

## Enhanced Combat Helmet (ECH)

### Executive Summary

- The Enhanced Combat Helmet (ECH) underwent a third First Article Test (FAT III) and a second Full-Up System-Level (FUSL) live fire test because the manufacturer changed the ballistic shell laminate material from that which was previously tested.
- The ECH successfully met its ballistic and non-ballistic requirements during FAT III. However, while the ECH protects against perforation by the specified small arms threat, it does not provide a significant overall improvement in operational capability over currently-fielded helmets against the specified small arms threat. The deformation induced by the impact of a non-perforating small arms threat impact exceeds accepted deformation standards across most of the threat's effective range. The ECH is therefore unlikely to provide meaningful protection over a significant portion of the threat's effective range. The ECH provides improved fragmentation protection compared to the fielded Advanced Combat Helmet and the Light Weight Helmet (LWH).
- The manufacturer has started ECH production, with first deliveries anticipated in early FY14.

### System

- The Marine Corps developed the ECH in response to a 2009 Urgent Statement of Need to produce a helmet that provides ballistic protection from energetic fragments and selected small arms ammunition, yet maintains all other characteristics of the Marine Corps' LWH and the Army's Advanced Combat Helmet (ACH).
- The ECH is compatible with and is typically worn in conjunction with other components of infantry combat equipment such as body armor systems, protective goggles, night vision equipment, and a camouflage fabric helmet cover. This new helmet is intended to provide Marines and Soldiers improved protection compared to the currently fielded LWH and ACH.
- The ECH consists of a ballistic protective shell, a pad suspension system, and a 4-point chin strap/nape strap retention system. Unlike the ACH and LWH helmets, which are constructed with aramid fibers, the ECH is constructed



using ultra-high-molecular-weight polyethylene fibers. Unlike aramid composites, the ultra-high-molecular-weight polyethylene ballistic material absorbs ballistic impact and dissipates energy via extensive plastic strains. This results in more resistance to penetration but it also results in large permanent helmet shell deformations and larger damaged areas following impact for a wide range of ballistic threats.

### Mission

Forces equipped with the ECH will rely on the helmet to provide ballistic protection from selected threats when engaged with enemy combatants during tactical operations in accordance with applicable tactics, techniques, and procedures.

### Major Contractor

Ceradyne, Inc. – Costa Mesa, California

### Activity

- The Marine Corps approved full-rate production in 2012 following successful completion of FAT II.
- During testing of Engineering Change Proposals intended to increase manufacturing capacity, the ECH failed small arms testing. Subsequent attempts to implement and verify corrective action failed to produce a helmet that could pass the small arms portion of the FAT.
- In February 2013, the manufacturer changed the ballistic shell laminate to improve small arms protection. This change required the helmet to undergo another FAT (FAT III) and a follow-on FUSL live fire test.
- The Program Office conducted and successfully completed FAT III in March 2013 and the FUSL live fire test from April

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through May 2013. Testing was conducted in accordance with the DOT&E-approved test plan.

- The manufacturer has started producing ECHs to support both Marine Corps and Army requirements, with the first deliveries anticipated in early FY14.

## Assessment

- Although the ECH protects against perforation by the specified small arms threat, it does not provide a significant overall improvement in operational capability over currently fielded helmets against the specified small arms threat. It is unlikely to provide meaningful protection against this small arms threat over a significant portion of the threat's effective range. However, the ECH does provide improved penetration protection against fragments relative to currently fielded helmets. The ECH met all ballistic performance requirements.
- In stopping high-energy threats, the helmet absorbs the projectile energy by deforming inward toward the skull. It is unknown, definitively, whether the ECH provides protection against injury when the deforming helmet impacts the head. There is, however, reason to be concerned because the deformation induced by the impact of a non-perforating small arms threat exceeds accepted deformation standards (established for a 9 mm round) across most of the threat's effective range.
- There are no definitive medical criteria or analytic methods to correlate the extent of helmet deformation to injury. However, the potential for helmet deformation to cause significant blunt force and/or penetrating trauma to the head is a concern.

- Structural degradation as a result of prolonged temperature and humidity exposure may be a concern for the ECH. Published data document the degradation of ballistic performance in ultra-high-molecular-weight polyethylene materials, but the long-term performance of the ECH's specific ballistic material is unknown. The ECH Program Office plans to study the durability of the helmet's ballistic material.

## Recommendations

- Status of Previous Recommendations. As the Program Office is not procuring the helmet described in the FY12 report, those recommendations are no longer valid.
- FY13 Recommendations. The ECH Program Office should:
  1. Conduct durability testing to determine whether moderate blunt impacts degrade ECH ballistic performance.
  2. Conduct testing to determine whether long-term exposure to elevated temperatures and humidity degrades ECH ballistic performance.
  3. Carefully monitor the results of lot acceptance testing when ECH production begins for indications of variations in the manufacturing process that could affect the ECH's ballistic protection.
  4. Improve ECH protection by reducing the amount of helmet deformation caused by non-perforating small arms impacts, as improvements in materials and manufacturing processes permit.
  5. Continue to support development of test methodologies and techniques that would reduce limitations associated with the current, single-sized clay-filled headform used for testing.