

# ARCHIVED REPORT

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## BQQ-5(V)

### Outlook

- Spares and maintenance market only
- Full unit production completed thus forecast chart has been omitted
- TL-29A surface ship towed array version in production
- This report will be archived next year

### Orientation

**Description.** The U.S. Navy's BQQ-5(V) is a digital, low-frequency, multibeam, active/passive sonar suite for fast attack and ballistic missile submarines using a hull-mounted/towed array.

#### Sponsor

U.S. Navy  
Naval Sea Systems Command  
Arlington, VA USA

**Status.** Integrated into BQQ-10. Production completed; improvements through upgrades continue.

**Platform.** Installed on SSN-688/688I Los Angeles and SSBN-726 Ohio class submarines.

The BQQ-5 is also believed to be installed on the three Seawolf class attack submarines, where it is integrated into the BQQ-10 suite. (It was originally installed on U.S. Navy Permit, Narwhal, Sturgeon, and Lipscomb class submarines, which are now out of service.)

**Application.** Active search and passive classification sonar for anti-submarine warfare.

**Price Range.** The per-unit/system price was estimated to be \$10 million in 1994 U.S. dollars, based on contract cost averaging, which is roughly \$20.75 million in 2023 U.S. dollars when adjusted for inflation.

### Contractors

#### Prime

<b>Lockheed Martin Rotary and Mission Systems</b>	<a href="http://www.lockheedmartin.com/en-us/who-we-are/business-areas/rotary-and-mission-systems.html">http://www.lockheedmartin.com/en-us/who-we-are/business-areas/rotary-and-mission-systems.html</a> , 9500 Godwin Dr, Manassas, VA 22110-4157 United States, Tel: + 1 (703) 367-2121, Fax: + 1 (703) 367-6091, Prime
<b>L3Harris - Chesapeake Sciences Corp</b>	<a href="http://www.l3harris.com">http://www.l3harris.com</a> , 1121H Benfield Blvd, Millersville, MD 21108 United States, Tel: + 1 (410) 923-1300, Fax: + 1 (410) 923-2669, Second Prime

**BQQ-5(V)****Ultra 3 Phoenix**

<http://www.ultra-electronics.com/os>, 14585 Avion Pkwy, #200, Chantilly, VA 20151  
United States, Tel: + 1 (703) 956-6480, Second Prime

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 75 Glen Road, Suite 302, Sandy Hook, CT 06482, USA; [rich.pettibone@forecast1.com](mailto:rich.pettibone@forecast1.com)

**Technical Data**

**Design Features.** The BQQ-5(V) is used on U.S. Navy attack submarines and on Ohio class submarines. The BQQ-5(V) is a digital system that uses both hull-mounted and towed acoustic hydrophone arrays. It provides long-range acoustic detection through an active multibeam sonar and passive sensors. The sensor array can be towed at a maximum distance of 800 meters or retracted and stowed along the submarine's hull.

The BQQ-5(V) includes a hull-mounted system that can be either active or passive. Active installations

comprise a BQS-14 transmitter and a BQS-13 digital, multibeam, narrow-band sonar.

**Operational Characteristics.** The fore and aft taper of the towed array minimizes drag and flow noise, and ship speed is reduced no more than 0.5 knots. Except on the seven initial systems, the towed array can be cut away in the event of an emergency. Reportedly, the array does not interfere with any of the submarine's maneuver or mission requirements, but can cause an abrupt change of direction.

**Variants/Upgrades**

**BQQ-5.** The baseline sonar system for Los Angeles class (SSN-688) attack submarines consists of the BQS-13 sonar, CP-1122 passive broadband sonar signal processor, CP-1123 active sonar signal processor, CP-1124 signal-classification processor, CP-1125 post-classification signal processor, J-3107 beam interface-spectrum analyzer, CV-3010 passive beam-former, CV-3011 active beam-former, and CV-3035 passive beam-former processor. It also consists of three OJ-274 control-display consoles, one OH-275 performance-monitoring and fault isolation console, one IP-1124 analog-video display, and one UYK-7 signal processing computer.

**BQQ-5A(V)1/2/3.** The BQQ-5A(V)1 was the first upgrade of the BQQ-5, performed for Los Angeles class submarines. It features the CP-1359 broadband passive processor, CP-1362 active signal processor, CP-1365 signal-classifier processor, CV-3010A passive beam-former, CV-3011A active beam-former, and CV-3527 passive beam-former processor. It also consists of three OJ-431 control consoles, an additional UYK-7 computer, an IP-1325 analog-video display, and an IP-1417 analog-video display.

The BQQ-5A(V)2 was produced for Sturgeon class attack submarines and differs from the A(V)1 components in that it has only one IP-1325 analog-video display. The BQQ-5A(V)3 is on Permit class attack submarines and utilizes the BQS-11 sonar, CP-1360 broadband passive processor, CP-1363 active sonar signal processor, CP-1366 signal-classifier processor, CV-3521A passive beam-former, CV-3522A active

beam-former, and CV-3528 passive beam-former processor. The BQQ-5A(V)3 also consists of three OJ-432 control consoles, two UYK-7 computers, and one IP-1326 analog-video display.

**BQQ-5B(V)1/2/3.** This sonar system incorporates the steerable hull-array beam-former. It features an improved control display console – specifically, the OJ-462 for the BQQ-5B(V)1 (Los Angeles) and BQQ-5B(V)2 (Sturgeon), and the OJ-463 for the BQQ-5B(V)3 (Permit).

**BQQ-5C(V)1/2/3.** This sonar system features expanded direction low-frequency analysis and ranging (DIFAR) reception in the form of a multiple interface unit and a digital spectrum analyzer with three UYK-44 computers. The BQQ-5C(V)1 includes the CP-1556 passive broadband signal processor, CV-3770 passive beam-former, and CV-3771 passive beam-former processor, and four OJ-544 control display consoles. The BQQ-5C(V)2 differs in that it has the CP-1356 passive broadband signal processor.

**BQQ-5D.** The BQQ-5D is the block upgrade for Los Angeles class SSN-688 submarines not equipped with the BSY-1 submarine combat system. It features the TB-23 thin-line towed array, a multi-array signal beam-former, and a spectrum analyzer. Development was completed in 1988, and it then entered service. The BQQ-5D(V)1 equips the Los Angeles class (also known as 688 class), and the BQQ-5D(V)2 was on Sturgeon class submarines.

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**BQQ-5(V)/688I.** Transitioned to full-scale engineering development in FY93, the BQQ-5(V)/688I upgrade was originally referred to as the BQQ-5E(V)3. It has been backfitted to those Improved Los Angeles class attack submarines (SSN-688I class) not equipped with the BSY-1 submarine combat system (SSN-688 to SSN-750). While details are scant, it is believed that it is a variant of the BQQ-5E with the TB-29 long twin-line array. Other improvements included the integration of low-frequency active (LFA) operations, color displays for the OJ-544 control console, dual towed processing, full spectrum processing, and full spatial vernier processing for the TB-29 array. Additionally,

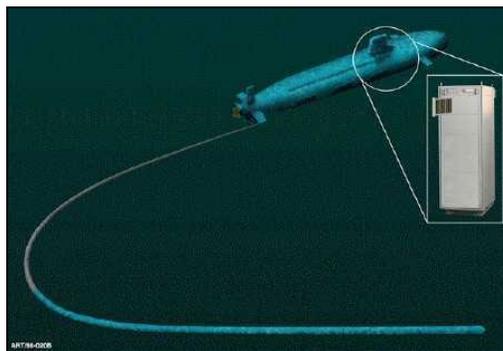
the BQQ-5(V)/688I provides low-frequency active interference rejection capability to Los Angeles class (SSN-688 and 688I) and Ohio class (SSBN-726) platforms, as well as TB-29 capability to 688I platforms.

**BQQ-5E(V)4.** The BQQ-5E(V)4, with the TB-29 (TB-12X) long twin-line towed array, is primarily intended as a passive-only version for Ohio class (SSBN-726) submarines. It provides a major improvement in long-range detection and localization, and significantly enhances defensive capabilities. The BQQ-5E(V) first went into low-rate production in FY94.



BQQ-5 Onboard Trainer and BQQ-5 Digital LF Multibeam Active/Passive Sonar for Submarines, Either Hull-Mounted or Towed

Source: Lockheed Martin



Lockheed Martin TB-29A Towed Array Used by U.S. Navy Submarines

Source: Lockheed Martin

**BQQ-5(V)****Program Review**

**Background.** The first BQQ-5 model was developed to meet the Soviet submarine threat of the 1970s, 1980s, and beyond. Following successful tests, the BQQ-5 was approved for operational service in 1974. The first units were installed aboard the last three units of the Sturgeon class and the first units of the Los Angeles class. The U.S. Navy also began retrofitting the BQQ-5 to older submarines equipped with the BQQ-2. Concerns in the late 1970s over Soviet submarines spurred the Navy to begin an upgrade program for the BQQ-5 in FY80.

The BQQ-5E(V) upgrade is in progress for the older Los Angeles class attack submarines not equipped with the BSY-1 combat system (SSN-688 to SSN-750), and for Ohio class ballistic missile submarines, where it replaces the BQQ-6 passive sonar system. The version that will equip the Ohio class is designated BQQ-5E(V)4, and is a passive design integrated with the Mk 2 Mod 3 Combat Data System as part of the improvement program.

In July 2004, Digital System Resources and General Dynamics were each awarded a \$21.5 million contract modification to continue system integration and development of enhanced capabilities for the Acoustic-Rapid Commercial off-the-shelf Insertion (A-RCI) effort, which enables the U.S. Navy to upgrade legacy submarine combat capability through annual software enhancements and periodic hardware upgrades. The initial system developed under the A-RCI was the Multipurpose Processor (MPP), which replaced the signal processor and displays of the BQQ-5 on SSN-688 and SSN-688I submarines. In February 2005, Digital System Resources (now a part of General Dynamics Advanced Information Systems) was awarded two further contracts – one an option, the other a modification for MPP work.

PE#0604503N: SSN-688 and Trident Modernization. This program element, under Project F0219 Submarine Sonar Improvement, delivers block updates to submarine sonar systems installed on SSN-688/688I and SSBN-726 class submarines. The goal is to ensure submarine stealth by maintaining acoustical, tactical, and operational superiority over the entire spectrum of submarine and surface combatant threats to a variety of missions. The BQQ-5E, with the TB-29 array, reportedly provided quantum improvements in long-range detection and localization for all platforms, and enhanced the defensive capability of the SSBN-726 class submarine.

***Towed Array Extends Life of Legacy Sonar Suite***

The TB-29 was developed and manufactured under the U.S. Navy towed systems omnibus contract awarded in FY99 to Lockheed Martin. It is used by submarine, surface ship, and surveillance towed systems. An operational evaluation (OPEVAL) of SSN-688 and SSN-688I platforms was delayed until the second quarter of FY03 to support a Milestone III Release to Fleet in the third quarter of FY03.

The TB-29A is a commercial off-the-shelf (COTS) version of the legacy TB-29 and has been backfitted on Los Angeles and Seawolf class submarines and forward-fitted on Virginia class submarines. The first phase of the TB-29A's technical evaluation (TECHEVAL) was completed in December 2001 using a Los Angeles class submarine. According to reports, the Lockheed Martin system worked very well. The second phase of TECHEVAL was completed in February 2002, again with excellent results reported. The system has since entered operational use.

In January 2009, the U.S. Navy released a Request for Information (RFI/Market Survey for the Future Generation Thin Line Towed Array) regarding an array for submarine employment that would continue to provide acoustic performance equivalent to that of the legacy TB-29A but with significantly improved reliability. In March 2010, the Navy awarded Lockheed Martin a \$14.7 million modification to previously awarded contract N00024-09-C-6238 to build five TB-29A thin-line towed arrays. This option would bring production under the contract to 10 TB-29A thin-line towed arrays, at an overall value of \$29.9 million.

The Future Generation Thin Line Towed Array (FG-TLTA) is anticipated to be the replacement for the legacy TB-29A and TB-23 thin-line towed arrays. It will serve as the primary passive sensor for the BQQ-10(V) sonar system. This capability is needed for submarine platforms, including all Los Angeles, Seawolf, Virginia, and Ohio classes.

Since the deployment of the TB-29A array to the Fleet in 2002, the technology to field an affordable thin-line array with better reliability has dramatically matured, the result of investments by the Navy and industry. The Navy is considering industry's approach in its application of these new technologies to the submarine TLTA to ensure fleet mission requirements are met over a sustained period of time. At the present time, the Navy is developing the TB-33, TB-34, and TB-37 towed arrays. The TB-33 reportedly provides more

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affordable and reliable thin-line arrays using fiber-optic technology and eliminates "wet end" electronics.

***TB-29A Request Delayed***

The U.S. Navy announced in March 2012 that it was in the process of determining if procurement of the TB-29A should be conducted as a limited or full and open competition. In May 2013, the U.S. Navy announced it was delaying release of the solicitation for procurement of the TB-29A/BQ thin-line towed array.

***U.S. Navy Increases Value of Contract for Two TB-29A Towed Arrays***

In April 2014, Ultra Electronics 3 Phoenix Inc (UE3P) of Chantilly, Virginia (an Ultra Electronics company), was awarded a \$7,263,632 modification to previously awarded contract N00024-13-C-6264 from the U.S. Navy to procure two TB-29A Inverted Passive Electrical Network (iPEN) production-representative units, associated spares, and test equipment. iPEN leverages technology developed under Small Business Innovation Research Topic N04-138, "Real-time Data Fusion and Visualization Interface for Environmental Research Data."

iPEN telemetry acts as a data fusion point for the integration of towed array handling system sensor data. This technology is expected to provide significant improvement in the reliability and operational availability of TB-29A towed arrays.

Contract work was performed in Wake Forest, North Carolina (50 percent); Houston, Texas (25 percent); Hanover, Maryland (15 percent); and Chantilly (10 percent). It was completed by August 2015.

The Naval Sea Systems Command, Washington, DC, was the contracting activity.

***UE3P to Produce Thin-Line Towed Arrays for U.S. Navy***

Ultra Electronics announced in August 2015 that its UE3P had been awarded a \$2,856,769 cost-plus-fixed-fee contract by the U.S. Navy to reduce the cost of thin-line towed arrays.

This two-year contract was issued through U.S. Department of the Navy Rapid Innovation Fund Broad Agency Announcement 13-020. Under the contract, UE3P will provide non-recurring engineering for the design, development, test, and integration of seven reduced-cost TB-29A iPEN modules to support current and future submarine thin-line towed arrays.

This contract is part of an ongoing effort by UE3P to increase the reliability and reduce the cost of thin-line towed arrays. Current thin-line towed arrays are

expensive and suffer from reliability issues. UE3P is currently under contract to incorporate its iPEN telemetry technology into existing TB-29A and TB-23 towed arrays – more specifically, this effort is developing mechanical and acoustic technologies that can be integrated into these systems.

Andy Liverman, president of UE3P, said, "The TB-29A iPEN development is a critical initiative in our overall effort to support our Navy customer in development of more reliable and less expensive systems that add significant value to the submarine force."

***ATAR Completes Development Ahead of Schedule***

In December 2015, UE3P posted that it had successfully completed development and verification testing of the Advanced Towed Array Receiver (ATAR) system earlier in the year on July 14.

ATAR system development succeeded in migrating towed array data recovery from completely custom hardware to a programmable software/firmware solution hosted within commercially available, ruggedized telecommunications equipment.

The ATAR system also minimizes or eliminates the need for hardware changes to accommodate new arrays and/or multiple configurations of existing arrays. Further, the ATAR system, reports UE3P, provides significant improvement for high-speed analog-to-digital upstream reception and digital-to-analog-based downstream command and control transmission, as well as enhanced performance monitoring and fault localization.

The ATAR system is fully integrated with the TB-29A iPEN submarine towed acoustic array to interface with the submarine sonar system.

***Ohio Class Replacement Program (Columbia Class) Working on TLTA Handling System***

On July 7, 2016, Electric Boat Corp of Groton, Connecticut, was awarded a \$24,630,413 cost-plus-fixed-fee modification to a previously awarded contract (N00024-13-C-2128) from the U.S. Navy to procure the preliminary design for the thin-line towed array handling system and provide detailed design, prototype manufacture, and qualification tests in support of the Columbia class submarine program (formerly known as the Ohio Replacement Program). Work was performed in Groton, and completed in December 2020.

Fiscal 2016 RDT&E (Navy) funding in the amount of \$8,500,000 was obligated at time of award.

The U.S. Navy's Supervisor of Shipbuilding Conversion and Repair, Groton, was the contracting activity.

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***L3Harris Chesapeake Sciences to Produce TB-29X TLTA Assembly***

On September 21, 2016, L3Harris Chesapeake Sciences Corp of Millersville, Maryland, was awarded a \$46,598,315 cost-plus-fixed-fee, firm-fixed-price, and cost-plus-incentive-fee contract from the U.S. Navy to develop and produce a first article TB-29X thin-line towed array assembly, a first article towed array receiver unit, test sets, shipping reels, technical manuals, a technical curriculum, and provisioned item orders.

The TB-29X is a TLTA passive sonar receiver installed aboard Navy submarines. The TB-29X is in the same form factor as the TB-29 array, but offers increased capability, greater reliability and reduced obsolescence.

This contract includes options that, if exercised, would bring its cumulative value to \$238,235,578.

Contract work was performed in Millersville (64 percent); Syracuse, New York (35 percent); and Norfolk, Virginia (1 percent), and was completed by May 2018.

Fiscal 2016 Other Procurement (Navy) and fiscal 2016 RDT&E (Navy) funding in the amount of \$23,842,155 was obligated at time of award. This contract was competitively procured via the Federal Business Opportunities website, with two offers received.

The Naval Sea Systems Command, Washington, DC, was the contracting activity. The contract award number was N00024-16-C-6251.

***U.S. Navy Exercises Option for Procurement of Six TB-29A Compact Towed Arrays***

In May 2017, L3Harris Computer Sciences Corp was awarded a \$13,592,178 fixed-price-incentive contract modification to a previously awarded contract (N00024-15-C-6275) from the U.S. Navy to exercise an option

for procurement of six TB-29A compact towed array production-representative units.

Work was performed in Millersville, Maryland (41 percent); Liverpool, New York (38 percent); and Ashaway, Rhode Island (21 percent), and completed by September 2018.

Fiscal 2016 Other Procurement (Navy) funding in the full contract amount of \$13,592,178 was obligated at time of award.

The U.S. Navy's Naval Sea Systems Command, Washington, DC, was the contracting activity.

***U.S. Navy Orders Two TL-29A Twin-Line Towed Arrays***

The U.S. DoD reported in August 2017 that Lockheed Martin Corp, Rotary and Mission Systems, of Liverpool, New York, had been awarded a \$29,973,243 contract (N00039-15-C-0214) from the U.S. Navy for the production of two U.S. twin-line towed array (TL-29A) systems and additional items.

The modification increased the original contract value from \$71,086,405 to \$101,059,648. Work was performed in Syracuse, New York, and completed by October 2019.

Fiscal 2017 Operations and Procurement (Navy) funding in the amount of \$17,402,634 was obligated at time of award. This contract modification was not competitively procured because it was a sole-source acquisition in accordance with the authority of 10 U.S. Code 2304(c)(1). Noncompetitive procedures were approved for this modification under Justification and Authority 17,811.

The U.S. Navy's Space and Naval Warfare Systems Command, San Diego, California, was the contracting activity.

**Funding**

	U.S. FUNDING							
	FY22 QTY	FY22 AMT	FY23 QTY	FY23 AMT	FY24 QTY	FY24 AMT	FY25 QTY	FY25 AMT
<b>RDT&amp;E (U.S. Navy)</b>								
PE#0604503N (a)								
SSN-688 and Trident Modernization	-	92.1	-	93.5	-	93.4	-	98.3

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	FY26 <u>QTY</u>	FY26 <u>AMT</u>	FY27 <u>QTY</u>	FY27 <u>AMT</u>	FY28 <u>QTY</u>	FY28 <u>AMT</u>	FY29 <u>QTY</u>	FY29 <u>AMT</u>
<b>RDT&amp;E (U.S. Navy)</b>								
PE#0604503N								
SSN-688 and Trident Modernization	-	98.5	-	98.4	-	100.0	-	N/A

N/A = Not Available

All \$ are in millions.

Source: U.S. Department of the Navy FY24 R-2 RDT&E Budget Item Justification

	FY19 <u>QTY</u>	FY19 <u>AMT</u>	FY20 <u>QTY</u>	FY20 <u>AMT</u>	FY21 <u>QTY</u>	FY21 <u>AMT</u>	FY22 <u>QTY</u>	FY22 <u>AMT</u>
<b>PROCUREMENT (U.S. Navy)</b>								
SSN Acoustic Equipment								
(Line 39)(b)	-	331.3	-	367.6	-	374.7	-	N/A

N/A = Not Available

Source: U.S. Department of the Navy FY21 Procurement Program (P-1)

(a) PE#0604503N delivers block updates to submarine sonar systems and supports the BQQ-5 modernization effort. Project 0219 Sub Sonar Improvement funding is not broken out at this time.

(b) SSN Acoustics is P-1 Line Item No. 38, which includes several acoustics system improvements (such as the BSY-1) in addition to work on the BQQ-5.

## Contracts/Orders & Options

<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
Lockheed Martin	50.8	Feb 2018 – A modification that increased the contract value from \$101,059,648 to \$151,926,787. The contract modification included the production of two twin line towed array (TL-29A) systems and one TL-29A spare array, two array refurbishments, and additional engineering services, plus material and spares for the Maritime Surveillance Systems Program Office, Program Executive Office Submarines. Work was performed in Syracuse, NY, and completed Feb 2018. Fiscal 2017 Operations and Procurement (Navy) funding in the amount of \$11,525 was obligated at time of award. This contract modification was not competitively procured because it is a sole-source acquisition in accordance with the authority of 10 U.S. Code 2304(c)(1) – there is only one responsible source (Federal Acquisition Regulation Subpart 6.302-1). Noncompetitive procedures were approved for this modification under Justification and Authority 17,811. The Space and Naval Warfare Systems Command, San Diego, CA, was the contracting activity.
L3Harris Chesapeake Sciences	27.5	Jul 2018 – A modification to previously awarded contract N00024-16-C-6251 to exercise options for the production of TB-29X thin-line towed arrays. Work was performed in Liverpool, NY (46 percent); Millersville, MD (35 percent); and Ashaway, RI (19 percent), and completed by Nov 2019. Fiscal 2018 Other Procurement (Navy) funding in the amount of \$27,571,496 was obligated at time of award and did not expire at the end of the fiscal year. The Naval Sea Systems Command, Washington, DC, was the contracting activity.

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<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
Lockheed Martin	29.3	May 2019 – A fixed-price-incentive, firm-fixed-price, and cost-plus-fixed-fee modification to previously awarded contract N00024-13-C-6292, from the U.S. Navy for the production of surface ship towed TB-37 production units, accessories, shipping products, and spare modules. Work was performed in Liverpool, NY (66 percent); Millersville, MD (33 percent); and Marion, MA (1 percent), and completed by Jun 2021. Fiscal 2019 and 2018 Other Procurement (Navy) funds in the amount of \$21,730,248 were obligated at time of award. The Naval Sea Systems Command, Washington, DC, was the contracting activity.
Lockheed Martin	24.6	Sep 2019 – A cost-plus-fixed-fee contract from the U.S. Navy to develop the first production unit of the surface ship towed TB-37X multifunction towed array (MFTA). This contract includes cost-plus-fixed-fee, cost-plus-incentive-fee, fixed-price-incentive, and firm-fixed-price options, which, if exercised, would bring its cumulative value to \$297,015,157. Work will be performed in Liverpool, NY (53 percent); Millersville, MD (44 percent); Marion, MA (1 percent); Cleveland, OH (1 percent); and Albuquerque, NM (1 percent), and is expected to be completed by Oct 2026. Fiscal 2019 Other Procurement (Navy) funding in the amount of \$24,657,488 would be obligated at time of award. The Naval Sea Systems Command, Washington, DC, is the contracting activity. (N00024-19-C-6120)

**Worldwide Distribution/Inventories**

The BQQ-5(V) is in service aboard U.S. Navy submarines.

**Forecast Rationale**

The BQQ-5(V) is a digital, low-frequency, multibeam, active/passive sonar suite. It is a legacy system that has been kept in operation through numerous upgrades such as the incorporation of the Multipurpose Processor (MPP). These upgrades are expected to continue now that the BQQ-5E(V)4 variant has been integrated into the BQQ-10 sonar suite (itself upgraded with A-RCI sonar).

The BQQ-10 is destined to fully take over the role currently performed by several older stand-alone systems. It is also the primary sonar system for the Virginia class submarine – SSN – and the future Columbia class –SSBN – ballistic missile submarine.

The U.S. Navy has been working on replacing the TB-29A towed array component with the TB-33 fiber-optic thin-line towed array, which will serve as the primary passive sensor for the BQQ-10; however, the U.S. Navy is still actively developing enhancements and upgrades for the venerable TB-29A.

Production of the full BQQ-5(V) suite has ended. No replacement units are expected to be produced. Instead, any spare parts are likely to be cannibalized from retiring Los Angeles class and Ohio class submarines. Therefore, the production chart has been omitted.

This report will be archived next year.