shops. The Commander and various staff members of the Maintenance Center Albany made personal visits to the vendors' facilities and recognized the employees for their support.

Gunner Shield Armor Kit Design and Fabrication: The goal was to **produce** a gunner shield armor kit that provided 360 degree protection to the user while allowing the user full range of operation. The front shield was a **proven design** and provided frontal protection. A collaborative effort between MARCORSYSCOM, Nevada Automotive Test Center, and Maintenance Albany was initiated. The initial design of the rear gunner shield was **developed** at Nevada Automotive Test Center with a cardboard mock up and **forwarded** to Maintenance Center Albany for manufacturing. There were several design changes during the prototyping effort; a final design was approved by MARCORSYSCOM. Rolling the rear shield's tight radius was difficult due to the hardness of the armor and required a specialized 600-ton rolling press. Maintenance Center Albany requested the assistance of Namasco to cut and roll the rear shield.

Namasco was able to produce 50 rear shields a day. The process was very tedious and dangerous. If too much pressure was applied, the shield would snap in two. If insufficient pressure was applied, the shield would spring open.



Prototype gunner shield with universal pintle adapter mounted on MTRV

Universal pintle adapters and support bracket: Demand for gunner shield armor kits exceeded the available supplies of universal pintle adapters. The lead-time for manufacture to delivery from the original equipment manufacturer was 180 days. The Contracting Officer contacted machine shops in a 120-mile radius of Albany. They were requested to assemble at Maintenance Center Albany. The machine shop representatives were informed as to the importance of the requirement, given drawing packages, schedules and requested to return with prices and scheduled production. None of the machines shops were willing to commit to the manufacture of the universal pintle adapters due to its complex design, tight tolerances, specialized welding and multiple material requirements. Maintenance Center Albany was unwilling to wait 180 days for the original equipment manufacturer to produce universal pintle adapters. The machine shops that originally participated were again requested to assemble at Maintenance Center Albany. The Contracting Officer inquired as to what portion of the universal pintle adapter assembly they were capable of manufacturing. Eight machine shops plus the Maintenance Center Albany machine shop agreed to each manufacture a portion of the universal pintle adapter. The next challenge was **locating** and **establishing** timely delivery of the nine different alloys and metals **required** in the manufacture of the

universal pintle adapter. Contracts Department purchased the required alloys and metals from five different vendors in three different states and used various shipping methods to ensure on time delivery. The use of multiple contractors to produce different components of the same assembly meant that Maintenance Center Albany had to accept the risk that some parts would not be compatible thus rendering the assembly useless. Due to the cooperative **teamwork** of various contractors and elements of Maintenance Center Albany, all components **matched** the drawings and specifications.

Support from other Commands: Working together was not limited to our commercial vendors. Due to the continuous demand for a new and improved product and a small engineering staff at the Maintenance Center, MARCORSYSCOM staff **developed** and **published** the installation **instructions** for each of the different armor kits.

Movement of material to maintain production: Aggressive schedules and continuous **emerging requirements** required materials to be **expedited**. Armor shipments from Clifton Steel were often delayed due to limited availability of flat bed trucks. Maintenance Center Albany transportation coordinator enlisted the help of the DLA. Traditionally, DLA contracts for movement of material from their facility to using units. Transporting material from a vendor location to Maintenance Center Albany was outside DLA normal scope. This cross agency **cooperation** ensured timely **delivery** of armor shipments. To maintain awareness of the shipments, Maintenance Center Albany transportation coordinator required each driver to provide their cellular phone number. One shipment was delayed at a Department of Transportation weigh station because the driver had exceeded his allowed operating hours. The material was required for second shift production. To **prevent** an eight-hour delay in receiving the armor and a work stoppage, Maintenance Center Albany transportation coordinator **negotiated** a solution with the truck driver. A Base Garrison Mobile Equipment (GME) driver was dispatched from Maintenance Center Albany and drove the detained driver and material to our facility in time for the start of the second shift. Base GME office leased two tractor-trailers and made daily runs to Namasco, Suwannee, Georgia, facility and made pickups and delivery of material to the local machine shops. Other shipping methods used included airfreight, Federal Express Customer Critical services, and tandem drivers for over the road shipments.

Communication was an important element and integral part of **maintaining** a steady flow of material into and out of Maintenance Center Albany. Armor production team conducted two detailed production meetings a day to ensure information was flowing within the team and passed between shifts. A daily status update was conducted with the Maintenance Center Albany Commander and his staff. DLA and Contracts Department representatives were on hand to address any unforeseen requirements.

Shipping crates: Each armor kit required an air transportable wooden shipping crate. DLA was unable to meet the demands of producing approximately 2,000 shipping crates a month. To maintain an uninterrupted production flow and ensure shipment of armor kits as they were completed, Maintenance Center Albany temporarily **loaned** DLA ten employees to **assist** in the building of the shipping crates.

SECTION 2; (1) LOGISTICS PROCESS INNOVATION, (2) RELIABILITY, MAINTAINABILITY, AND SUPPORTABILITY IMPROVEMENTS AND COST AVOIDANCE, RESOURCE USE IMPROVEMENTS, AND CYCLE TIME IMPROVEMENTS

MARCORSYSCOM, Army Research Lab, and Maintenance Center Albany jointly developed and designed the second generation of Marine Corps armor. The MAK is an integrated armor solution for the HMMWV. Maintenance Center Albany engineers used lessons learned in development of zonal armor and incorporated them into the new kit design. The initial kit design had multiple armor components covering select areas of the HMMWV with multiple seams. Seams are a weak point allowing for easier penetration of the blast and blast material. Maintenance Center engineers **reconfigured** the multiple armor components into a single armor component reducing the number of seams. The reconfiguration **saved** cutting and processing time, **eliminated** waste of material and handling, and installation efforts were **minimized**.



Two door MAK with integrated cargo flanks and tailgate

Other improvements include **enlarging** the door windows for **better visibility** of the occupants and changing the window frame material from **multiple steel components** to a **single aircraft grade aluminum frame** to reduce processing time and weight. The ballistic glass for the windows and windshields was changed to a new thinner/lighter product that provided a **33 percent weight reduction**, while maintaining prescribed

protection levels with a hardened diamond coat film that protects the outside against abrasions and scratches. The hardened diamond coat film **increases service life** of the ballistic glass from approximately six months to **three years**. At a cost of \$1,950 a windshield and \$550 a door window set, **cost saving will be exponential**.

Additions to the design included a 3/8-inch mild steel overlay on the doors and side rocker panels. The mild steel overlay **slows the projectiles**, enhancing the kits **ability to protect**. Underbody protection was **added** giving the personnel compartment **protection** against a four-pound mine blast. An air conditioning system was added to **reduce** the **heat stress** of an enclosed steel vehicle in the desert heat. Testing of the air conditioning system using a paint-drying oven showed that at an outside ambient temperature of 150 degrees could be reduced to 87 degrees inside the HMMWV. On the two-door HMMWV, an **integrated** armor cargo box with tailgate was **designed** to provide troop **protection**.

With a quick start program and limited availability of armor plate, it was more advantageous to have the armor cutting contracted directly to the armor distributor. As the armor program increased and funding was identified, ballistic steel of the required type and thickness was purchased and either shipped to Namasco or “shipped-in-place” for future use at Clifton Steel. The result was that since the Marine Corps **owned** the steel, cutting could then be **competed** between the two companies possessing the high definition plasma cutters, resulting on an average **cost savings of \$10** each for 30,917 armor components.

Process enhancements/changes were made throughout the production of the armor kits. The second generation MAK is more complex than the interim zonal armor. The interim zonal armor was simple in design and kitted into different zonal applications. The MAK was a complete integrated kit with multiple sub kits containing assemblies and sub-assemblies. **Procurement** of MAK material was started in July 2004 to ensure **on time delivery**. To reduce processing and handling times in the Maintenance Center, detailed statements of work were written for the MAK sub kits. The MAK sub kits were then competed in the private sector to ensure the **most economical price** and best delivery **schedule**.

The standard armor master plate size is 96 inches by 288 inches. Maintenance Center Albany required the cutting sources to have cutting tables capable of accepting master plates. Cost saving are generated in several ways. The **master plates** did not have to be cut into smaller plates to accommodate a smaller cutting table. It allows for more **efficient** nesting of the armor components being cut, thus **reducing** waste and cutting time. It also allows for larger component size, **reducing** the quantity of the components in the kit and **providing** the added benefit of better protection.

The procurement of piano type door hinges initially was in 8-foot sections at a cost of \$31.94 each. The hinges were then cut into 20-inch lengths, holes punched and the ends welded at a local machine shop at a cost of \$8.00 per hinge section resulting in a per hinge cost of \$15.86. As an additional 30,000 hinge requirements materialized for MAK,

discussions with the hinge manufacturer indicated that the hinge material could be purchased in pre-determined lengths, thus **eliminating** the 16-inch **waste** per every four hinges. The manufacture agreed to punch the holes and weld the hinges at their facility during production for a **cost avoidance** of \$5.71 per hinge.

The price of just the ballistic glass for the HMMWV door set was \$550. **Negotiations** with the vendor resulted in the vendor painting the window frames, installing the glass, and packaging the windows sets in **ready to ship** containers for the original price of \$550 a set. The vendor benefited as the window frames protected the glass in shipment and there was no longer a requirement for **specialized** shipping crates. **Cost avoidance** to Maintenance Center Albany will be \$78 per door set with scheduled production of 8,400 sets.

In preparation of armor production, Maintenance Center Albany industrial engineers developed **process flows**. During the planning effort, sandblasting of the armor plate was identified as having the greatest impact on cycle time. Since the sandblasting facility was already a capacity constrained resource, processing an additional 46,962 armor components through these same facilities was not possible and would prevent expeditious shipment of armor. The solution was to have the master plates of armor sandblasted at specialized sandblasting facilities prior to having them cut into components. The cut components were then transported under tarps to prevent moisture reaching them. Prior to painting, Maintenance Center Albany Civilian Marines used hand grinders to remove any surface rust.

Painting using conventional methods in spray booths and drying of the paint would also have a significant impact on cycle time. Maintenance Center Albany had a powder coat facility in place that had never been used for a major production program. The successful operation of the powder coat facility would be key to meeting aggressive production schedules. A trial run was made during the design phase. The powder coat facility paint chain had the capacity to paint 10 linear feet a minute. Paint cycle time from hanging a raw plate to a ready to use product is 45 minutes compared to conventional methods of six to eight hours cycle time.

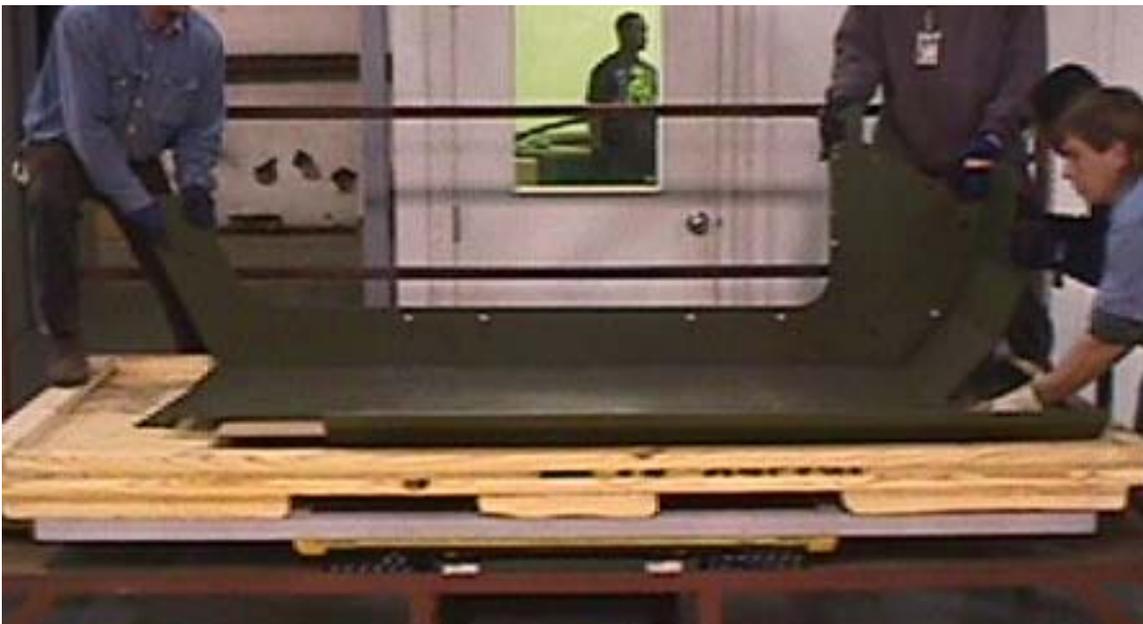
To keep all the different pieces moving and not impact Master Work Schedule production, 20 forklifts were rented to support armor production. Special racks were **designed** and **manufactured** to **accommodate** the various shapes of armor. Specialized fixtures were **manufactured** to **reduce** set up time for the welding of the armor assemblies. Specialized stands were **manufactured** to **hold** the armor components during the assembly process.

SECTION 2: (1) EFFECTIVE TECHNOLOGY INSERTION IN PROCESSES AND PRODUCTS AND (2) MAINTENANCE CONCEPT OR PROCESS IMPROVEMENT IMPLEMENTATION

Powder Coating Facility: The advantages range from economic to environmental. It is a finishing **technique** offering economic and performance **advantages** over conventionally applied coatings. Economically, powder coatings have bottom-line savings in three key cost areas. The process provides materials, energy, and environmental compliance. Material costs are low because efficiency is high – up to 99 percent of overspray is reduced or recycled. Energy costs are low because spray booth and bake oven ventilation is reduced. Two familiar environmental **costs**, volatile organic compounds control and sludge disposal, are virtually eliminated because powder coatings are solvent free. Additional **savings** are realized in the areas of **reduced** labor cost, and **decreased** production time, due to **reduced** handling and cure/wait time.



Left to right: 1. Loading armor components onto the powder coat chain. 2. Powder paint being applied to electrically charged armor components. 3. Protective edge being applied to painted armor components as they move on the powder coat chain.



Armor components being packaged into shipping container directly from the powder coat chain.

Electronic drawings were developed for all armor components and fabricated parts using industry-standardized software. The drawings packages were transmitted electronically to vendor via the Contracting Officer, allowing vendors to review requirements instantaneously, thus expediting bid submittal and awarding of contracts. Additional time was saved as the electronic drawings could be programmed directly into the vendor-computerized controllers and reduced the possibility of re-programming errors.

Clifton Steel and Namasco provided **uninterrupted production** utilizing state of the art cutting tables with **60-foot cutting surface**. The long table allowed one master plate to be cut at one end while the second master plate was being loaded at the opposite end of the table. Once the first master plate is cut into components, the computerized controller moved to the second master plate and commences cutting. The armor components and scrap from the first plate are unloaded from the table and a new master plate is put into place.

As new designs were developed and prototypes assembled, digital pictures were transmitted to the MARCORLOGCOM Liaison Officers in Iraq for review and submittal to the field Commanders.

Maintenance Center Albany is registered ISO 9001 to 2000 Standard and maintains work instructions to ensure an efficient production flow. With established and documented processes in place, the **risk** of integrating a new program into the Maintenance Center Albany was **low**. Using established work instructions, process flows and bills of material were developed and input into the shop floor control system, Manufacturing Resource Planning II. **Work orders** with material routes were automatically **generated** prior to receipt of the first material. Other established ISO procedures included **placing** the packing instructions and electronic bills of materials on the Maintenance Center Albany ISO web page ensuring **instant access** to the most recent information.

Electronic bills of material were developed using Excel spreadsheets. The spreadsheet listed required material of one kit. Formulas were used to perform calculations. Once a requirement was received, the quantity of kits was entered into the spreadsheet and material requirements were available. **Time** required to submit orders was reduced and errors were **eliminated**. The value of electronic bills of material increased exponentially as the complexity of the kits increased. L-shape armor door kits had **72** components parts, 4-door MAKs have **1,050** component parts.

The production process for armor kits was **developed using Theory of Constraints and LEAN principles**. The production model is based on a one-kit production line with a pull-based flow that maintains a constant **level of work in process** and **consistent throughput**. The drum “pacing resource” within the system is the powder coating chain system. Armor was processed one kit at a time and sequenced on the powder coat chain. The armor components were then removed from the chain and placed directly into the shipping container. Packaging of armor components is determined by the tac time of the

powder coating chain system. On average, a MAK is packaged and ready to ship every 23 minutes with an overall capacity of 2,000 kits a month.

From the start of the program to 30 September 2004, Maintenance Center Albany **processed** 46,962 armor components weighing 5,453,394 pounds with one lost time accident. This was **accomplished** using the principles of **LEAN**. The work areas were **maintained** in a clean and clutter free state. Safety briefs were **provided** at the beginning of each shift. Personal protective equipment, material handling racks, fixtures, lifting devices, and stands were readily **available**.

SECTION 3

During the period 26 January 2004 to 30 September 2004 Maintenance Center Albany personnel demonstrated outstanding achievement in maintenance management and production by designing, fabricating, and delivering 18,190 vehicular armor protective kits to support the warfighters of Operation Iraqi Freedom II, Operation Enduring Freedom and the overall Global War on Terrorism. With a mounting death toll associated with improvised explosive devices and small-arms attacks, the professionals of Maintenance Center Albany responded magnificently to a short-fuse, combat essential requirement, by volunteering their time to provide life-saving vehicular armor to the Marines, Sailors and Soldiers heading into harm's way. Their responsiveness, resourcefulness, agility and creativity, produced the armor protective kits to our warfighters within budget and time constraints, without sacrificing quality, evidenced by the lives saved in battle. The extraordinary response of Maintenance Center Albany personnel exhibits the can-do, will-do and must-do attitude that has become synonymous with Marines. The Corps dialed 9-1-1 and Maintenance Center Albany answered the call. Their maintenance awareness, maintenance excellence and untiring devotion exceed the requirements of the Corps and helps keep Marines alive. By their superior performance of duty, initiative and genuine concern for the welfare of military personnel they so proudly support, Maintenance Center Albany personnel reflected the highest credit upon themselves, the United States Marine Corps, and the Department of Defense.