



AN/SPQ-9B Radar



The AN/SPQ-9 Surface Surveillance and Tracking Radar, developed by Northrop Grumman Norden Systems, Melville, NY, is a track-while-scan radar used with the MK-86 Gunfire Control system on surface combatants. The AN/SPQ-9B detects sea skimming missiles at the horizon even in heavy clutter while simultaneously providing detection and tracking of surface targets and beacon responses. The AN/SPQ-9B is available as a stand-alone radar or as a replacement for the AN/SPQ-9 in the Mk 86 Gun Fire Control System, which will be integrated into the Mk 1 Ship Self Defense System (SSDS). The Radar Set AN/SPQ-9B is a high resolution, X-band narrow beam radar that provides both air and surface tracking information to standard plan position indicator (PPI) consoles. The AN/SPQ-9B scans the air and surface space near the horizon over 360 degrees in azimuth at 30 Revolutions Per Minute (RPM). Real-time signal and data processing permit detection, acquisition and simultaneous tracking of multiple targets. The AN/SPQ-9B provides raw and clear plot (processed)

surface video, processed radar air synthetic video, gate video, beacon video synchro signals indicating antenna relative azimuth, Azimuth Reference Pulses (ARP), and Azimuth Change Pulse (ACP). The radar will maintain its capabilities in the presence of clutter from the sea, rain, land, discrete objects, birds, chaff and jamming. In the Radiate state the AN/SPQ-9B has three modes of operation: the Air mode, Surface mode and Beacon mode. Both Air and Surface modes have a submode for Organic Combat System Operator/Team Training. The AN/SPQ-9B serves as a complement to high-altitude surveillance radars to detect missiles approaching just above the sea surface. The system emits a one-degree beam that, at a range of approximately 10 nautical miles, is capable of detecting missiles at altitudes up to 500 feet. Since the beamwidth expands over distance, the maximum altitude will increase at greater ranges.



- The Air Mode uses the Pulse-Doppler radar for detecting air targets. When the AN/SPQ-9B radar detects an air target and initiates a track, it will determine the position, speed, and heading of the detected target. The Air mode has a sector function called, the Anti-Ship Missile Defense (ASMD), and a look back waveform. In the Radiate state, the Air mode is enabled continuously.
- The Surface Mode generates a separate surface frequency and an independent pulse with a Pulse Repetition Interval (PRI) commensurate with a range of 40,000 yds, not including radar dead time. The AN/SPQ-9B radar has a 360-degree scan coverage for surface targets. The radar displays raw and clear plot video. The AN/SPQ-9B Radar Surface mode has a submode called Surface-Moving Target Indicator (MTI), and operates concurrently with the Air mode. While in the radiate state, the Surface Mode is enabled continuously.
- The Beacon Mode generates a separate beacon frequency and an independent pulse with a PRI commensurate with a range of 40,000 yds, not including radar dead time. The AN/SPQ-9B radar has a 360-degree scan coverage for beacon targets. The received beacon video is sent to the console for display and distribution. Beacon track data is sent to the computer for processing. The AN/SPQ-9B Radar Beacon mode operates concurrently with the Air mode and Surface mode.

- *The ASMD Sector Function allows quick response detection of low-flying high-threat targets by the Air mode. The radar automatically detects, tracks, and reports any targets entering the ASMD sector that meet the conditions for targets with a time-to-go of less than 30 seconds. The ASMD azimuth sector width is operator selectable between 5 and 360 degrees. The ASMD range within that sector is operator selectable from the minimum range of the radar to a maximum of 20 nmi. The AN/SPQ-9B Radar ASMD sector function operates concurrently with the Air mode, Surface mode, and Beacon mode.*
- *The Surface-MTI Submode allows for the cancellation of non-moving targets by the Surface mode. The Surface-MTI azimuth sector width is operator selectable between 5 and 360 degrees. The AN/SPQ-9B automatically displays any targets with a radial speed exceeding 10 Kn. The AN/SPQ-9B Radar Surface-MTI submode will operate concurrently with the Air mode, Surface mode and Beacon mode.*
- *The Organic Combat System Operator/Team Training Submode provides for external scenario control by organic training systems for both static and dynamic targets in clutter in either the Radiate or Test state.*

The program includes a variety of upgrades for search radar equipment to meet the evolving threat, and will provide anti-ship missile defense capability for surface combatants. The upgraded SPQ-9B - which uses a high-resolution, track-while-scan, X-band, pulse-Doppler radar - will enable detection and establishing firm track ranges on subsonic and supersonic sea-skimming missiles. In 1991, the Naval Research Laboratory Radar Division, supported by the Program Executive Office, Theater Air Defense, developed the AN/SPQ-9B radar concept for the Navy's anti-ship missile defense mission. The system concept includes a new air mode that provides a new, low-cost, quality sea-skimmer detection capability and a surface mode with improved performance in support of the MK 86 Gun Fire Control System and backup navigation. The radar's receiver and processor use high-performance Commercial-Off-The-Shelf (COTS) technology. The AN/SPQ-9B antenna provides for three beams. If an air target is detected in the main beam, two look-back beams provide confirmation and track promotion resulting in "single-scan" track disclosure to a ship's weapon system. An ultra-low noise exciter provides for accurate tone and clock signals.

The AN/SPQ-9B is at the end of its development phase. An Advanced Development Model (ADM) radar was developed by the Naval Research Laboratory and successfully demonstrated in land-based tests in 1993-94 against threat representative targets and again in at-sea tests in 1994-95. The design, fabrication, and testing of the Advanced Demonstration Model of the SPQ-9B by the Naval Research Laboratory have eliminated all serious technical risk. Initial performance testing of the ADM was completed at Wallops Island prior to a successful operational assessment conducted by the Self-Defense Test Ship during 1995. As a result of successful testing, the Navy awarded a contract to Northrop Grumman Norden Systems for two AN/SPQ-9B pre-production kits with an option for six low-rate initial production units. A preliminary design review was accomplished FY 1996. Development for Mk 86 and SSDS interfaces is in progress. First Production Proof Kits (PPK) were delivered in late 1997, with a Milestone III decision and Initial Operational Capability (IOC) planned for FY 1999. The Research and Development (R&D) units are in the midst of First Article Test (FAT). The radars were delivered in the summer of 1998 at NSWC Port Hueneme Division where they underwent land-based testing. Land-based development testing on pre-production kit number was successfully completed in December 1998. Shipboard testing of the R&D units began in the first quarter of FY99, and was scheduled for completion in late 1999.

Deployment

The AN/SPQ-9B is slated to be installed on ships and aircraft carriers in the following classes:

- *CG-47 TICONDEROGA-class cruisers*
- *LHD-1 amphibious ships*
- *LPD-17 SAN ANTONIO-class amphibious ships*
- *DD-963 SPRUANCE-class destroyers*
- *DDG-51 destroyers*
- *CVN-68 NIMITZ-class aircraft carriers*



SPQ-9B (ADM) onboard Self Defense Test Ship, Fall 1994



AN/SPQ-9B Production Below Deck Equipment

Sources and Resources

[AN/SPQ-9B Radar System Health Analysis](#) Prepared by Naval Surface Warfare Center Crane Division Code 6022.