Combat Control System (CCS) Mk 2 (AN/BYG-1(V))

Status: In Production
System Type: Naval C4I System (Submarine)

Program Briefing

The AN/BYG-1(V) Combat Control System (CCS) Mk 2 is a submarine weapons and tactical control system, originally developed as a three-phase US Navy program for transforming several legacy submarine combat systems (AN/BSY-1, CCS Mk 1, CCS Mk 2 D(0), and DWS-118) to a common, more capable and flexible COTS/Open System Architecture (OSA) system.

The first new CCS Mk 2 Block 1C was installed on a *Los Angeles* class sub, but now CCS Mk 2/BYG-1 is common to all submarine classes in the US Navy, including new *Virginia*s, with well over 75 systems in service. Essentially, all US Navy subs now share only two major C4I/sonar systems – Raytheon's CCS Mk 2/BYG-1 and Lockheed Martin's Acoustic-Rapid COTS Insertion (A-RCI) sonar system.

In September 2002, Australia decided to acquire six CCS Mk 2-based systems for its *Collins* class subs, under a $220 million project. The production contract was awarded to Raytheon in July 2003, with these systems first receiving the AN/BYG-1 designation.

Major CCS Mk 2/BYG-1 production and support continue.

Executive

US Navy
Naval Sea Systems Command (NAVSEA)
2531 Jefferson Davis Highway
Washington, DC 20362-5101
tel: (703) 602-1556

Manufacturers

Prime

General Dynamics
Advanced Information Systems (GD AIS)
12350 Fair Lakes Circle
Fairfax, VA 22033
(was Digital System Resources)
(Tactical Control System [TCS])
(GD AIS originally earned about 15% of CCS Mk 2 funding)
($28.1M, 12/02; $34.7M, 11/03; $14.1M, 1/05; $10.2M, 2/06)
(20% of work in 2017)
(50% of work in 2017 is small businesses)

Raytheon Systems Co.
Portsmouth Operation
1847 West Main Rd.
P.O. Box 360
Portsmouth, RI 02871
tel: (401) 847-8000
fax: (401) 847-2364

(Original prime; weapon control system)

Subcontractors

- Anteon: COTS hardware ($4M, 05; $2M, FY05)
- DDL Omni: COTS hardware and software (05)
- EG&G: Installations
- General Dynamics AIS, Pittsfield, MA: Tech Insertion (TI) & APB Software integration (FY15-17+)
- Lockheed Martin (LM-MSS), Manassas, VA: Tech Insertion (TI) & APB Software integration (FY15-17+)
- MITRE: COTS hardware ($1.5M, 05; $0.5M, FY05 [continuing])
- Progeny, Manassas, VA: Information Assurance (FY15-17+)
- Systems Engineering Associates (SEACORP), Middletown, RI: Technical support services ($15.2M, 6/02)
- Thales: CCS Mk 2 hardware and software for Australia ($16.2M, 10/03)

Functional Description

Configuration

The Combat Control System (CCS) Mk 2 (AN/BYG-1(V)) is a submarine-based fire control system that provides fire control data for Mk 48 ADCAP torpedoes, Tomahawk and Harpoon missiles, and countermeasures. The CCS Mk 2 was originally a successor to the CCS Mk 1 and Mk 118 fire control systems aboard *Los Angeles* (SSN-688) and *Ohio* (SSBN-726) class submarines. Today's CCS Mk 2 is a much broader COTS/OSA weapon control and tactical control system replacement for several combat systems.

PE# 0604562N develops COTS based software and hardware upgrades to integrate improved weapons and tactical control capabilities for multiple submarine classes (SSN-688, -688I, SSGN, *Seawolf*, and *Virginia*).

PE# 0604562N also accommodates the annual integration of Advanced Processing Builds (APBs) software to both tactical control (APB(T)) and weapon control (APB(W)) subsystems. The tactical control integration effort incorporates the integration of other sensor (ESM, sonar, radar, etc.) inputs to provide a common operation picture and improve situational awareness in an information assurance (IA) compliant environment. The weapon control development effort provides improvements to the weapons control subsystem based on improvements to missiles and torpedos. AN/BYG-1 allows the submarine Navy to rapidly update the ship safety tactical picture, integrates the common tactical picture into the battle group, improves torpedo interfaces, and provides tactical Tomahawk (Tomahawk Block IV) capability.

PE# 0604562N funding was provided in FY05 to explore the feasibility of an alternative concept to the current process for submarine maintenance, training and logistics infrastructure for the AN/BYG-1 system. A submarine maintenance free operating period would minimize the need for maintenance support products, maintenance training/trainers and maintenance and logistics infrastructures by developing a highly available submarine combat system. At-sea maintenance would be by keyboard action only and Original Equipment Manufacturers (OEM) would provide pier-side maintenance and supply support. This would allow operators to focus on system employment versus system maintenance, while harnessing commercial processes and infrastructure for maintenance training and supply support.

Platforms

The CCS Mk 2 is carried aboard *Los Angeles* (SSN-688) and *Virginia* (SSN-774) class fast attack submarines, *Ohio* (SSBN-726) class Trident ballistic missile submarines, and the *Seawolf* (SSN-21) class. The Australian *Collins* class will also mount a CCS Mk 2-based system.

Variants/Related Systems

There were four versions of the original CCS Mk 2:

Mod 0—For Los Angeles class submarines without vertical launch tubes (SSN-688 through SSN-718). This CCS Mk 2 version replaces the CCS Mk 1 system in these subs.

Mod 1—For *Los Angeles* class submarines with vertical launch tubes but no AN/BSY-1 (SSN-719 through SSN-725, and SSN-750). This also replaces the CCS Mk 1.

Mod 2—For Los Angeles class submarines with vertical launch tubes and the AN/BSY-1 (SSN-751 through SSN-779). Mod 2 lacks an attack console, having instead a weapons launch console.

Mod 3—For Ohio class ballistic missile submarines (SSBN-726 through SSBN-743). This variant controls only torpedoes and countermeasures, and replaces the Mk 118 Fire Control System. It lacks the AN/UYK-44 processor, because it does not handle Tomahawk or Harpoon missiles. It has four Mk 130 consoles and one Mk 92 Mod 1 attack-control console. The CCS Mk 2 Mod 3 is associated with the AN/BQQ-5E(V)4 sonar system.

AN/BSY-1(V) SUBACS—This is the designation for the Submarine Advanced Combat System, derived from the original SUBACS Basic system. It was in service on later SSN-688 Los Angeles class nuclear attack submarines (SSN-751 on).

Contract Briefs

The following is a listing of contract announcements that have been made by the Pentagon involving the award of, or modification to, unclassified prime contracts with a base value of $5 million or more since the beginning of FY88 (10/1/87).

Date	Contract Number	Agency	Obligation	Details
Digital Systems Resources				
12/13/2002	N00024-03-C-6206	NAVSEA	$28,135,728	CPI/AF contract for development of the Tactical Control System (TCS) under the CCS Mk2 Combat Control program.

General Dynamics, Advanced Information Systems

1/4/2005	N00024-03-C-6206	NAVSEA	$14,051,775	CPIF/CPAF modification to previously awarded contract for engineering and procurement of integrated electronic equipment cabinets in support of the weapons control system under the CCS Mk2 combat control program.
2/16/2006	N00024-03-C-6206	NAVSEA	$10,168,700	CPIF/CPAF modification under previously awarded contract for continuation of engineering services work in the development of the next generation of Combat Control System Mk2, Weapons Control subsystem development.

Raytheon, Electronic Systems

11/22/2006	N00024-03-C-6207	NAVSEA	$5,507,984	CPFF modification under a previously awarded contract to exercise an option for additional engineering services and incidental material/travel/subsistence in support of the AN/BYG-1 Combat Control System.
2/5/2007	N00024-03-C-6207	NAVSEA	$9,587,820	CPFF modification under a previously awarded contract for an additional 72,306 hours of engineering services in support of the AN/BYG-1 Combat Control System.

Funding History

RDT&E ($ Millions)	FY09	FY10*	FY11**	FY12	FY13*	FY14**	FY15	FY16*	FY17**	FY18**
PE# 0604562N Submarine Tactical Warfare System	64.5	67.0	50.5	47.3	49.1	49.1	37.8	52.7	43.2	49.6

Procurement ($ Millions)	FY09	FY10*	FY11**	FY12	FY13*	FY14	FY15	FY16*	FY17**	FY18**
Navy Other Procurement (OPN) BA 4: Ordnance Support Equipment										
SSN Combat Control Systems	104.7	113.2	88.0	89.2	71.3	73.1	60.8	96.0	130.7	124.2

**Appropriation*
***Request*
NOTE: PE# 0604562N RDT&E funding is predominantly for the CCS Mk 2/BYG-1
NOTE: SSN Combat Control Systems primarily funds the CCS Mk 2/BYG-1

Costs

Contract awards have indicated CCS Mk 2 unit cost for *Virginia* class submarines is only about $6 million, but overall funding is much higher than this.

Program Overview

History

CCS Mk 2 Development

Development of the CCS Mk 2 began during the mid-1980s, when the Navy wanted a new fire control system for the Los Angeles class submarines, which would be capable of providing faster target data and have better displays. Raytheon won the CCS Mk 2 development contract in September 1988.

CCS Mk 2 Program D(0) Block 1: BSY-1 Integration (Los Angeles class)

CCS Mk 2 Program D(0) Block 1 integrates CCS Mk 2 into the AN/BSY-1, replaces additional obsolete equipment, updates the World Vector Shoreline database and incorporates a direct GPS interface, incorporates the Navy Tactical Command System-Afloat (NTCS-A), and implements Tomahawk Block 3 Phase III (Tomahawk Strike Planning System) and ADCAP torpedo improvements. It also interfaces with the Joint Maritime Command Information System (JMCIS).

CCS Mk 2 Program D(0) Block 1C: *Virginia* class

In August 1996, NAVSEA issued Raytheon a $41.5 million maximum price cost-plus-incentive-fee (CPIF)

contract with a not-to-exceed (NTE) target cost-plus-target fee (CPTF) for development of the Block 1C upgrade to the Mk2 CCS. The work is to be conducted in Portsmouth, RI (95%) and Waltham, MA (5%), and completed in April 1999.

Phase I (CCS Mk 2 Block 1C) in FY00 introduced automated strike engagement planning capability (ATWCS) and *Virginia* class data distribution and services.

Phase II (Block 1C ECP 4) in FY02 introduced advanced weapons improvements and processing with the installation of the *Virginia* class equivalent COTS processors, replaces AN/UYK-43 computers and supports Tactical Tomahawk missile and weapon control system (TTCWS), the ADCAP CBASS torpedo, and improved mining (ISLMM) capabilities.

Phase III (Block 1C ECP 5) in FY07 will install *Virginia* class weapons-launch improvements and provides an at-sea end-to-end launcher testing capability.

BSY-2 Integration (*Seawolf* class)

AN/BSY-2 upgrade work from early this decade includes A-RCI(V)5 development for *Seawolf* and plans to integrate a CCS Mk 2 variant into BSY-2.

$220 Million *Collins* Contract

In September 2002, Australia decided to acquire six CCS Mk 2-based systems for its *Collins* class subs, under a $220 million project. Raytheon beat out the Anglo-German STN Atlas (a joint venture of Rheinmetall and BAE Systems) ISUS 90 combat system.

Competitions for Taiwan and Other Subs

In December 2002, the US Navy announced it will limit the competition to supply 8 diesel attack submarines for Taiwan to: General Dynamics and Northrop Grumman (builders) and Lockheed Martin and Raytheon (systems integrators). A formal NAVSEA RFP was expected in 2QFY03, with selection by the Navy originally planned for late 2003. Construction of the first sub could begin in 2006, with the lead sub to be delivered in 2010. Raytheon will probably offer a combat system based on the CCS Mk 2, with Lockheed Martin offering its COTS open architecture SUBICS (Submarine Integrated Combat System).

Lockheed Martin has already offered SUBICS (based on the Acoustic-Rapid COTS Insertion [A-RCI] program for the US Navy), and Raytheon has offered CCS Mk 2, to Spain for a new-build submarine program planned for 2003.

There are also possibilities in Egypt for new-build subs, and in India, Brazil, and Colombia for mid-life upgrades.

Potential $370 Million CCS Mk 2 Contracts: TCS and WCS

In December 2002, after receiving four bid proposals, NAVSEA issued Digital System Resources (Fairfax, VA) a $28.1 million cost-plus-incentive/Cost-plus-award-fee (CPIF/CPAF) contract to fund the development of a Tactical Control System (TCS) under the CCS Mk 2 program. The TCS is a segregated portion of the CCS Mk 2 baseline program that includes ECP 004, to be installed on al submarine classes. The award contains (four one-year) options, which if exercised, would bring the cumulative value of the contract to more than $169 million. POC is Ms. Veronica S. Brimmer (mervs@navsea.navy.mil).

At the same time, NAVSEA awarded Raytheon (Portsmouth, RI) a $20.2 million CPIF/CPAF, award after receiving two offers, to finance development of the Weapons Control System (WCS) under the CCS Mk 2 program. The WCS is also a segregated portion of the CCS Mk 2 baseline program that includes ECP 004, to be installed on al submarine classes. The award also contained (four one-year) options, which if exercised, would bring the cumulative value to more than $205 million.

The Digital System Resources contract stated that work would be conducted in Middleton, MD (20%); McLean, VA (5%); Waterford, CT (4%); Fairfax, VA (54%); and in Pittsfield, MA (17%), Raytheon would do its work in Portsmouth, RI (68%); Fairfax, VA (11%); Middletown, RI (7%); Fort Worth, TX (4%); San Diego, CA (3%); Roswell, GA (3%); Tiverton, RI (2%); Manassas, VA (1%); and Beverly Hills, CA (1%). Both actions would be completed in December 2003. Contract funding for both will be allocated from the Navy Surface Combatant Combat System (PE# 0604307N) (N00024-03-C-6206/N00024-03-C -6207).

Collins Production for Raytheon

In July 2003, NAVSEA awarded Raytheon Integrated Defense Systems a $32.4 million CPIF/CPAF add-on to exercise an option to provide systems engineering and technical services, and the production of five CCS Mk 2 1C ECP004 (now designated AN/BYG-1) Mod 6 variants that are to be installed on Royal Australian *Collins* class submarine platforms. The work is to be performed in Portsmouth, RI, and is to be completed by April 2006. Contract financing will come from the Foreign Military Sales (FMS) account (N00024-03-C-6207).

CCS Mk 2 Loses in Spain

In July 2005, Spain chose Lockheed Martin Maritime Systems & Sensors (MS2), Manassas, VA, to help build the combat system for its planned S-80A diesel electric submarines. Lockheed will help develop a system based on its SUBICS (Submarine Integrated Combat System) and A-RCI, to include open architecture sonar, command and control, and weapons control systems. Losing bidders included Raytheon (based on its CCS Mk 2, with Atlas Elektronik or Thales sonars), Thales (Paris, France), Kongsberg Gruppen (Kongsberg, Norway), and Atlas Elektronik (Bremen, Germany

[owned by BAE Systems]). Atlas was the recent favorite, with its widely proven ISUS 90 diesel electric sub combat system. The combat system program could be worth more than $300 million, for the initial four subs, to enter service from 2011.

SWFTS

In March 2006, NAVSEA awarded Lockheed Martin Integrated Systems, Bethesda, MD, a $17.4 million cost-plus-fixed-fee CPFF) contract to finance systems engineering and integration in support of Combat SWFTS (System Warfare Federated Tactical Systems), the system that is composed of all submarine combat system subsystems, mainly consultation, command, control, communications, computers, and intelligence (C5I). The contract was competitively awarded via advertisements on the Navy Electronic Commerce On-line website, with two proposals solicited and received. The effort provides for the overall architecture integration of the subsystems to achieve a single combat system for naval battlegroup interconnectivity. The work is to be conducted in Manassas, VA (44%); Middletown, RI (12%); San Antonio, TX (8%); Groton, CT (7%); Woodbridge, VA (7%); Newport, RI (7%); Riverdale, MD (5%); Canton, IL (3%); Greensboro, NC (3%); Bethesda, MD (2%); North Waterford, CT (3%); and Mystic, CT (1%), and is to be completed by December 2006. Contract funding will be allocated from the Navy O&M account (N00024-06-C-6272).

USN Submarine Plans

The *USS Virginia* (SSN-774) has already been commissioned. The USS *Texas* (SSN-775) completed intitial sea trials in May 2006, and is to be delivered to the Navy in June. Six additional subs were under construction in May 2006, with a total of nine under contract. The USS *Hawaii* (SSN-776) is to be delivered in 2007, the USS *North Carolina* (SSN-777) in 2008, with the USS *New Hampshire* (SSN-778) and USS *New Mexico* (SSN-779) to follow.

The Navy plans to begin buying two *Virginia*-class (SSN-774) submarines per year in 2012 – if per ship costs are reduced from $2.4 billion to $2 billion – but will also begin decommissioning *Los Angeles*-class attack submarines (SSN-668) at a rate of four per year beginning in 2013. In any case, two *Virginia*s per year will not actually be built until after our forecast period. Not until 2021 will half the sub force will be made up of the *Virginia*-class.

There have been continuing calls to up *Virginia* production to two per year, especially if costs can be reduced, but with the Navy already planning more more ships than they can afford (even if DD(X)is cancelled again), we will wait before we alter our production forecast.

CCS Contracts

In January 2007, NAVSEA issued Lockheed Martin, Maritime Systems and Sensors, Manassas, VA, a $5.2 million CPAF modification to exercise an option for engineering services and material, travel, and subsistence, in support of the Combat Control System (CCS) Structurally Integrated Enclosure CC 3-Bay program. The work is to be conducted in Manassas, VA, and is to be completed by December 2007. Contract financing will come from Navy O&M accounts (N00024-06-C-6243).

In February 2007, NAVSEA issued Raytheon a $9.6 million CPFF modification to exercise an option for an additional 72,306 hours of engineering services in support of the BYG-1. The work is being performed in Portsmouth, RI, and is to be completed by December 2007. Contract financing will come from Navy O&M (N00024-03-C-6207).

Submarine C4I Contracts

In November 2006, the Space and Naval Warfare Command's Systems Center (SPAWAR SYSCEN), San Diego, CA, reported the release of contracts to three competing companies to fund support services for its Submarine Communication Information and Command, Control Communications, Computers and Intelligence (C4I) Systems Div. The firms receiving indefinite-delivery/indefinite-quantity (ID/IQ) contracts were the Aviation and Marine services Div. of L-3 Communications' Titan Corp. in Marlton, NJ; Science Applications International's Technology Services Group in San Diego, CA; and SERCO in Vienna, VA.

SPAWAR SYSCEN-San Diego issued ID/IQ contracts with cost-plus-fixed-fee (CPFF pricing of $38.7 million to Titan Corp; $34.9 million to Science Applications International; and $33.3 million to SERCO, to support Submarine C4I Systems Div. with technical support services for submarine and satellite communication, information technology (IT), and other C4I efforts. Each of the contracts awarded is to run for a three-year period, and have two one-year options. This would increase the cumulative contract value by varying amounts, depending upon the contract recipient.

The work is to be conducted in primarily in San Diego, CA, with small amounts at the contractor's base location (in the case of Titan and SERCO). Contract funding will come from Navy O&M as task orders are competed for and won by one of the three companies. The awards are the result of a SPAWAR SYSCEN solicitation published on the Federal Business Opportunity website (N66001-06-R-0018). There were only three respondees to the solicitation (N66001-07-D-0014—Titan Corp; N66001-07-D-0015—Science applications; N66001-07-D-0013—SERCO).

Advanced ASW Technologies Solicitation

In October 2007, NAVSEA announced that its Advanced Development Office for Undersea Warfare (formerly Advanced Systems and Technology Office or ASTO) within the Program Executive Office for Integrated Warfare Systems (PEO IWS), Washington Navy Yard, Washington, DC, is soliciting engi-

neering services for advanced software and hardware technology improvements for ASW projects.

The Navy's primary objective is to acquire engineering services to support development of advanced ASW technologies that can rapidly transition to fleet introduction via acquisition programs, and that significantly improve ASW capability while reducing Total Ownership Costs. Some current projects under development are discussed within these paragraphs to provide examples of the kind of technology services being sought. These discussions are not intended to limit the scope of future technologies and services that are obtained under this solicitation. SOL is N00024-08-R-5200, POC is Maya Edmondson, tel: (202) 781-1948; email: maya.edmondson@navy.mil.

Lockheed Martin Combat System for Brazil

In January 2008, NAVSEA issued Lockheed Martin a $35.3 million FFP contract to fund the adaptation, testing, and logistics effort for the modernization of the Brazilian Navy's *Tupi* Class submarine's Integrated Combat System (ICS). The work is to cover the adapting, procuring, integrating, testing, and conducting factory acceptance of the ICS modernization effort, including sonar systems and flank arrays. The work is to be conducted in Manassas, VA (60%); Syracuse, NY (19%); Salt Lake City, UT (15%); Oldsmar, FL (4%); and Baltimore, MD (2%), and is to be completed by June 2011. Contract funding is coming from FMS (N00024-08-C-6271).

BYG-1 Support RFPs

In July 2008, NAVSEA, Washington Navy Yard, DC, issued a synopsis under a full and open competitive procurement for engineering technical services and support of submarine tactical control system (TCS) (N00024-R-6295) and the weapons control system (WCS) (N00024-08-R-6294) of the BYG-1 combat system. Comments must be sent to the PCO, Mr. Peter Richmond at e-mail: Peter.Richmond@navy.mil, tel: (202) 781-3920. Two separate draft RFPs are provided to encourage industry participation in the BYG-1 Tactical Control System (TCS) and Weapons Control Systems (WCS) development, production, engineering and technical services for SSN-688, SSN-688I, SSN-21, SSGN, SSBN, *Virginia*, *Collins* and Future Class submarines including other foreign navies.

These competitive procurements are to provide engineering technical services including materials and support for the development and implementation of Technical Insertions and Advanced Processing Build (APB) integration for the TCS/WCS under the BYG-1. NAVSEA intends to release the formal/final solicitation in late July or early August 2008. The Government intends to award separate Cost Plus Incentive Fee (CPIF) contracts, each with one (1) base year, four (4) option years, and five (5) possible award term periods for the development, systems engineering, system integration, production, installation, logistics and support for the TCS and WCS. SOL is N00024-08-R-6294, POC is Eneida I Breaux, tel: (202) 781-1341, or Peter E Richmond, tel: (202) 781-3920.

Biennial TI and APB Upgrades

BYG-1 hardware upgrades (Technology Insertions [TIs]) are developed on a biennial basis to provide improved capability and address COTS obsolescence. Funding also accommodates the biennial integration of software Advanced Processing Builds (APBs) for both tactical control (APB T) and weapon control (APB W) subsystems.

The tactical control integration effort incorporates the integration of other sensor (ESM, sonar, radar, etc.) inputs to provide a common operation picture and improved situational awareness in an information assurance (IA) compliant environment.

The weapon control development effort provides improvements to the weapons control subsystem based on improvements to missiles and torpedoes. The BYG-1 allows the submarine Navy to rapidly update the ship safety tactical picture, integrates the common tactical picture into the battlegroup, improves torpedo interfaces, and provides Tactical TOMAHAWK (TOMAHAWK Block IV) capability.

In February 2010, BYG-1 Advanced Processing Builds (APBs) are planned for Release-To-Fleet in 3QFY09, 3QFY11, 3QFY13, and 3QFY15.

BYG-1 APG/TI Upgrade Contracts

In July 2009, NAVSEA awarded General Dynamics a $10.2 million CPIF contract to fund engineering services in support of the BYG-1, funding 117,000 engineering service hours, to migrate the BYG-1 WCS from technology insertion baseline TI-08 to a TI-09, integrate advanced processing build APB-09, and deliver this capability in multiple variants to multiple submarine platforms. The work is to be conducted in numerous locations, with Fairfax, VA (53.6%); Cape Canaveral, FL (17.6%); and Roswell, GA (12.5%), primary in terms of funding. The work is to be completed in July 2010. Contract funding from Navy O&M and RDT&E (PE# 06045621N) (N00024-09-C-6246).

In August 2009, NAVSEA issued General Dynamics a $21.3 million CPIF contract for 228,000 man-hours of BYG-1 engineering services, to migrate from baseline TI-08 to T-10, and integrate APB-09. The work is to be conducted in Fairfax, VA (58.6%); Middleton, RI (26%); Fairfax Station, VA (4%); San Diego, CA (3.4%); Hampton, VA (2.2%); McLean, VA (1.8%); Shoreview, MN (1.3%); Brigham City, UT (1%); Manassas, VA (1%); Greensboro, NC (0.5%); Arlington, VA (0.1%); and Beaverton, OR (0.1%), and is to be completed by July 2010. Contract funding is expected to come from PE# 0604503N (N00024-09-C-6250).

SSBN/SSGN Fire Control Procurement

In November 2011, The Navy Strategic Systems Programs Office (SSPO), Washington, DC, awarded General Dynamics' Advanced Information Systems, Pittsfield, MA, a $96 million CPIF, CPFF, FPI contract to purchase fire control systems for SSBN and SSGN submarines, specifically FY12 and FY13 funding for the US and United Kingdom (UK) Trident II Strategic Weapons Systems SSBN Fire Control Subsystem, SSGN Attack Weapons Control Subsystem, and US SSBN replacement and UK SSBN successor common missile compartment engineering support. The work will be conducted in Pittsfield, MA, and is to be completed September 2012. The contract contains options, which if exercised, would bring the contract value to $$225 million (completed in April 2016). Contract funding will come from Navy Weapons Procurement (WPN) and Foreign Military Sales (FMS) offices (N00030-12-C-0006).

SSBN-726 Refurbs

Since FY06, SSBN-726 class submarines have been modernized with CCS MK2 BLOCK 1C systems removed from SSN-688 class submarines.

SSN-688 Upgrades

In Aril 2013, funding was planned for two SSN-688 class non-VLS to be modernized in FY17 with TI-14 Tech Insert Kits procured in FY15. Non-VLS platforms are not being upgraded with configurations higher than TI-14.

Continuing BYG-1 Contract Mods

In July 2015, the Navy awarded General Dynamics Advanced Information Systems (AIS), Fairfax, VA, a $32.7 million modification to previously awarded contract (N00024-09-C-6250) for BYG-1 Tactical Control Systems (TCS) Technology Insertion (TI-14) Advanced Processing Build (APB-15) software for delivery to multiple submarine platforms.

Also in July 2015, the Navy awarded General Dynamics a $20 million contract modification to continue modernizing the BYG-1 Weapons Control System (WCS) TI and APB software for US Navy and Royal Australian Navy submarines.

SSBN-726 to be Modernized to TI/APB

In February 2015, the FY16 budget announced Navy plans to modernize SSBN-726 class submarines from the CCS Mk2 Block 1C system to the TI/APB model.

Current Developments

Virginia Block III

In February 2016, the Navy planned the first of the Block III *Virginia* class submarines to be entering service in FY16. Procurement funding provided for sustainment of the Common Weapon Launcher (CWL) for Block III, as well as obsolescence management for the Weapon Launcher Console Integrated Enclosure (WLCIE) on *Virginia* Blocks I and II.

Continuing BYG-1 Upgrades

In February 2016, Navy procurement funding in SSN Combat Control Systems, Proj. #VB011 Combat Systems Technology Refresh/Legacy Integration will procure tactical control hardware upgrades to SSN-688, SSN-688I, SSBN, SSN-21, and SSGN class submarines for legacy combat control systems. These updates provide accelerated delivery of tactical capability to the fleet and bridge the gap between legacy combat control systems and AN/BYG-1. It will procure Engineering Changes (EC) and Ordnance Alterations (ORDALT) to correct fleet reported problems with legacy Combat Control System software and hardware. It will procure Weapons Launch System, Multi-tube Weapon Systems (MTWS) and provide support for fleet introduction of the Common Weapon Launcher (CWL) transition and integration into the TI/APB process. It will provide system engineering in support of Tactical Local Area Network (TacLAN); Information Assurance (IA); Onboard Team Trainer (OBTT); and Command, Control, Computer and Intelligence Maintenance Tool (C3IMT).

Proj. #VB034 Submarine Combat Control System Modernization Program will procure hardware and software upgrades for the BYG-1 system for installation on all submarine platforms. The BYG-1 is the combat control system common across all submarine platforms which incorporates tactical control, weapon control, and Tactical Local Area Network (TacLAN) functions into a single procurement program. The BYG-1 allows the submarine Navy to rapidly update the ship safety tactical picture, integrates the common tactical picture into the battlegroup, improves torpedo interfaces and provides tactical Tomahawk capability.

BYG-1 systems will be continuously updated with hardware enhancements to address COTS obsolescence and capability improvements as defined by the Advanced Processor Build (APB) process. These updates are referred to as Tech Insertion (TI) kits and are differentiated by year of development (i.e., TI10, TI12, etc.). The TI upgrades provide the baseline for all future AN/BYG-1 procurements. In addition, this budget also provides tech insertion "kits" to update existing BYG-1 platforms. The BYG-1 nomenclature was adopted in FY05 to incorporate the addition of the *Virginia* Class Combat Control System to a common acquisition and development strategy. This allows for the BYG-1 to be the common combat control system nomenclature across all submarine platforms. Funds are for the installation of Combat Control System equipment included in the Fleet Modernization Program.

Teal Group Evaluation

The AN/BYG-1(V) Combat Control System (CCS) Mk 2 is a submarine weapons and tactical control system, now installed on all submarine classes in the US Navy, including the new Virginias, with more than 75 systems in service. Essentially, all US Navy subs now share only two major C4I/sonar systems – Raytheon's CCS Mk 2/BYG-1 and Lockheed Martin's Acoustic-Rapid COTS Insertion (A-RCI) sonar system.

CCS Mk 2 has thus become a hugely important and well-funded program, worth far more than unit cost alone would indicate. Continuing biennial upgrades are planned, now that US subs finally have a truly COTS combat system. In the 1980s and 90s, billions of dollars were spent on intricate but stove-piped combat systems for individual classes. The AN/BSY-1 (*Los Angeles* class) and AN/BSY-2 (*Seawolf*) were each marvels of technology at the time, but also suffered long delays and cost overages in development. The Navy now finally (beginning only a few years later) has a genuinely common system, which should lead to major savings in the future.

The CCS Mk 2's chances for international sales were also good, but will suffer from stiff competition. In September 2002, Australia decided to acquire six CCS Mk 2-based combat systems for its *Collins* class subs, under a $220 million project. At the time, CCS Mk 2 was not yet proven, and there were major problems (the Australian system was originally quite different, and only after it basically didn't work did the US Navy allow Raytheon to provide a system much more similar to the CCS Mk 2). This bad beginning affected the CCS Mk 2's reputation, even though the diesel electric *Collins* subs have already "sunk" US subs in exercises.

CCS Mk 2 was bid for Spain's diesel electric S-80A program, but lost to Lockheed Martin, which developed a system based on its A-RCI. Brazil also chose Lockheed Martin's sub combat system in January 2008.

But even without additional foreign sales, CCS Mk 2/BYG-1 will remain a major US Navy program for decades, with substantial funding continuing. In 2017, General Dynamics AIS stated more than 50% of CCS/BYG-1 upgrade work was being conducted by small businesses.

Funding Forecast

RDT&E (FY17$ Millions)	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26
All RDT&E										
CCS Mk 2/BYG-1	48.0	50.0	62.0	66.0	68.0	70.0	72.0	70.0	74.0	76.0
Procurement (FY17$ Millions)	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26
All Production and Upgrade & Support										
CCS Mk 2/BYG-1	170.0	170.0	190.0	250.0	300.0	180.0	140.0	160.0	220.0	240.0

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