

Active Protection Systems (APS) Program

Executive Summary

- The Active Protection System (APS) program is intended to improve the survivability of ground combat vehicles against anti-tank guided missiles, rocket-propelled grenades, and recoilless rifle threats by using a kinetic “hard kill” mechanism to intercept and disrupt/defeat the incoming threat.
- In 2017, in support of the European Deterrence Initiative, the Army initiated an expedited installation and characterization of three Non-Developmental Item (NDI) “hard kill” APS: Rafael Trophy APS for the Army Abrams M1A2 and Marine Corps M1A1 tanks, the Artis Iron Curtain for the Stryker vehicles, and the IMI Systems Iron Fist APS for the Bradley vehicles.
- The Army divided APS testing into two major phases to assess technology maturity, performance, and integration, and to support the Urgent Material Release (UMR).

Trophy APS

- Trophy APS demonstrated the potential to provide improved protection to the Abrams tank when compared to the existing systems without APS.
- The test was designed to assess fundamental APS capability in basic range conditions and engagements. The test was not designed to enable detailed assessment of vehicle survivability and force protection after the engagement.
- The Army issued a directed requirement to procure and install Trophy APS systems on Abrams for a total of four Armored Brigade Combat Teams, by the end of FY20.

Iron Curtain APS

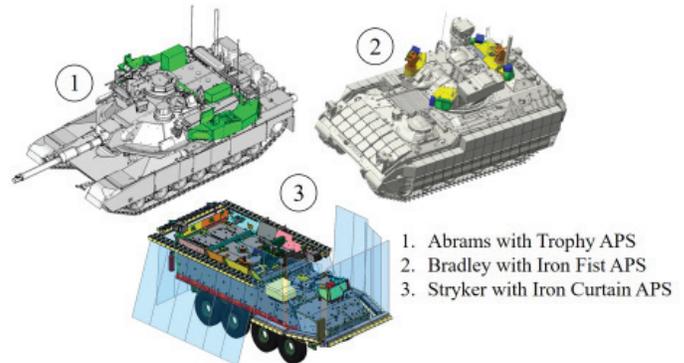
- Iron Curtain APS did not demonstrate sufficient threat intercept and Stryker/force protection capability. Consequently, the Army issued a request for information for other Stryker APS systems with the intent to test in late CY19.

Iron Fist APS

- Phase I Iron Fist APS testing on the Bradley is complete. This test supported the Army Requirements Oversight Council (AROC) decision meeting on November 30, 2018.

System

- The APS solutions are designed to enable the system to detect and declare a threat, deploy counter-munitions, and disrupt/defeat the threat. A successful APS intercept of a threat does not imply the absence of residual damage to the combat vehicle or its crew following an engagement. The Army selected the following to be installed and characterized:
 - Rafael Trophy APS on the Army Abrams M1A2 and Marine Corps M1A1 tanks
 - Artis Iron Curtain on the Stryker
 - IMI Systems Iron Fist on the Bradley.



Trophy APS

- The Trophy system is designed to engage incoming threats with a kinetic projectile intended to destroy the threat or cause early detonation. The Abrams base armor is expected to be able to absorb post engagement threat residuals (threat by-products generated after the collision). The Trophy APS adds approximately 7,200-pounds to the platform. In addition to the installation of the Trophy system onto the tank, the Army has incorporated limited integration of the Trophy system into the tank’s situational awareness system.

Iron Curtain

- The Iron Curtain is designed to engage incoming threats with a kinetic projectile intended to prevent function of the warhead. The Iron Curtain adds approximately 5,700 pounds to the Stryker vehicle.

Iron Fist

- The Iron Fist is designed to engage incoming threats with an explosive projectile intended to destroy or divert the threat, and adds approximately 1,543-pounds to the platform. The fielded Bradley A3 does not generate sufficient power to operate the APS. Power components from the Bradley A4, currently under development, were integrated into the APS test asset.

Mission

- Army and Marine units intend to use Abrams main battle tanks equipped with the Trophy APS to disrupt/destroy certain classes of enemy fire while safely maneuvering across the full range of military operations.
- Army commanders intend to use Stryker vehicles equipped with the Iron Curtain APS to disrupt/destroy enemy military forces, to control land areas including populations and resources, and to conduct combat operations to protect U.S. national interests while increasing protection to the vehicle and its crew.

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- Army units intend to use Bradley vehicles equipped with the Iron Fist APS to provide protected transport of soldiers, to provide over-watching fires to support dismounted infantry and suppress an enemy, and to disrupt/destroy enemy military forces and control land areas.

Major Contractors

- DRS – St. Louis, Missouri
- IMI Systems – Ramat HaSharon, Israel
- Artis, LLC – Reston, Virginia

Activity

- The Army used a two-phased approach to characterize the performance of the various APS solutions in support of the UMR:
 - Phase I consisted of limited characterization testing of threat interactions with the APS system. It was intended to determine fundamental performance and limitations of the APS and feasibility of installing APS systems on the host platforms.
 - Phase II is intended to test production-representative APS as installed on operationally representative systems under realistic combat condition. It is intended to adequately assess the capabilities and limitations of the systems prior to fielding in support of the UMR.
- Phase I live fire testing for each of the three APS solutions included up to 50 events. Approximately 70 percent of the tests were performance characterization events and the remaining tests were operationally relevant environment events. The Army conducted APS testing at the Redstone Test Center, Alabama.

Trophy APS

- The Army completed Phase I testing in September 2017. Phase I testing also included 10 Marine Corps Abrams tests with moving vehicle and inert threats.
- Phase II test planning is ongoing.

Iron Curtain APS

- The Army completed Phase I testing in March 2018 and is analyzing the results.
- The Army is reassessing the path forward for Stryker APS.

Iron Fist APS

- The Army completed Phase I testing in August 2018. The contractor (IMI Systems Iron Fist) conducted follow-on testing to implement and retest minor changes to the system design needed for the AROC decision to enter Phase II.

Assessment

Trophy APS

- Phase I live fire testing demonstrated the capability of the system to counter most of the threats tested under basic range conditions and simple threat scenarios. Phase I testing included several limitations that inhibit an assessment of the APS performance with confidence:
 - The Army performed the majority of the tests on a ballistic hull and turret asset that did not independently power the APS, nor have any internal operational features as they would in a fielded configuration.

- The Army relied heavily on the contractors to set up the APS due to the limited knowledge of the foreign system.
 - The test was not designed to enable assessment of the vehicle vulnerability after an engagement: rolled homogeneous armor plates were used as witness material in lieu of the complex armors used by the Abrams.
 - Testing for Trophy and Iron Curtain has had limited scope pertaining to logistical considerations for installation, maintenance, counter-munition resupply, and transportation. This will limit the Army's understanding of the logistical burden Trophy and Iron Curtain place on units that receive the system
- Phase II testing will require more operationally realistic testing and evaluation (using adequate modeling and simulation tools) to support the UMR. Phase II testing is scheduled to start in November 2018. The modeling and simulation tools need to be updated to enable more comprehensive evaluation of systems equipped with APS.

Iron Curtain APS

- Phase I live fire testing demonstrated an improved ability of the Iron Curtain system to intercept incoming threats compared to prior DOT&E tests (held in 2011) and ground combat vehicle tests (held in 2014). However, damaging effects to the Stryker vehicle base armor occurred regularly even with successful intercepts. An upgrade to the baseline armor will be necessary if this APS is to be employed on a Stryker vehicle. The Army has also observed other limitations regarding performance in low light and simulated rainy conditions. Consequently, the Army is pursuing other systems for Stryker.

Iron Fist APS

- Phase I Iron Fist live fire and user testing was completed in 2018. Preliminary assessment by the Army was that the system demonstrated an inconsistent capability to intercept threats. Counter-munition dudding and power failures to the launcher were leading contributors to the low intercept rate. The Program Office has been working with the vendor on design improvements to address the system performance shortcomings. Some prospective solutions have been implemented and will be tested in Phase II.

Recommendations

The Army should:

1. Conduct live fire test of final APS solutions installed on combat-configured vehicles against operationally

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- representative threats to adequately evaluate force protection and survivability of the vehicle.
2. Ensure Phase II testing is designed to assess force protection and the survivability of the vehicle (residual mission capability and damage effects) post engagement, even given a successful APS intercept of the threat.
 3. Minimize contractor involvement during Phase II testing to fully characterize the capabilities and limitations of the system.
 4. Develop and advance the appropriate modeling and simulation tools needed to support the test planning and evaluation of systems equipped with APS.
 5. Include logistical considerations for installation, maintenance, counter-munition resupply, and transportation in future user test design.

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