

Precision Guidance Kit (PGK)

Executive Summary

- In May 2015, the Army conducted the Precision Guidance Kit (PGK) IOT&E in accordance with a DOT&E-approved test plan.
- PGK's demonstrated accuracy and reliability achieved the Army's desired mission effects. Remaining reliability failure modes should be addressed to further enhance PGK effectiveness.
- In January 2016, DOT&E published an IOT&E report assessing the following:
 - PGK is operationally effective. A field artillery unit equipped with PGK can deliver effective, near-precision fires when firing PGK-fuzed conventional, unguided 155 mm high-explosive projectiles.
 - PGK is accurate. PGK exceeded its accuracy requirement of 50 meters Circular Error Probable (CEP) by demonstrating a median radial miss distance of 10 meters in accuracy testing. Accuracy data indicate that with 90 percent confidence, the true CEP is less than or equal to 20.9 meters.
 - PGK is operationally suitable. PGK met its reliability requirement of 92.0 percent at a point estimate (92.1 percent) but not with confidence. PGK's achieved accuracy causes PGK-fuzed projectiles to exceed expected effectiveness even with a reliability that does not meet the reliability requirement with confidence.
 - PGK is survivable. Cybersecurity assessments identified vulnerabilities that indicate PGK may be susceptible to cyber threats with physical access to the fuze.
 - Cybersecurity testing of PGK and the M777A2 lightweight, towed 155 mm howitzer identified vulnerabilities which affect the operational employment of PGK. Cybersecurity assessments of the Army's end-to-end artillery fire support mission-processing system should be conducted to identify and support mitigation of vulnerabilities, which could affect the effectiveness of all artillery fire support systems.
 - A Full-Rate Production (FRP) decision is scheduled for 2QFY16.

System

- PGK is a combined fuze and GPS guidance module that improves the ballistic accuracy of the current stockpile of high-explosive, field artillery projectiles.
- The Army developed PGK for 155 mm, high-explosive projectiles (M795 and M549A1) with a threshold accuracy of 50 meters CEP and objective accuracy of 30 meters CEP.



- The PGK will operate with existing and developmental artillery systems that have digital fire control systems and inductive fuze setters, such as the M777A2 Lightweight Towed Howitzer, the M109A6 Paladin Self-Propelled Howitzer, and the M109A7 Paladin Integrated Management Self-Propelled Howitzer.
- The procurement objective is 102,921 PGK fuzes. The Army plans to enter full-rate production in 2QFY16.

Mission

Field artillery units employ PGK-fuzed projectiles to support maneuver units with indirect fires with less than a 50-meter accuracy. PGK-fuzed projectile accuracy allows field artillery units to fire fewer projectiles to achieve comparable effects of conventionally-fuzed artillery ammunition.

Major Contractor

Orbital ATK Advanced Weapons Division – Plymouth, Minnesota

FY15 ARMY PROGRAMS

Activity

- Following an unsuccessful attempt to move the beyond low-rate initial production line from Minnesota to West Virginia in 2013, Orbital ATK moved the production line back to the original contractor production facility in Minnesota in 2014.
 - In November 2014, the contractor delivered the First Article sample of PGK's from the Minnesota production line to the government. These PGK's successfully completed a First Article Acceptance Test and safety testing at Yuma Proving Ground, Arizona, in December 2014, and cold regions testing at Fort Greely, Alaska, in January 2015.
 - In March 2015, the Army conducted a cybersecurity vulnerability and penetration assessment of the PGK fuze and the Army's M777A2 lightweight, towed 155 mm howitzer.
 - DOT&E approved an updated PGK Test and Evaluation Master Plan on April 24, 2015.
 - In April 2015, the Army conducted the first of four Lot Acceptance Tests (LATs) to be conducted in FY15 in support of the scheduled FRP decision. Following successful completion of these tests, the Army accepted 1,539 low-rate initial production PGKs for fielding to Army units.
 - In May 2015, the Army conducted the PGK IOT&E in accordance with a DOT&E-approved test plan.
 - During the test, a towed howitzer battery from the Army's 10th Mountain Division fired 24 tactical PGK missions from M777A2 howitzers against an array of threat representative targets.
 - The Army conducted an Adversarial Assessment to determine the ability of a unit equipped with PGK to protect, defend, recover and restore effective unit operations while withstanding validated and representative cyber threat activity.
 - In January 2016, DOT&E published an IOT&E report supporting the Army's planned FRP decision. The report analyzed data from testing, three of the four LATs, and multiple developmental performance and safety test events conducted prior to September 2015.
- indirect fires when firing PGK-fuzed conventional, unguided 155 mm high-explosive projectiles in support of maneuver units.
- PGK is accurate. PGK exceeded its accuracy requirement of 50 meters CEP by demonstrating a median radial miss distance of 10 meters in accuracy testing. Accuracy data indicate that with 90 percent confidence the true CEP is less than or equal to 20.9 meters.
 - PGK is operationally suitable. In LATs 1 through 3, PGK met its reliability requirement of 92.0 percent at a point estimate (92.1 percent) but not with confidence. The lower bound of an 80 percent confidence interval is 88.7 percent. Correction of recurring reliability failure modes will permit PGK to meet its reliability requirement with confidence. PGK's achieved accuracy causes PGK-fuzed projectiles to exceed expected effectiveness even with a reliability that does not meet the reliability requirement with confidence.
 - PGK is survivable. Cybersecurity assessments identified vulnerabilities PGK may be susceptible to cyber threats. Cybersecurity testing showed a need for further testing of the Army's artillery fire support command and control systems.

Recommendations

- Status of Previous Recommendations. The Army addressed previous recommendations.
- FY15 Recommendations. The Army should:
 1. Continue to conduct failure mode investigations and take corrective actions to address remaining reliability shortfalls and meet PGKs reliability requirement with confidence.
 2. Perform cooperative and adversarial cybersecurity assessments on all elements of the artillery's end-to-end fire support mission processing system and take necessary actions to mitigate or eliminate these vulnerabilities.

Assessment

- DOT&E assessed the following based on observations from the IOT&E and LATs 1 through 3:
 - PGK is operationally effective. A field artillery unit equipped with PGK can provide effective, near-precision