

Weapon of first resort: Tomahawk Block IV missile readied for a mid-life makeover

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The upcoming recertification of the Tomahawk Block IV cruise missile has given the US Navy an opportunity to modernise the weapon system and, at the same time, re-embrace the maritime strike mission. *Richard Scott reports*

It was the opening salvos of Operation 'Desert Storm' in January 1991 that gave the US Navy's (USN's) Tomahawk land-attack missile (TLAM) its first test in combat and, at the same time, opened a new chapter in strike warfare.

Launched into Iraq from US ships and submarines, more than 200 surface-launched RGM-109 and submarine-launched UGM-109 weapons were targeted against critical military and political infrastructures. Footage of missiles flying at little more than rooftop height through downtown Baghdad quickly brought Tomahawk to the public's attention, while simultaneously providing political and military leaders with a clear demonstration of the flexibility and precision afforded by Tomahawk's conventional deep-strike capability. Here was a stand-off weapon that could be launched from sea, fly more than 1,000 miles into heavily defended airspace, and then hit a high-value fixed target with minimal collateral damage. Additionally, TLAM could deliver pinpoint effects without the need for a pilot to be anywhere near the potential target.



A Tomahawk Block IV cruise missile launches from the forward Mk 41 vertical launcher on board the guided-missile destroyer USS Farragut (DDG 99) during a training exercise. (US Navy)

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The Block II variant that was used to such devastating effect in 'Desert Storm' was followed by the improved Block III missile. Entering service in 1993, the RGM/UGM-109D Block III introduced an improved Williams International F107-WR-402 engine (offering higher thrust and lower fuel consumption), GPS, time-of-arrival software, the smaller and lighter WDU-36/B unitary warhead (delivering the same effect, but increasing fuel space to extend range), and an updated digital scene matching area correlator (DSMAC). Some Block III missiles were remanufactured from retired BGM-109B Tomahawk Anti-Ship Missile (TASM) rounds.

As with the earlier Block II, the Block III missile was fielded in two variants: the Tomahawk Block IIIC conventional variant (TLAM-C) fitted with the WDU-36/B 1,000 lb-class blast/fragmentary unitary warhead and the submunition variant (TLAM-D) including a submunitions dispenser with combined effect bomblets. The Block III missile was first used in September 1995 as part of Operation 'Deliberate Force' (the NATO air offensive against selected targets in Serb-held Bosnia-Herzegovina).

The RGM/UGM-109E Tomahawk Block IV missile – originally developed under the moniker Tactical Tomahawk – was conceived as a more flexible, responsive, and low- cost strike weapon able to deliver the 1,000 lb-class WDU-36/B unitary warhead out to a range well beyond 1,000 miles. In particular, Block IV afforded a much-improved capability to defeat relocatable and emergent time-critical targets.

As with the earlier Block III missile, Tactical Tomahawk typically employs inertial guidance or GPS to fly out on a preset course over water; once over land, the missile's guidance system is aided by terrain contour matching (using the missile's radar altimeter to measure the terrain profile beneath the flight path). Terminal guidance is provided by DSMAC (using a downward- looking electro-optical sensor to produce a digital scene of natural and man- made terrain features that are then compared with stored scenes in the flight plan) or GPS, producing an accuracy of about 10 m.

However, Block IV introduced a number of design changes, including an enhanced navigation and guidance computer; improved anti-jam GPS capability (latterly including the integration of a Selective Availability Anti-Spoofing Module); and the capability to reprogramme the missile while in-flight, via two-way UHF satellite communications, to strike any of 15 pre-programmed alternate targets, or redirect the missile to any GPS target co-ordinates. Additionally, the Block IV missile is capable of loitering over a target area in order to respond to emerging targets or, with its onboard camera, provide battle-damage information.

The other fundamental change was a radically different engineering and manufacturing philosophy realising significant producibility and cost benefits. Raytheon Missile Systems, which has since 1994 had sole responsibility for Tomahawk All-Up-Round (AUR) manufacture and depot maintenance, transitioned to a new lighter airframe structure, and re-engineered the missile to dramatically reduce the number of parts, fasteners, circuit cards and connectors. This new manufacturing methodology also resulted in significantly fewer assembly/test hours.

Introduction of the Block IV missile was accompanied by the introduction of the Tactical Tomahawk Weapon Control System (TTWCS). Developed by Lockheed Martin and achieving initial operational capability (IOC) in 2004, the TTWCS is integrated with the host platform's navigation, communication, situational awareness, and launch systems to compute the missile's route to target. The TTWCS also provides the capability to plan new missions aboard the launch platform and communicate with multiple Tomahawks to rapidly retarget and redirect the missiles in flight.

A major update to the TTWCS began roll-out to the fleet in 2017. This introduces new hardware and software, which, in combination, streamline workflow to increase the speed of engagement planning. The update also introduces a simplified user interface and improves cyber security.

Operational record

Since January 1991 more than 2,000 Tomahawks of all marques have been fired in combat operations and a further 500 flight tested. The most recent use of Tomahawk in April 2017 saw the DDG 51 guided-missile destroyers USS *Porter* and USS *Ross* launch 59 missiles against targets on Shayrat airbase in Syria.

With the rundown of remaining Tomahawk Block III inventory already in progress – all Block III AURs will be removed from active service by the end of 2022 – the Block IV variant will shortly become the only marque in the USN's inventory. To date, US Naval Air Systems Command (NAVAIR), through the Tomahawk Weapons System Program Office [PMA-280], has purchased approximately 4,000 Block IV missiles, of which more than 250 have been fired in anger. Production continues at Raytheon Missile Systems' Tucson, Arizona, plant, but the fiscal year 2018 (FY 2018) buy – full-rate production (FRP) Lot 15 – will be the final new-build offtake. FRP 15 covers a total of 100 AUR missiles.

However, that does not mean a stop to further evolutionary development, with the entry point being a mid-life recertification programme beginning in FY 2019. "The goal of the recertification programme is to replace and recertify life-limited components allowing an additional 15 years of service life to Block IV missiles," said Captain Mark Johnson, PMA-280 programme manager, "so extending service life of newer weapons into the late-2040s."

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