

Small Diameter Bomb (SDB) II

Executive Summary

- The Air Force completed Multi-Service Operational Test and Evaluation (MOT&E) Phase I flight testing and LFT&E of the Small Diameter Bomb (SDB) II on the F-15E Strike Eagle in December 2019, releasing a total of 59 weapons.
- MOT&E Phase I flight test missions built upon the capabilities demonstrated in Government Confidence Testing (GCT). This included demonstrating the ability to successfully engage a target with multiple weapons on a single pass, operate in a GPS-jamming environment, perform a commanded abort, employ an exclusion zone, and override the exclusion zone to engage a target.
- DOT&E published a classified MOT&E Phase I early fielding report in July 2020.
- The Air Combat Command authorized fielding of the SDB II on the F-15E on September 23, 2020.
- The Navy initiated a quick reaction assessment (QRA) in FY20 to enable fielding on the F/A-18E/F by January 2021 within a limited employment envelope.
- Further operational test (OT) on the F/A-18 E/F is scheduled to continue in FY21. MOT&E Phase II activities on F-35B and C are scheduled to begin in FY21 and continue into FY24. The program will accomplish a Full-Rate Production (FRP) decision upon completion of F-35 B/C testing.
- The Air Force continues to advocate for initiatives to streamline the cryptographic information delivery, loading, and verification process. The current process complicates the ability to employ the SDB II in normal attack (NA) mode at standoff range.
- Lethality analysis indicates the weapon performs as expected against target surrogates for legacy main battle tank, infantry fighting vehicle, anti-aircraft gun, surface-to-air missile target-erector-launcher, rocket launcher, and small patrol boat.

System

- The SDB II is a 250-pound, air-launched, precision-glide weapon that uses deployable wings to achieve standoff range.
- The Air Force directed the design of the SDB II to achieve the capabilities deferred from SDB I. Capability improvements include a weapon datalink and multi-mode seeker.
- The weapon datalink allows post-launch tracking and control of the weapon, which provides standoff employment capability against mobile targets.

Activity

- The Air Force completed MOT&E Phase I operational test flights using the F-15E in May 2019. In total, the F-15E released 59 weapons, encompassing 43 NA, 8 CA, and 8 LIA missions. The program flew the test plan-required 56 releases plus 2 additional releases due to hardware failures and



- In addition to a GPS and an Inertial Navigation System, to achieve precise guidance accuracy in adverse weather, the SDB II employs the millimeter-wave radar component of the multi-mode seeker.
- The NA mode is used primarily to strike mobile targets in adverse weather. The Laser Illuminator Attack (LIA) mode is used to guide the weapon to a laser spot generated by the launching aircraft or a third party source. The Coordinate Attack (CA) mode is used primarily to strike stationary targets and can be used in adverse weather.
- The SDB II incorporates a multi-function warhead (blast, fragmentation, and shaped-charge jet) designed to defeat armored and non armored targets. The weapon can be set to initiate on impact, at a preset height above the intended target, or in a delayed mode.
- An SDB II-equipped unit or Joint Terminal Attack Controller (JTAC) will engage targets in dynamic situations and use a weapon datalink network to provide in-flight target updates, in-flight retargeting, weapon in-flight tracking, and if required, weapon abort.

Mission

Combatant Commanders will use units equipped with the SDB II to attack stationary and moving ground and littoral targets in adverse weather conditions at standoff ranges.

Major Contractor

Raytheon Missiles and Defense – Tucson, Arizona

- 1 additional release due to previously failed maritime target mission.
- With the exception of cybersecurity testing, the Air Force conducted MOT&E Phase I testing in accordance with the

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DOT&E-approved Milestone C Test and Evaluation Master Plan (TEMP) and test plans. DOT&E published a classified MOT&E Phase I F-15E early fielding report in July 2020.

- The Air Force submitted a waiver package in October 2020 to the National Security Agency (NSA) which requests relief from some of the cryptographic key handling requirements for SDB II employment from the F-15E.
- The Air Force has reached a price agreement for the Low-Rate Initial Production lot 6 contract for 1,208 weapons (747 Air Force, 461 Navy) and plans to award the contract in October 2020.
- The Navy initiated a QRA in late FY20 to enable fielding on the F/A-18E/F in early 2021 within a limited employment envelope. The coronavirus (COVID-19) pandemic caused moderate delays to the F/A-18E/F QRA, which may delay initial operating capability by 3 months.
- MOT&E Phase II on the F-35B and C in FY21 and FY22 will further characterize its operational effectiveness against small patrol boats, and to evaluate carrier/shipboard operability. Phase II will also include captive flight tests to provide data for employment against additional types of maritime targets. The SDB II Program Office will accomplish an FRP decision following the completion of MOT&E Phase II.
- The Air Combat Command authorized fielding of the SDB II on the F-15E on September 23, 2020.
- The Air Force and Navy are in the process of updating the Milestone C TEMP based on the results of MOT&E Phase I. This update will drive the specifics of MOT&E Phase II.

Assessment

- MOT&E Phase I and LFT&E were adequate to evaluate SDB II effectiveness, lethality, and suitability. Cybersecurity testing of the SDB II was not adequate to holistically evaluate the weapon's survivability in a cyber-contested environment. However, the cyber assessments provided good characterization of the cyberattack surface, insight into the interfaces between the SDB II and supporting equipment, and a working knowledge of how the weapon and support equipment process messages. The classified DOT&E early fielding report contains further details.
- MOT&E Phase I flight test missions built on the capabilities demonstrated in GCT by showing the ability to successfully engage a target with multiple weapons on a single pass, operate in a GPS-jamming environment, perform a commanded abort, and both employ an exclusion zone and override the exclusion zone to engage a target.
- In the CA mode, the system performed as expected with all weapons hitting at appropriate distances from the planned coordinates provided to the weapon. In the LIA mode, all weapons hit in very close proximity to the directed laser spot.
- The weapon performs well in NA mode against moving targets if it receives valid targeting data. Two factors affected

the weapon receiving valid targeting data during MOT&E Phase I: the cumbersome process for loading Link 16 datalink cryptographic information and the lack of a DOD standard JTAC ultrahigh frequency (UHF) datalink kit.

- The process to load Link 16 datalink cryptographic keys is cumbersome due to NSA protection requirements for national security systems. These requirements mandate the keys used for F-15E SDB II mission planning be split into multiple keys to enable secure transfer to the aircraft and weapon. Splitting the keys complicates the preflight process as cryptographic key verification on the aircraft, weapons, and mission planning systems is not possible prior to mission time. The waiver package submitted to the NSA, if approved, should eliminate many of the cryptographic key complications encountered during MOT&E Phase I.
- During testing, JTACs used multiple different UHF datalink kits. The lack of JTAC familiarity with the different kits, particularly their ability to ensure the kit was compatibly keyed to transmit data to the weapon, resulted in incorrect targeting data being passed to the weapon.
- Mission planning is also a significant challenge, with average planning times of over 50 minutes per weapon (the threshold time is 5 minutes per weapon). Much of this is related to a time intensive, error prone cryptographic data entry process, and a poor exclusion zone creation process.
- Lethality analysis indicates the weapon performs as expected against target surrogates for legacy main battle tank, infantry fighting vehicle, anti-aircraft gun, surface-to-air missile target-erector-launcher, rocket launcher, and small patrol boat. The detailed lethality analysis appears in the classified DOT&E early fielding report.
- The Air Force did not conduct MOT&E Phase I cybersecurity on an operational SDB II test article, which limited the relevance and validity of the test data.

Recommendations

The Air Force and Navy should:

1. Develop a MOT&E Phase II cybersecurity test and evaluation strategy.
2. Continue to improve the mission planning cryptographic data entry and exclusion zone creation processes to decrease the mission planning timeline.
3. Characterize lethality against modern main battle tanks.
4. Update the Milestone C TEMP to address MOT&E Phase I cybersecurity shortfalls.
5. Ensure future SDB II cybersecurity testing includes the use of an operationally representative test article and operational users.
6. Investigate options for standardizing JTAC UHF datalink kits for use in MOT&E Phase II.