

# From the JED Archives: Electronic Attack is Back – US Navy Reinvests in Non- Kinetic Defense

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*By Richard Scott*



The DDG 51 Flight IIA destroyer USS Pinckney is the first ship to receive the SEWIP Block 3 EA subsystem. The new hemispherical antenna array (hidden by a

protective cover) is fitted on a new deckhouse sponson. CHRIS CAVAS

As it continues to modernize key electronic warfare (EW) capabilities across its surface fleet, the US Navy will later this year see its next-generation shipborne electronic attack (EA) system go to sea for the first time.

The Surface Electronic Warfare Improvement Program (SEWIP) Block 3 introduces what the Navy believes will be the most advanced onboard EA system of its kind anywhere in the world. Developed by Northrop Grumman, it constitutes the latest increment in an overarching EW recapitalization effort, which is delivering significantly improved electronic support and countermeasures capabilities to the surface force.

More is to come, including a new podded airborne Advanced Offboard Electronic Warfare (AOEW) payload under development by Lockheed Martin is now in flight test with the MH-60S/R helicopter and early work is underway on a next-generation long-endurance active offboard decoy.

Meanwhile, the fleetwide rollout of the SEWIP Block 2 electronic support (ES) sensor continues to major surface combatants, nuclear-powered aircraft carriers (CVNs) and large amphibious ships. A first major technology refresh for Block 2 is now in progress.

## **SEWIP ORIGINS**

Emerging in 2002 in the aftermath of the cancelled AN/SLY-2(V) Advanced Integrated Electronic Warfare System (AIEWS) program, SEWIP is a spiral block upgrade program based on integrating technology advances and incrementally adding functionality into the legacy AN/SLQ-32(V) system to improve ES (emitter detection, analysis, identification and threat warning) and EA (to counter anti-ship missile threats) performance. There are currently three established block upgrades, with a fourth

planned.

SEWIP Block 1, delivered by General Dynamics Mission Systems, comprises a series of low-risk, near-term upgrades to address obsolescence and at the same time improve anti-ship missile defense (ASMD), counter-targeting and counter-surveillance capabilities. The Block 1A fit, of which 121 were completed, introduced an updated Improved Control and Display (ICAD) human machine interface and electronic surveillance enhancements. This updated the obsolete AN/SLQ-32 display and pulse processing with a much-needed refresh based on commercial-off-the-shelf (COTS) technology.



Lockheed Martin has now delivered over 130 SEWIP Block 2 systems to the fleet. US NAVY

Block 1B1 added a standalone Specific Emitter Identification (SEI) capability using the Naval Research Laboratory (NRL)-developed AN/SSX-1 Small Ship Electronic Support Measures module (comprising the AS-1200A antenna, AN/UYX-4 processor unit, CS-5020C receiver/tuner, and a standalone laptop for display). Block 1B2 integrated this SEI functionality into the ICAD/Q-70 console environment, and added network centric and mission planning capabilities. General Dynamics completed 148 Block 1B1 and 1B2 systems.

A further sub-block, known as Block 1B3, introduced a High-Gain High-Sensitivity (HGHS) capability. Implemented through the addition of an HGHS processor and mast antenna, the Block 1B3 is an adjunct threat correlation/situational awareness sensor forming a critical sub-component of the AN/SLQ-32(V)6 system architecture realized in SEWIP Block 2.

Following competition, Lockheed Martin was selected in 2009 by Naval Sea Systems Command (NAVSEA) to deliver SEWIP Block 2 (the Block 1B3 HGHS adjunct sensor and Block 2 units are installed in conjunction to create the AN/SLQ-32(V)6 system). The Block 2 embodiment introduces a major ES upgrade comprising a new antenna array and new digital receiver to deliver improved emitter detection and measurement accuracy, plus a new open combat system interface.

Lockheed Martin's technical solution promoted the maximum use of COTS electronics, with an architecture based on Mercury Systems' Echotek Series microwave tuner and digital receiver products. Another key subcontractor for SEWIP Block 2 is CAES, which supplies the interferometer-based antenna array panel assemblies for AN/SLQ-32(V)6. As well as a fine angular resolution, SEWIP Block 2 also provides elevation measurement.

A first low-rate initial production (LRIP) contract was awarded in January 2013. SEWIP Block 2 transitioned into full rate production (FRP) in 2016. An initial AN/SLQ-32(V)6 installation was completed on the guided missile destroyer

USS *Bainbridge* (DDG 96) in 2014 for at-sea testing. The system has subsequently been rolled out to DDG 51 destroyers, large amphibious ships and CVNs as both a backfit and for new construction.

“We are continuing full rate production, and to date we have delivered over 130 [SEWIP Block 2] systems,” says Joe Ottaviano, Lockheed Martin’s Director, Maritime Airborne Cyber Electronic Warfare. “The number and complexity of threat signals is increasing all the time, and Block 2 is giving the Navy the ability to detect and analyze those more complex emitters.”



The SEWIP Block 3 EDM seen during testing at Northrop Grumman’s Baltimore facility. The EDM was delivered to the Surface Combat Systems Center at Wallops Island in

mid-2021. □Northrop Grumman

A compact SEWIP Lite variant, known as AN/SLQ-32C(V)6, has entered production to provide early detection, signal analysis and threat warning for smaller combatants ships where topside margins are more limited. This followed the rapid build and demonstration of an engineering development model which was tested at sea in late 2014/early 2015.

Initial deliveries of AN/SLQ-32C(V)6 are supporting the US Coast Guard *Heritage*-class Offshore Patrol Cutter program, says Ottaviano. This scaled variant is also in production for the Littoral Combat Ship, and is slated for the new FFG-62 *Constellation*-class frigate.

Lockheed Martin is now implementing a first substantial tech refresh for SEWIP Block 2, for which Mercury Systems is providing new hardware. The first increment of hardware deliveries began last year, to be followed in 2024 by the introduction of RF-system-on-a-chip (RFSoc) technology into the system. RFSoc will rationalize part count, increase reliability and offer greater bandwidth.

## ENTER BLOCK 3

Lockheed Martin teamed with Raytheon to bid for SEWIP Block 3, which adds an advanced EA module to AN/SLQ-32(V)6 to create the AN/SLQ-32(V)7 system. However, following a protracted competition, NAVSEA in February 2015 selected a rival bid from Northrop Grumman for Block 3 design and development. General Dynamics Mission Systems, as subcontractor, is leading on human systems integration and training tasks.

SEWIP Block 3 will introduce an integrated EA capability, based on wideband active electronically scanned array (AESA) technology, to provide non-kinetic defense against RF-guided threats. Block 3 additionally encompasses a government software development effort for a Soft-Kill Coordination

System (SKCS) to provide direction and scheduling for both onboard and offboard RF decoys; SKCS also incorporates Softkill Performance and Real-Time Assessment (SPARTA) algorithms designed to measure EA effectiveness and perform real-time assessment and adjustment of effects.

RADM Seiko Okano, Program Executive Officer for Integrated Warfare Systems (PEO IWS), confirmed to January's Surface Navy Association (SNA) annual symposium, that SEWIP Block 3 will go to sea this year. "This system is going to be just unprecedented in capability," she added. "It will provide us with a critical electronic warfare capability as the pace and complexity of emerging threats continues grow."

According to Mike Meaney, Northrop Grumman's vice president, Land and Maritime Sensors, the big advantage on an onboard EA system is that it provides the command with a near inexhaustible "deep magazine" to complement hard-kill weapons. "You can defend yourself against the threats that Navy ships face in a number of ways," he explains. "But when you're protecting yourself kinetically – launching missiles against missiles – eventually you will run out of missiles. Non-kinetic offers that opportunity so you can defend yourself for a long time against a wide range of different threats."

Each SEWIP Block 3 system is comprised of 16 AESA arrays, split into four faces per quadrant (two for receive, two for transmit). "Because we can steer beams near instantaneously, we can put out multiple beams simultaneously to jam multiple threats," Meaney says. "Also, an AESA allows you to generate a very narrow and focused beam."



Exploitations of NRL's Transportable Electronic Warfare Module (TEWM) program have been developed to address UONS raised by the US Sixth Fleet (Europe) and Seventh Fleet (Pacific). The SEWIP Block 3T program introduced the AN/SLQ-59 system to address the Seventh Fleet UONS (the antenna is visible above the SEWIP Block 2 array on USS Spruance); a separate TEWM exploitation, codified as AN/SLQ-62, has entered service to meet a classified Sixth Fleet UON. □ US Navy

Under the SEWIP Block 3 Engineering and Manufacturing Development (EMD) phase, Northrop Grumman has built a production-representative Engineering Development Model for laboratory and field testing. Following the completion of

contractor testing at its Baltimore site, the EDM was in mid-2021 shipped to NAVSEA's Surface Combat Systems Center at Wallops Island, VA, for evaluation.

Northrop Grumman received an order in late 2018 for two SEWIP Block 3 LRIP units following a Milestone C acquisition approval. The first of these units has now been installed on board the DDG-51 Flight IIA destroyer USS *Pinckney* during the ship's refit in San Diego, and will go to sea later in 2023.

In September 2020, NAVSEA awarded Northrop Grumman a contract for FY 2020-24 SEWIP Block 3 electronic attack subsystem full-rate production and AN/SLQ-32(V)7 integration. In September 2022, the company received a five-year, sole-source contract, valued at up to \$83.5 million, for Design Agent services in support of the SEWIP Block 3 EA subsystem.

"We are moving forward on all cylinders," says Meaney. "That first installation is underway on the west coast and is proceeding well. At the same time, we have our [EDM] continuing testing at Wallops Island, and that is proceeding well.

"In parallel, we have production underway in our factory in Baltimore. We currently have nine systems under contract, with further options available to the Navy to exercise."

The US Navy is currently looking at approximately 20 SEWIP Block 3 backfit installations on DDG-51 Flight IIA destroyers as part of its DDG MOD 2.0 effort. The DDG MOD 2.0 upgrade will also introduce the AN/SPY-6(V)4 Air and Missile Defense Radar, an AESA based system that features four array faces (each with 24 radar module assemblies) covering 360 degrees and the Baseline 10 version of the Aegis combat system.

DDG 51 Flight IIA ships are receiving the AN/SLQ-32(V)7 Hemisphere configuration, with sponson-mounted installations on the port and starboard sides of the main deckhouse block. A modified Quadrant configuration, using distributed and

repackaged hardware building blocks, is planned for the CVNs and *Wasp*-class amphibious assault ships.

“Last year we finished the Quad design, which is aimed at those large deck ships,” Meaney explains. “That design is complete and the technical data package has been handed over to the Navy and accepted. As part of their planning process, they’re now thinking about when they go buy some of those [Quad] configuration systems. In most ways it is the same system, but just configured differently for a much larger ship.”



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It is noteworthy that Northrop Grumman's SEWIP Block 3 solution has leveraged technology and techniques previously matured and de-risked under the Office of Naval Research's (ONR) Integrated Topside (InTop) Innovative Naval Prototype (INP) program. Begun back in 2009, InTop sought to demonstrate a scalable suite of EW, information operations (I/O) and line-of-sight communications hardware and software for use on naval surface platforms. Northrop Grumman was subsequently selected to lead on the development of an integrated Multibeam EW/I/O/Comm Advanced Development Model (ADM) embodying multifunction, multi-band and multibeam wideband arrays.

"ONR had the vision of combining all these functions [EW, IO and communications] together," says Meaney. "We built very wide frequency band apertures, we built the resource manager and then we demonstrated an entire series of very complex, simultaneous mission capabilities for ONR and the Navy in general."

The Multibeam EW/I/O/Comm ADM was delivered to NRL's Chesapeake Bay Detachment (CBD) facility in 2014; testing performed in late 2015 demonstrated simultaneous EW, IO and communications functionality for the first time. Evaluations have subsequently continued at CBD, with the Multibeam EW/I/O/Comm ADM directly supporting technology maturation relevant to SEWIP Block 3.

In advance of the arrival of AN/SLQ-32(V)7 in the fleet, the US Navy has deployed two threat-specific interim EA systems derived from NRL's Transportable Electronic Warfare Module (TEWM) program to address separate Urgent Operational Needs

Statements (UONS) raised by the US Sixth Fleet (Europe) and Seventh Fleet (Pacific). The SEWIP Block 3T program has introduced the AN/SLQ-59 system to address the Seventh Fleet UONS, while a separate TEWM exploitation, codified as AN/SLQ-62, has entered service to meet a classified Sixth Fleet UON.

## **E0/IR COUNTERMEASURES**

A still nascent SEWIP Block 4 has conceived of adding a shipborne electro-optical/infrared countermeasures (E0/IRCM) capability. ONR's Combined E0/IR Surveillance and Response System (CESARS) Future Naval Capabilities effort, begun in 2016, has informed potential SEWIP Block 4 requirements and helped to de-risk enabling technologies with a view to transitioning into a program of record.

CESARS embraced two distinct functional components: the Shipboard Panoramic E0/IR Cueing and Surveillance System (SPECSS); and Multispectral E0/IR Countermeasures for Advanced Threats (MEIRCAT). SPECSS was focused on wide field of view target detection and tracking, with subsequent cueing of MEIRCAT high-resolution sensors to perform target re-acquisition, tracking, classification/identification, 3-D ranging, threat assessment, countermeasures execution and countermeasures effectiveness monitoring.



Lockheed Martin's AOEW Active Mission Payload – designated AN/ALQ-248 – is a self-contained EW pod hosted by an MH-60R/S helicopter. □Lockheed Martin and Richard Scott

Three contracts were let by NRL in support of MEIRCAT: BAE Systems Information and Electronic Systems Integration was awarded a \$4.9 million in February 2016; Lockheed Martin's Aculight laser business was awarded a \$10.6 million contract in March 2016; and L-3 Cincinnati Electronics received a \$6.9 million contract in April 2016.

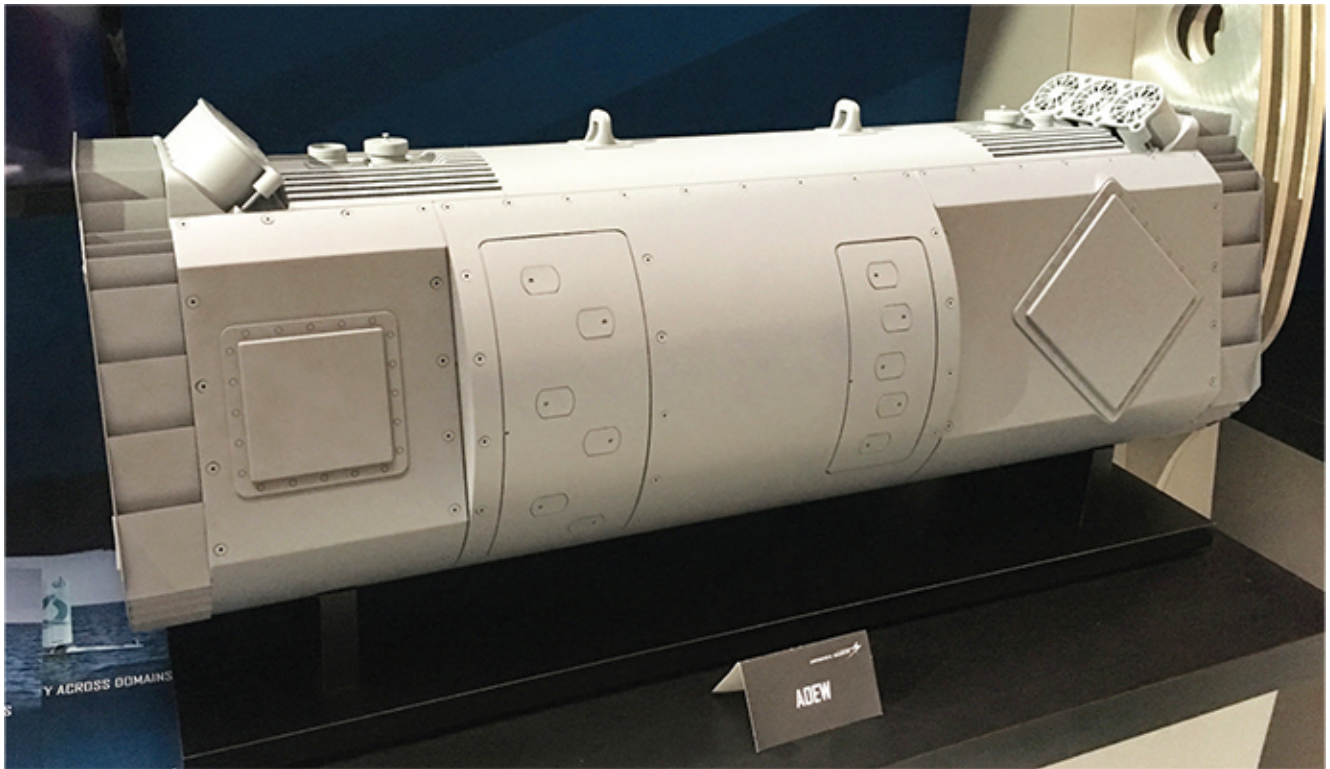
No details of MEIRCAT prototype testing have been publicly released, but Lockheed Martin earlier this year displayed a model of the system at the SNA annual symposium, describing it as an advanced laser EO/IRCM system for ship protection. In an accompanying infographic, the company said that MEICAT – as the CESARS “response system” – was designed to provide long-range EO/IRCM to support layered defense, and employed a “high power laser and agile turret for multi-threat countermeasures.” In addition, Lockheed Martin noted the adoption of a modular open system architecture design to enable easy integration and interfacing with Navy ship

systems.

## **ADVANCING AOEW**

Another key component in the Navy's non-kinetic defenses is a new helicopter-borne, long-endurance AOEW Active Mission Payload (AMP) being developed by Lockheed Martin. The system, which will be hosted as an external store by MH-60R and MH-60S multi-mission helicopters, is a self-contained pod – designated AN/ALQ-248 – providing both high sensitivity receiver and EA subsystems. CAES, as Lockheed Martin's partner and major subcontractor for the AN/ALQ-248 system, is supplying phased array transmit and receive antennas.

Operating independently, or in co-ordination with the shipborne AN/SLQ-32(V)6/(V)7 systems, the AOEW AMP is designed to provide Navy battle groups with enhanced electronic surveillance and ASMD countermeasure capabilities. In the former case, the pod will use its own high-sensitivity receiver system to detect, identify and track threat emitters, and then cue the advanced EA subsystem to generate and transmit the appropriate RF jamming techniques. In the coordinated mode, the shipborne AN/SLQ-32(V)6/(V)7 system will detect incoming anti-ship missile threats, then cue and control the AN/ALQ-248 system (via Link 16) using its SKCS function.



Following receipt of an AOEW AMP preliminary design contract in late 2016, Lockheed Martin received an EMD award from NAVSEA in September 2017. A number of Engineering Development Models are now supporting AOEW AMP test and certification; the program has also been required to complete MH-60R/S Avionics Operating Program software development to enable flight certification.

Initial operational test and evaluation is planned for the third quarter of FY 2026. “We received a first LRIP contract, for two systems, in September 2021,” explains Lockheed Martin’s Ottaviano. “LRIP2 followed in September last year, again for two systems. And we are now in discussion with the Navy on LRIPs 3 and 4.”

## **LEED ASTRAY**

Looking beyond AOEW, the US Navy is developing plans for a new persistent offboard ASMD decoy under the Long Endurance Electronic Decoy (LEED) program. LEED has conceived of an expendable autonomous off-board countermeasure – marrying a flight vehicle and an RF payload – able to integrate with the

AN/SLQ-32(V)6/(V)7 system to provide the fleet with enhanced EW coordination and capability, including the ability to stretch engagement timelines and counter heterogeneous missile attacks. The decoy flight vehicle will include a communications link for command-and-control updates in order to reposition and realign to the threat; a modular design philosophy is intended to allow for the rapid modification and evolution of the EW payload to stay ahead of new RF threat capabilities.

LEED countermeasure development is being executed under a Middle Tier rapid prototyping acquisition strategy. Lockheed Martin Missiles & Fire Control (Grand Prairie, TX) has been selected as prime contractor to lead the rapid development effort for LEED.

While information on LEED development remains limited, a summary note in the FY2023 DOD budget request indicated that Phase 1 development – including component integration, prototype build, preliminary demonstration testing and countermeasure performance testing – is planned to run through to the end of FY 2024. A follow-on Phase 2, running from FY2024 to FY2025, will build on the critical technologies from Phase 1 to develop a production-representative Engineering Development Model for delivery in mid-FY2025.

Phase 3, planned to start in FY2025, will procure and field initial units to the fleet, while the transition to major capability acquisition for full production and sustainment is executed. According to budget documents, operational demonstration assessment testing is planned to run in late FY2026

LEED is leveraging technology outputs from the ONR's Long Endurance Airborne Platform (LEAP) project, which began in FY 2021. The Navy believes that inputs from LEAP will accelerate the development cycle and support earlier LEED fielding



Lockheed Martin displayed a model of the MEIRCAT laser EO/IRCM system at the SNA annual symposium in January 2023. □ Richard Scott

The NRL has previously prototyped a low-cost rotary-wing mini-UAV known as NOMAD [Netted Offboard Miniature Active Decoy] as a part of ONR's NEMESIS (Netted Emulation of Multi-Element Signatures Against Integrated Sensors) Integrated Naval Prototype (INP) effort. The NEMESIS INP set out to develop a system of systems providing the ability to synchronize EW effects across a variety of distributed platforms so as to create a coherent and consistent EW response that confuses adversary surveillance and targeting systems. As well as the development of modular and reconfigurable EW payloads, the program also encompassed decoy and unmanned air and surface platforms and the implementation of EW functionality and decoys with autonomy, networking and countermeasures coordination techniques.

The tube-launched NOMAD vehicle developed by NRL features flip-out counter-rotating coaxial rotors located at either end of a longitudinally-extending body. A soft-launch CO<sub>2</sub> ejection system is used to eject the round, which can be deployed as either as a single unit, or in a coordinated "nest" of multiple decoys

First at-sea launches of NOMAD were performed from the destroyer USS *Pinckney* during mid-2016 as part of the RIMPAC 2016 exercise. During testing, the air vehicle achieved 30 minutes flight time – twice the expected endurance – so allowing NOMAD to keep up with the ship for more than 8 nautical miles, including transit at 20 knots.

Further testing of NOMAD was performed from the Littoral Combat Ship USS *Coronado* in August 2017. In this series, multiple NOMAD vehicles were launched in quick succession, conducted formation flying operations, and were then recovered sequentially on board. This marked the first time that the NOMAD multi-launch/recovery technology had been trialed on a US ship.

# NULKA UPGRADES

The US Navy has funded development of new RF payloads for the MK 234 Nulka active offboard decoy system under the Advanced Decoy Architecture Program (ADAP). In September 2015, L3Harris was awarded a three-year contract to develop ADAP payloads leveraging from earlier research and engineering development performed by the NRL under the ONR's E-Nulka program.

Nulka is an expendable soft-kill countermeasure designed to seduce radar-guided anti-ship missiles in their terminal homing phase. The original MK 234 electronic decoy cartridge combines a hovering rocket payload carrier vehicle (produced by BAE Systems Australia) atop which is mounted a broadband RF repeater payload (produced by Lockheed Martin) designed to seduce RF homing anti-ship missiles away from their intended targets. In US Navy service, the Nulka round is fired from the Mk 53 decoy launching system.

The ADAP payload upgrade effort was instigated by the US Navy as a rapid deployment capability (RDC) to field an improved Nulka decoy to address more advanced anti-ship missile threats. More specifically, ADAP incorporates an advanced transmitter and improved signal processing to target specific threats that the original payload on the Nulka decoy did not.

DOD budget documents have revealed the existence of two ADAP variants known as Nulka-X and Nulka-Y. Nulka-X – the first variant to be fielded with an ADAP payload as an RDC – is believed to form part of an EW/soft-kill chain tailored to defeat the threat posed by the Yakhont (SS-N-26 Strobile/SSC-5 Stooze) supersonic anti-ship missile threat in the eastern Mediterranean and the Black Sea.

Alongside the Nulka X/Y payloads introduced under ADAP, information released as part of the FY2023 budget submission reveals the existence of a Nulka Advanced Payload (which provides additional threat-based capability through the

introduction of an advanced transmitter and increased signal processing capability). The exact relationship between the ADAP program and the Advanced Payload developments has not been publicized.

NAVSEA in September 2021 awarded L3Harris a contract worth up to \$124 million to supply ADAP payloads (MK 234 Mod 10/11/12/13) to both the US And Australian navies.

## **Son of Sidekick?**

Following the attack on the USS Stark in May 1987, the US Navy raised an urgent requirement to introduce an EA capability on FFG-7 Oliver Hazard Perry class frigates equipped with the passive-only AN/SLQ-32A(V)2 ES suite. This RDC effort led to the fielding of a small and lightweight point defense jammer known as Sidekick; the AN/SLQ-32A(V)2 system in combination with Sidekick received the nomenclature AN/SLQ-32(V)5.

Some 35 years later, the US Navy is again giving consideration to the acquisition of a compact EA system tailored to smaller surface combatants. And while the Navy has yet to stand up a program of record, industry is already investing its own dollars to explore potential solutions should the requirement solidify.

Northrop Grumman, for example, is pursuing a scaled down "Ultra-Lite" derivative of SEWIP Block 3 in anticipation of a possible requirement for an onboard EA capability for smaller ship classes. "We think any ship going in harm's way should have some form of protection [and that] putting a non-kinetic system on any ship represents outstanding value for money," says Northrop Grumman's Mike Meaney.

Two key drivers are foremost in mind, adds Meaney. "First, it has to have high if not total compatibility with what already exists today in the [SEWIP Block 3) system, both in terms of

parts and software. Also, as you scale the system down, we're thinking about that ship install process – with a much smaller system it becomes much, much easier to integrate on board a ship. Right now, a full SEWIP [Block 3] system is an extensive undertaking, so we're creating a more platform-agnostic and flexible design.”

In January, Northrop Grumman revealed that key components of its Ultra-Lite EA solution were demonstrated in collaboration with the NRL on board a DDG-51 destroyer as part of last year's RIMPAC 2022 exercise. In this case, the company integrated Ultra-Lite EA transmit/receive technology with NRL's expeditionary EA antenna subsystem. According to the company, the combined system was “successfully demonstrated over many RIMPAC exercise events” and proved that the scaled EA solution “can effectively support US Navy missions.”

Additional concept demonstrations are planned to run during 2023 to further demonstrate the reliability and scalability of the system to the US Navy. “This will include lab trials, land-based tests and further at-sea demonstrations,” says Meaney.

Lockheed Martin is also looking at how it could address the Navy's nascent requirement for a small surface combatant EA solution. Its candidate – dubbed Scaled EA – derives from the company's experience with both SEWIP Block 2 and AOEW.

Ease of ship installation figures large in the mind, with Lockheed Martin looking at a ship fit availability typically lasting 60-90 days. A demonstrator system was tested during RIMPAC 2022, and more tests are planned during 2023. – *R. Scott*