Evolved Seasparrow Missile (ESSM)

The Evolved Seasparrow Missile (ESSM) is a short-range missile intended to provide self-protection for surface ships. It was developed to balance total system effectiveness against the low-altitude supersonic anti-ship cruise missile (ASCM) threat. On Aegis ships, ESSM will be launched from the Mark 41 Vertical Launch System. Four missiles are stored, with tail fins folded, in each launcher cell. (The number of cells is either 90 or 96 on an Aegis destroyer and either 122 or 128 on an Aegis cruiser.) Vertical launch requires a thrust vector control system on the ESSM rocket motor. Guidance is provided by up-linked commands until the ESSM is near the target, at which time guidance transitions to semi-active homing on reflected radar signals from the target. ESSM may also be launched in a home-all-the-way mode (no up-linked commands). At this time, ESSM installation is funded for Aegis ships only. On non-Aegis ships (aircraft carriers, amphibious assault ships, other surface combatants), ESSM will be fired from other launch systems and guidance will be in homing-all-the-way to intercept. ESSM uses an 8-inch diameter modified guidance section and a new warhead section. A new 10-inch diameter rocket motor provides higher thrust for longer duration than predecessor Seasparrow missiles. ESSM is a cooperative development effort that includes 13 participating governments.

The Milestone II review was conducted in November 1994. During 1998, the program was restructured to add an operational assessment (Operational Test-IIA) based on missile flights at White Sands Missile Range (WSMR), New Mexico, to support the first low-rate initial production (LRIP) decision. A second low-rate initial production decision was added and was supported by results of operational testing (Operational Test-IIC) with the Self Defense Test Ship (SDTS). The full-rate production decision will be supported by the operational evaluation (OPEVAL). LFT&E component/section-level ground testing, conducted in FY96-FY98, included arena warhead tests against fragmentation mats and components of United States and foreign targets. In addition, LFT&E used results of flight testing during OT-IIC, technical evaluation, and OPEVAL.

TEST & EVALUATION ACTIVITY

OT-IIC missile firings with the SDTS were completed in early FY03. Technical evaluation and OPEVAL were conducted on *USS Shoup*, an Aegis destroyer, in March and April 2003, respectively. All of the testing was conducted at the Naval Air Warfare Center Weapons Division sea range at Point Mugu, California. DOT&E staff or their representatives observed portions of the testing.

TEST & EVALUATION ASSESSMENT

Although DOT&E approved the OT-IIC and OPEVAL Test and Evaluation Master Plans and operational test plans, the OPEVAL was not conducted in accordance with those plans as a result of unsatisfactory aerial target performance. This is the first OPEVAL of a Navy system for which the testing was not adequate to determine operational effectiveness. The Navy must give development and sustainment of threat-representative targets higher priority.

Self Defense Test Ship Phase (Operational Test-IIC). The combat system installed on the SDTS was intended to approximate the system on non-Aegis ships that use the Mark 29 rail launcher. However, the combat system on the SDTS had limitations that constrained ESSM capability against some operationally realistic threats. As a result of better

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understanding the impact of these limitations, two missile firing scenarios planned for the SDTS phase were modified and moved to the OPEVAL.

Fifteen ESSMs were launched at various targets in FY02/FY03. Included were maneuvering and non-maneuvering, subsonic and supersonic, low-altitude targets, as well as a supersonic high diving target. Some of the critical scenarios were scripted to be unrealistic or used targets that were not adequately threat-representative. ESSM problems were discovered during flight tests, solutions were implemented, and corrections were demonstrated.

OPEVAL. As a result of unsatisfactory aerial target performance, the testing was not adequate for determining ESSM operational effectiveness. ESSM capability against the supersonic, maneuvering ASCM threat was not demonstrated. Capability against the high-altitude, supersonic, terminal diving missile threat was not demonstrated. ESSM demonstrated capability against the non-maneuvering, low-altitude, subsonic ASCM threat. ESSM is operationally suitable. As demonstrated during OPEVAL and live fire test and evaluation events, the ESSM warhead is lethal against the ASCM threat.

Although capability against a supersonic low-G maneuvering sea-skimming ASCM target was demonstrated in technical evaluation and during OT-IIC, the scenarios were scripted to be unrealistic. Although capability against a high-altitude, supersonic, terminal diving missile target was demonstrated during OT-IIC, it was not adequately threat-representative.

The supersonic, maneuvering sea-skimmer targets and supersonic, high-altitude, terminal diving target scenarios moved from the SDTS phase became more difficult to execute as a result of the significant challenge in balancing range safety requirements against operationally realistic scenarios involving a manned ship. The scenarios were not conducted as planned due to the unsatisfactory target performance. Fourteen scenario attempts resulted in six scenarios that produced useable test results. The other attempts involved target problems.

Follow-on OT&E (FOT&E). FOT&E requires flight testing against the threat ASCM categories that were not adequately examined during the OPEVAL, primarily as a result of the unsatisfactory aerial target performance. Flight testing is also required in the presence of electronic jamming and with ESSMs that have undergone fleet representative shipboard storage time. In addition, a new ASCM threat has appeared for which there is no credible surrogate target. The Navy needs to acquire adequate surrogates and conduct ESSM testing against them.

The OPEVAL was conducted with an Aegis Weapon System Baseline 6.3 with Mark 41 vertical launch system. Other combat systems are sufficiently different that ESSM flight testing is required when it is integrated with them.

ESSMs are intended to provide close-in defense of Aegis ships against ASCMs, with standard missiles providing interceptor capability at longer ranges (both self defense and defense for other ships.). There are circumstances in which the Aegis Weapon System could be controlling ESSMs and SM-2s simultaneously. This is primarily an Aegis Weapon System (Baseline 6.3) issue that requires operational testing under the DDG-51 program's FOT&E.

Although it is not a requirement, non-Aegis combat systems with predecessor Seasparrows provide a useful capability against surface targets. Limitations in the Aegis Weapon System Baseline 6.3 computer program and shipboard illuminator radars precluded testing ESSM's capability against surface targets. Consideration should be given to providing this surface target engagement capability with this and follow-on Aegis baselines.