ARCHIVED REPORT

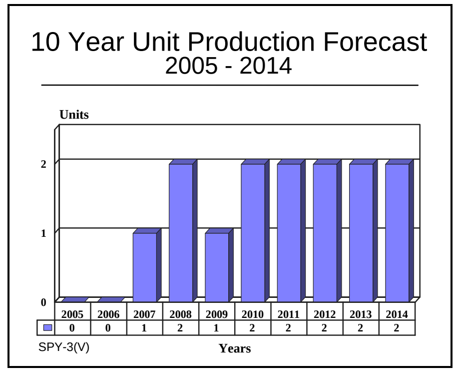
For data and forecasts on current programs please visit

www.forecastinternational.com or call +1 203.426.0800

Volume Search Radar (VSR) – Archived 5/2006

Outlook

- Next-generation horizon search radar
- Combined into SPY-3(V) Dual Band Radar
- Will cue SPY-3(V)
- Applications without SPY-3(V) possible in the future



Orientation

Description. A new Fleet Volume Search Radar (VSR) is planned for non-AEGIS ships to replace the SPS-48(V) and SPS-49(V). It will perform long-range search as well as cueing for the Multi-Function Radar (MFR).

Sponsor

United States Navy
Naval Sea Systems Command (NAVSEA)
1333 Isaac Hull Avenue SE
Washington Navy Yard, DC 20376
USA
Tel: +1 (202) 781-0000
Web site: http://www.navsea.navy.mil

Status. Concept papers requested, industry briefing held.

Total Produced. Initial prototypes only to date.

Application. DD(X), CVN77/78, CVN-21 next-generation aircraft carrier and surface combatants developing from the DD(X) program. A retrofit to LPD-17 and LHA-1 amphibious ships may be considered.

Price Range. The Navy cost goal had been set at $10 million per system.

Contractors

Raytheon - Integrated Defense Systems, http://www.raytheon.com, 50 Apple Hill Dr, Tewksbury, MA 01876 United States, Tel: 1 (978) 858-5246, Fax: 1 (978) 858-9414, Prime

Technical Data

	Metric	U.S.
Dimensions		
To be determined		
Characteristics (planned)		
Coverage	360 deg in azimuth 70 deg in elevation	
Range	463 km	250 nm
MTBF	5,000 hr	

Design Features. The VSR will operate in a littoral environment contaminated by clutter and hostile signals. The initial radar coverage requirement is 360 degrees in azimuth, 70 degrees in elevation, to 120,000 feet in height, and with an instrumented range of 250 nautical miles.

Guidelines for radar supportability were a mean time between failures (MTBF) goal of 5,000 hours, with full built-in test capability down to the line-replaceable unit (LRU) level. It would have to be Battle Force Tactical Training (BFTT) system-compatible and supported by minimal manning.

Ruggedized commercial off-the-shelf (COTS) equipment will be used whenever possible, and documentation and logistics will have to meet a tailored military standard. Flexibility is key, and the largest anticipated antenna size and weight were requested from respondents so that the effect on ship construction could be determined. A modular construction will be considered to accommodate a changing COTS environment.

Operational Characteristics. The VSR is planned to replace the SPS-48(V) and SPS-49(V) series search radars, and was to be installed as part of the SPY-3(V) Dual-Band Radar on DD(X)s, the CVN-77 (as a retrofit), CVN-78, and some other surface ships, as well as the CVN-21 next-generation aircraft carriers.

One of the new radar's missions will be to track threats such as aircraft, missiles, unmanned air vehicles, and helicopters with rapid hand-off to engagement systems. Other missions would include situational awareness, air traffic control, Identification Friend or Foe (IFF), and fire finding. These mission goals were considered desirable, if not a cost driver.

Variants/Upgrades

None to date. Adaptation for different ships can be expected.

Program Review

Background. The SPS-48(V) and SPS-49(V) surveillance radars have been in service with the Fleet since the 1970s. Although they are capable sensors and have seen ongoing upgrades and enhancements, they are aging. The U.S. Navy mission is changing from blue water, deep-sea operations to missions in the littoral environment, and the aging radars do not have the up-to-date technology needed to adapt effectively to the new needs of the surface Fleet. Instead of continuing to upgrade the old workhorses, the Navy will develop a new radar to meet the new need.

In a May 1997 *Commerce Business Daily*, the Navy issued a Sources Sought announcement seeking concept papers for a new Volume Surveillance Radar (VSR) from companies qualified to design, construct, and test the radar. The concept papers were to be submitted within 80 days to the Naval Sea Systems Command. This release followed an April 1997 industry briefing at the Naval Research Laboratory.

<u>Raytheon Selected for Multi-Function Radar EMD</u>. On June 2, 1999, the Naval Sea Systems Command awarded Raytheon Systems Company, Massachusetts, a $140.4 million cost-plus-award-fee agreement for the development and construction of one Multi-Function Radar (MFR) engineering and manufacturing development (EMD) prototype, and associated supplies and services. The development effort was to be completed by April 2004. The MFR would be more than a cruise-missile defense radar – it would provide multifunction surveillance to meet the performance requirements in all related mission areas.

The VSR was planned to complement the MFR by providing situational awareness, air control, track identification, counter-battery locating data, and cue quality track data for ship self-defense. Both the MFR and VSR radar will result in lower life-cycle costs, manpower reductions, and reductions in topside signature. Together, the combined radars will be called the SPY-3(V).

On July 30, 2003, the Navy announced a decision to use S-band rather than L-band technology for the VSR planned for the DD(X). The higher-frequency radar will improve the ability of the destroyer to track aircraft and missiles, and to counterattack shore-based gun or missile batteries that attempt to strike the ship.

"The shift to S-band technology is a very carefully considered, logical decision which seeks to ensure every investment dollar is leveraged to achieve near term and long term goals," said Assistant Secretary of the Navy, Research Development and Acquisition John Young. "The decision effectively creates a radar roadmap for the Navy that draws on extensive, successful experience with S-band on AEGIS, provides enhanced capability for DD(X) as well as a future growth path, and supports the advancement of radar technology necessary for the CG(X) cruiser. Our industry partners, Northrop Grumman, Lockheed Martin, and Raytheon, have been exceptional in working cooperatively to allow this decision to be made, demonstrating their understanding of the benefits to the fleet and the priority they place on supporting the Navy and Marine Corps."

DD(X) will be designed to perform in multiple warfare areas, and its original missions are unchanged. First and foremost, DD(X) will support joint and allied troops ashore by performing precision strike and fire support. The ship will also be able to fight other ships and submarines, and can defend against airborne threats.

DD(X) is not to perform ballistic missile defense. Its S-Band radar will not have the power output required to fulfill that mission. However, the radar does have the potential to be scaled up in size for possible use on the next-generation cruiser, CG(X), which will have significant ballistic missile defense capability.

The shift to S-Band technology is not expected to impact the major milestones for the next-generation destroyer program. The Navy still expects to award the lead-ship construction contract in FY05 to support delivery of that ship in FY11.

The change to S-band will be effected through a contract modification to the existing DD(X) contract with Northrop Grumman Ship Systems. Raytheon and Lockheed Martin are sub-contractors under the contract.

PE#0604300N, Project 2735, Volume Search Radar (VSR). This project provides funds for the development of the S-Band Volume Search Radar (VSR) in association with DD(X). It provides DD(X) and other applicable surface ships with an affordable, high-performance air search radar. This system is based on solid-state active array radar technology, and will provide search, detect, and tracking while dramatically reducing manning and life-cycle costs associated with multiple systems that perform these functions today. VSR provides long-range above-the-horizon surveillance and timely cueing to MFR. A Test Article will be available in FY06 to support Developmental Test/ Operational Assessment (DT/OA) land-based and at-sea testing.

From FY03 through FY05, designers completed Phase II development efforts. In Phase III, the DD(X) Design Agent will finalize an S-Band VSR design, procure Engineering Development Model (EDM) hardware and begin fabrication of a sensor. They will begin test and evaluation planning. In FY06, developers will deliver the EDM to Wallops Island, Virginia, to conduct VSR Factory Qualification Testing and prepare for Land Based Testing in FY05.

Funding for these efforts is programmed at $36.057 million in FY03, $66.501 million in FY04, and $51.527 million in FY05. The remaining programmed funding will be used for test and program support.

Acquisition Strategy. Downselect to a DD(X) Design Agent occurred 3QFY02. The DD(X) Design Agent initiated fabrication delivery of the VSR EDM in FY04. MFR/VSR Radar Suite DT/OA was planned for FY03 through FY05.

Funding

U.S. FUNDING

	FY03		FY04		FY05(Req)		FY06(Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E (USN)								
PE#0604300N DD(X) Systems Engineering								
2735 VSR	-	47.7	1	72.2	-	57.7	-	0.002
PE#0603513N								
Ship Sys Component Dev		247.5	-	36.7	-	19.0	-	33.3
Procurement (USN)								
BLI211900/SCN	-	0.0	-	0.0	-	0.0	-	99.4

	FY07(Req)		FY08(Req)		FY09(Req)		FY10(Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E (USN)								
PE#0603513N								
Ship Sys Comp Dev	-	23.1	-	21.8	-	21.8	-	TBD
Procurement (USN)								
BLI211900/SCN	-	3,594.0	-	3,320.5	-	4,695.7	-	TBD

All $ are in millions.

Recent Contracts

No contracts have been awarded.

Timetable

Month	Year	Major Development
Apr	1997	VSR briefing to industry
May	1997	Sources Sought announcement
4Q	FY99	PDR both DD-21 teams
1Q	FY01	CDR both DD-21 teams
	2002	DD-21 program restructured
3Q	FY02	DD(X) Design Agent Selection
	FY04	Begin EDM fabrication
3Q	FY04	PDR
1Q	FY05	CDR
4Q	FY06	EDM delivery to land-based test site
1Q-4Q	FY07	Factory qualification/land-based testing
1Q-2Q	FY08	At-sea testing

Worldwide Distribution

This is a **United States** only program in the earliest stages of concept development.

Forecast Rationale

Although the SPS-48(V) and SPS-49(V) radars perform well for their age and design, naval operations have changed. Sea battles will no longer be fought in the open ocean because conflict is moving to the coastal regions, the littoral environment. This places new demands on sensors and systems.

Clutter, crowding, low-flying hyper-fast missiles, and an increasingly demanding data processing and situational awareness system made it necessary to re-examine the underlying basis for a surface ship's sensor suite. Instead of modifying existing radars for the task, designers started from scratch and created a new sensor to meet the needs of the 21st century Navy. Front-line combatants will rely on AEGIS for combat operations. Non-AEGIS ships should be able to get along with something different, less expensive and less complex than the SPY-1(V) radars.

By developing a new sensor system, the Navy capitalizes on a variety of developments. Designers are moving away from large rotating antennas to phased and active arrays. New components are more stable and sensitive than those of a decade ago, significantly increasing the ability of new radars to perform detection and discrimination tasks not even thought of when the SPS-48(V) and SPS-49(V) were designed. Outputs are better adapted to advanced data processing.

The overall procurement climate is changing as well. Planners state their performance requirements and let designers find ways to meet them within a cost target. The use of commercial off-the-shelf equipment is another step toward ensuring affordability and performance. With some ruggedization, many highly capable commercial components perform quite well for military applications.

MFR and VSR will be the technological baseline for future ships. The Navy developed a Radar Roadmap in 1999 that did not include AEGIS. The adoption of the MFR and VSR designs has the added benefit of reducing the total number of radar types maintained in the Fleet.

The decision to switch from L-band to S-band for the VSR should result in better performance. It also takes advantage of the availability and capability of S-band active array components.

There is a move toward making ships more stealthy, making changes in the sensor antennas an absolute necessity. One of the newest and most innovative approaches that could impact future naval radars is the use of a composite sensor mast.

The topsides of warships today are a tangle of electronics antennas. Communications, counter-measures, counter-countermeasures, data links, SATCOM, fire control radar, search radar, and navigation radar all need space topside. There is a move toward designing ships to be more stealthy, making changes in the sensor antennas an absolute necessity. Now, decreasing a ship's radar electronic signature is a major consideration in the overall design, and one of the newest approaches is the use of a composite sensor mast embedded in a low-observable deckhouse.

Over the years, antenna growth has tended to be somewhat random. New developments needed antennas and a place for them. Communications, countermeasures, counter-countermeasures, datalinks, SATCOM, fire control radar, search radar, and navigation radar all need space topside. Weight, interference, and pattern optimization were significant and often conflicting considerations. An aircraft carrier can have as many as 114 antennas above the flight deck, fully a quarter of which involve surveillance and radar uses.

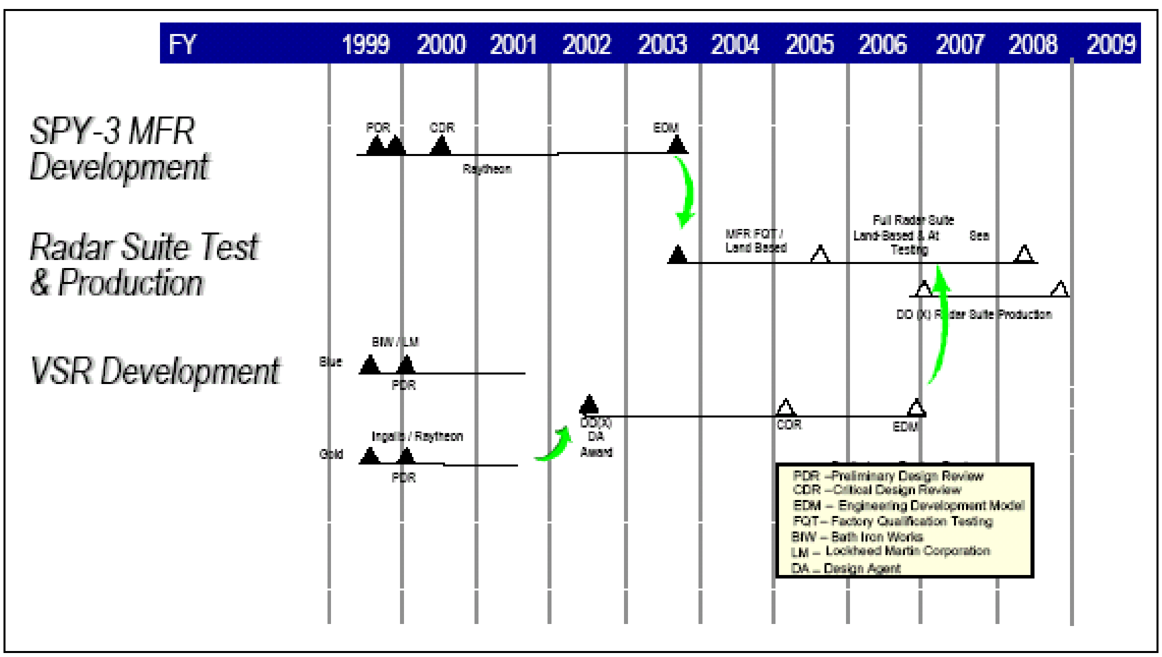
Designers are taking this problem on headfirst. An active array radar is computer intense, and some of the features the Navy is seeking were unavailable just a few years ago. An active array antenna is a must, so the power of the controlling computers will have to be massive. This creates headaches for engineers trying to accommodate the aperture to any stealth requirements for the ship. Data processing will be a challenge, with powerful software driving a system that must effectively and efficiently accommodate competing and sometimes mutually exclusive functions.

CVN-77 is going to have legacy radars installed initially, but is being designed to accept the SPY-3(V) as soon as it becomes available. The follow-on ship will carry the Dual Band radar Suite from the beginning, as will the next generation CVN-21.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

			High Confidence Level			Good Confidence Level			Speculative			
Designation	**Application**	**Thru 04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**Total 05-14**
SPY-3 (MFR)	CV(X) (USN)	0	0	0	0	0	0	0	1	0	0	0	1
SPY-3 (MFR)	CVN-77/78 (USN)	0	0	0	0	1	0	1	0	0	0	0	2
SPY-3 (MFR)	DD(X) (USN)	1	0	0	1	1	1	1	1	2	2	2	11
Total Production		1	0	0	1	2	1	2	2	2	2	2	14



U.S. Navy MFR/VSR Schedule

Source: U.S. Navy