



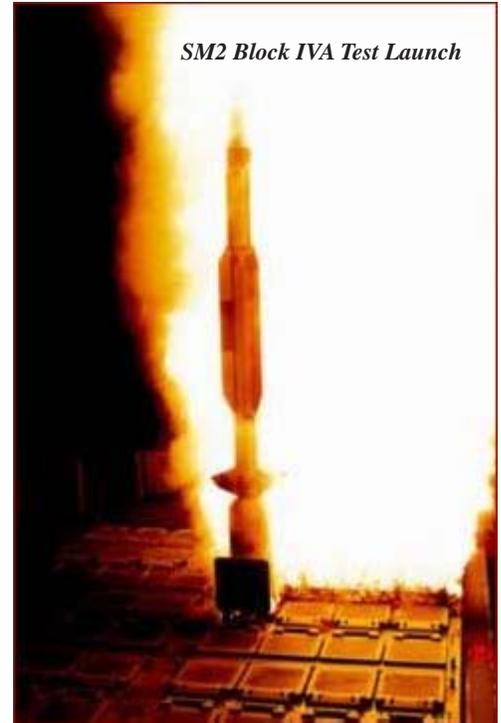
December 2004

Standard Missile-6 (SM-6) Moves Ahead

The Extended Range Active Missile (ERAM) or SM-6 is the next step in Anti-ship Cruise Missile (ASCM) defense for the US Navy. The desire for navies around the world to acquire a surface-to-surface missile capacity has been one primary goal of nearly every developing navy since the inception of the ASCM. Nearly every country with a coastline has some form of a navy with more than half possessing vessels capable of launching ASCMs. As the number of nations with ASCM capabilities increases so does the need for more capable surface launched air defense missiles. Raytheon Missile Systems will provide this capability with ERAM.

SM-6 is the Navy's next generation naval air defense missile following over 30 years of defense provided first by the Standard Missile-1 and then SM-2.

In January 2004, the Naval Sea Systems Command (NAVSEA) announced it was planning to award a contract, as a sole-source acquisition, to Raytheon Missile Systems to develop and produce the ERAM for an in-service date of 2010. Then, on 3 September 2004, Raytheon was awarded a US\$440M contract for the SM-6 with 80% of the work being done at the Tucson plant and the remainder in Arkansas and Massachusetts. Funding for the project has been addressed in the RDT&E budget until 2009 at which point the funding will likely fall under the procurement budget as the missile enters service.



SM2 Block IVA Test Launch

Additional milestones to be met will consist of a critical design review in fiscal year 2006 with flight-testing expected to start in 2008.

ERAM, designated "Talon" (a continuation of the Standard Missile, Tarter, Terrier, Talos series), is, based on the target set, expected to utilize the high-performance airframe of the SM-2 Block IVA (although reporting states Block IV) and the seeker head from the Advanced Medium Range Air-to-Air Missile (AMRAAM) Phase III missile (AIM 120-C7). The addition of the active seeker from the AMRAAM will allow for the missile to engage remote targets (not held on the firing ship's radars) or targets that are beyond the fire control illuminator's radar horizon over both water and land.

Missile guidance laws are generally based on one of several forms of proportional navigation (PN). While PN laws are robust, analytically tractable, and computationally simple, they are only optimal in a narrow operating regime. Consequently, they may not optimize engagement range, time to intercept, or endgame kinetic energy. The advent of miniaturized high-speed computers has made it possible to compute optimal trajectories for missiles using command mid-course guidance as well as autonomous onboard guidance. A missile's kinematic boundary can be described as the maximum theoretical range at which it can intercept a target assuming no noise in its sensors. ERAM is capable of utilizing the full kinematic capability of the missile to greatly expand the boundaries of the battlespace. [More »](#)

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Standard Missile-6 Moves Ahead (cont.)

In addition to the employment of the AMRAAM seeker, there will be software enhancements to the signal processor as well as changes to the guidance system and autopilot functions that will accommodate a semi-active mode of operation. This semi-active mode will give the missile the ability to counter the full spectrum of airborne threats posed to the fleet, which include not only ASCMs but also, helicopters, low/slow flying aircraft, Unmanned Aerial Vehicles (UAVs) and theater ballistic missiles while reducing the chance of engaging the wrong target.

Although the overall performance of the missile remains classified, it can be assumed the missile will have approximately the same range as the SM-2 Block IV of 200+ NM if equipped with the same propulsion stack consisting of the Mk 104 dual-thrust rocket motor (boost-sustainer) and the Mk 72 solid fuel booster. SM-6 is known to be utilizing the latest blast-fragmentation warhead similar to the Mk125 Mod 1 that is currently part of the SM-2 Block IIIB.

ERAM will be compatible with the existing Aegis Weapon System and launchable from the Mk 41 Vertical Launching System (VLS). This compatibility will provide the navies of Japan, South Korea, Spain, and Norway with a long-range option when SM-6 is approved for export. Likewise, Germany and the Netherlands will have an upgrade path from SM-2 Block IIIA. However, ERAM will likely find its first installation aboard the DD(X) and its new Mk 57 Peripheral VLS although not specifically called for in the current requirements. The 2010 in-service date coincides with the completion of the first DD(X) that is scheduled to commission in 2011 where as the CG(X) (which calls for a missile with SM-6's capabilities) will not commission prior to 2020.

According to the Navy, the US\$2M missile is "necessary...without it, we have to rely on a weapon that can only be deployed when the enemy is within radar range of a ship."

The enhanced capabilities of ERAM will allow for a fleet air-defense capability that will last well into the 21st century.



Chinese Surface-to-Surface Missile Development



Chinese JJ/TL-6B SSM

At the China Air Show 2004, Hongdu Aviation Industry Group displayed two new surface-to-surface missiles (SSM), one with two variants, the JJ/TL-6B, JJ/TL-10A and KJ/TL-10B as well as the redesigned C-701R.

The JJ/TL-10 missile appears identical to the Iranian TL-10 missiles currently being imported by Iran for their China Cat class Fast Attack Craft (FAC). Reports indicate Iran is interested in a variant of the JJ/TL-6 missile when it becomes available in the next two years.

Test launches of the TL-10 missile by China began in 1995 with launches from PLAN vessels and shore facilities against target vessels have shown great success. The JJ/TL-10A is a TV-guided SSM with a top speed of 0.85 mach with a range of 4 – 18km and contains a semi-armor piercing 30kg warhead.

Brochures from China National Aero Technology Import & Export Company (CATIC) list the indigenous FL-8 and FL-9 as being the export TL-10 and TL-6 respectively.

The third SSM exhibited, the C-701R, has been upgraded by replacing the electro-optical seeker with an advanced radar guidance unit, a longer missile body and solid fins in lieu of pop-out tips. The C-701R with a range of 25km and a speed around 0.8 mach is also being exported to Iran as an alternative to the TL-10 on the China Cat class FAC.

All three missiles and each variant are capable of being adapted for launch from canisters as well as aircraft. However, the KJ/TL-10B is designated as air launched only and is reportedly designed for launch from helicopters.

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BrahMos (PJ-10) Tests Continue

On 03 November 2004, the Indian Navy successfully tested a BrahMos supersonic anti-ship cruise missile in the Bay of Bengal. The missile was fired from the *INS Rajput*, a Kashin II class destroyer that was positioned about 90 km from the Chandipur missile test range. The missile was fired at 11:18 am at a test ship and was said to be successful in destroying the target.

The November test marks the seventh successful test firing of the missile since 12 June 2001.

The Indian BrahMos, which derives its name from the Brahmaputra and Moskva (Moscow) rivers, was developed by an Indo-Russian joint venture after the two countries signed an agreement in February 1998.

The 8.3-meter (27.55ft), 3,000 kg (6600 lb) missile is capable of achieving mach 2.8 and has a range of around 150 NM. Although the warhead is relatively small (300 kg) for the size of the missile body, BrahMos is capable of carrying a nuclear payload.

BrahMos is a two-stage anti-ship missile that contains a solid propellant booster and a liquid fuel ramjet sustainer capable of being launched from aircraft, land, ships or submarines. It utilizes various launching systems including angled canisters, vertical launch systems, land based mobile erectors and submarine canisters, both horizontal and vertical. It is also the only supersonic cruise missile that uses liquid ramjet technology.

The Indian Navy is currently constructing a variety of newly designed surface ships and submarines that will likely be equipped with both the anti-ship and land attack versions of the BrahMos.

It is now to be seen if this Indian and Russian joint venture will be able to successfully sell this new SSM into the international market.

Land Attack Missiles: A Look at U.S. Tactical Tomahawk and French Naval Scalp

In all recent combat operations, there has been an emphasis on power projection at a distance. In 2003, the war in Iraq moved inland and out of range very quickly, of all maritime land attack capabilities with the exception of Tomahawk.

As recent conflicts have demonstrated the importance of precision, stand-off land attack weapons, and the United States has limited the export market of the Tomahawk, Europe has found itself searching for an alternative.

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Land Attack Missiles - (cont.)

Tomahawk was initially conceived as a dual-purpose naval cruise missile, to attack either ships or land targets. It is now the U.S. weapon of choice for stand-off attacks against land targets, having been used extensively since the 1991 Gulf War. The newest member of the Tomahawk family is the Block IV Tomahawk (Tactical Tomahawk: TacTOM), see table below.

The TacTOM is launched vertically from U.S. Navy surface ships and submarines. Radar detection of the missile is made difficult due to the relatively small size and low altitude flight of the missile. These factors help ensure a high probability of survival enroute highly defended targets.



TacTOM was introduced into the fleet in May 2004, introducing innovative technologies such as a modular design for easy integration of future payload candidates, a two-way satellite data link allowing a strike controller to change a missile's preprogrammed target or redirect to a completely new target. This 'targeting flexibility' includes the ability to loiter over the battlefield awaiting assignment, and even the transmission of battle damage imagery.

The Tomahawk cruise missile, currently restricted to the U.S. and U.K., appears to be headed for Spain and possibly other nations in the near future, but perhaps in different variants (GPS guidance only). The Tomahawk will fit only in the strike length Mk41 Vertical Launching System (VLS), while most exports of Mk41 VLS have been of tactical length.

In 1997, France and the U.K. decided to acquire SCALP/Storm Shadow missiles, the first non-U.S. cruise missiles to be purchased by Western nations. Italy joined this industrial partnership in 1999.

This first generation European air-to-ground cruise missile is deployed from combat aircraft. In 2000, the French Navy's Staff stated objective of a cruise missile launched from a naval platform lead to MBDA to conduct preliminary studies for new versions of SCALP/Storm Shadow for sea and land launch.

Naval SCALP, in order to reduce development costs and lead-times, reuses, unchanged, some SCALP EG subassemblies: GPS/INS or TERCOM guidance, image processor, and IR seeker head. Other features, such as aerodynamics, will be amended to account for the specific constraints of installation inside vertical launchers and torpedo launcher tubes.

The surface ship type will be stowed in the DCN manufactured A70 Sylver vertical launch module, being designed as a versatile multiple missile launcher. The submarine version would be canister launched from a torpedo tube. In order to be launched from both a surface vertical launcher and a [More »](#)

Missile Characteristics	TacTOM	Naval Scalp
Unit Cost (USD)	0.653M	1.6M
Length	6.28 m	5.1m
Diameter	51.8 cm	63 cm
Span	266 cm	253 cm
Weight	1591 kg	1300 kg
Range (max.)	1411 km	250 km
Speed	550 mph	600 mph
Altitude	Low (about 500 ft)	-----
Guidance	TERCOM	GPS
	DSMAC	TERCOM
	GPS/INS	IR Seeker
Warhead	455 kg frag. unitary	450 kg BROACH

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Land Attack Missiles - (cont.)

torpedo tube, Naval SCALP will be cylindrical in shape, vice the current Storm Shadow square cross-section.

The naval versions of SCALP were explicitly included in the French five-year budget published in 2001 for both the new Barracuda class submarine and the multi-purpose frigate.

At the end of June 2001, it was announced that Naval SCALP would enter service in 2011 on board the first of the French multi-purpose frigates. A 36-month risk reduction phase was started in 2002, with detailed definition to begin in 2005, and full development in 2006. The first firing of a Naval SCALP is expected in 2008.

France hopes to interest the Royal Navy in program participation, even though they seem wedded to a Tomahawk solution for their submarines. France had hoped the U.K.'s Future Surface Combatant (FSC), outfitted with the A70 Sylver launcher could substitute Naval SCALP for ASTER missiles, just as U.S. warships substitute Tomahawk for Standard Missiles. However, the recent U.K. MoD decision to cancel the FSC program removes that option.

As the world's navies continue to expand the littoral combat role of warships, the role and importance of land attack cruise missiles will likewise continue to expand.



AMI International World Missile Systems News – December 2004

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