Acceptance speech for Pioneer Award, 1995

DEVELOPMENT OF THE AWACS RADAR

Surveillance of both friendly and hostile movements is vital in wartime. A high-power radar installed in a large aircraft has the potential of providing long-range, over-the-horizon surveillance of other aircraft. This airborne surveillance system gathers the data necessary for command and control of the air battle. Early airborne radars were limited in detecting and tracking low-flying targets by the strong reflections from the ground, called ground clutter. Targets cannot be detected when the clutter signal is stronger than the reflected signal from target aircraft. Thus, aircraft can avoid detection and penetrate enemy defenses by flying at low altitudes. A new type of radar was needed to close this door by its ability to detect low-flying targets in a severe clutter environment

The surveillance requirement fostered the development of pulse Doppler radar that utilizes the Doppler shift to provide improved overland down-look capability. The 1950's development of the pulse Doppler BOMARC seeker and airborne intercept radars based on high pulse repetition rate pulse doppler showed promise in achieving the goals. The AN/APQ-81 pulse doppler track-while-scan radar developed by Westinghouse for the Navy's Eagle Missile System from 1957 to the early 60's was a forerunner of the AWACS radar. It is of interest to consider that there were three significant evolutionary efforts underway leading to the AWACS. First, the technology in the early 1960's was not yet adequate for the long-range surveillance function and had to evolve and be proved. Second, the airborne surveillance missions supported by the Tactical Air Command (TAC) and the Air Defense Command (ADC) were evolving. Finally, system development required significant research and development funds, funds that were in competition with other worthy military developments. Each of these efforts was a drama to be resolved to bring the AWACS into being.

Realizing that the required technology for a new and improved airborne surveillance system was imminent, in 1963 the Air Force combined the TAC and ADC requirements and issued a joint Specific Operational Requirement entitled "Airborne Warning and Control System (AWACS)"

After reviewing the proposals prepared by the radar industry in response to SOR 206, the Air Force Scientific Advisory Board concluded that the feasibility of AWACS radar technology had not been established. The Overland Radar

Technology (ORT) Program was initiated to demonstrate the detection of aircraft targets in a down-look mode against a background of ground clutter. The development was competitive and a flyoff was conducted in a trio of EC-121 aircraft. The conclusion of the ORT program was that both the Westinghouse (high PRF) and Hughes (medium PRF) radar techniques could provide useful in-clutter detection for AWACS.

Concept formulation studies that followed established an overall radar concept and an airframe-to-radar interface definition. One-seventh scale model aircraft, antennas, and radomes were used in this phase. The antennas were very low sidelobe as required for the AWACS. The testing revealed areas where radome characteristics needed improvement before full-scale development was begun. Valuable information on aircraft effects was also obtained.

The Air Force issued a refinement of operational concepts (ADC/TAC ROC 1-66) in the fall of 1966. The AWACS support program was established and concepts for the proposed radars were further developed. Concurrently, the Air Force funded a full scale contract definition phase for the program. The support program contributed to this phase. Boeing, in competition with Douglas, was selected in mid-1970 as the prime contractor.

A flyoff of the competing Brassboard radars was conducted in 1972. The flyoff was to aid in the radar source selection and prove unequivocally that operationally useful overland capability had been achieved.

Design, Development, Test and Evaluation (DDT&E) and production proposals were required. The electronic art at this time supported significant changes permitting solid state technology and digital signal processing. Even with these changes, the Brassboard radars were designed, fabricated, tested and installed in the flight test aircraft in less than two years. Significant advances in the radar state-of-the-art resulted from the Brassboard program.

As a result of the flyoff results and the proposals, Westinghouse was selected as the radar supplier in late 1972. The production configuration incorporated methods to reduce radar weight, power, and cooling requirements. The design emphasized high reliability and incorporated Built-In test and automatic repair features. These efforts represented design challenges. Before AWACS funding approval, the system was demonstrated in a European target-rich environment. A series of countermeasures tests was successfully completed. In this time era, the Air Force concluded that there was no longer a

bomber defense requirement. This factor led to the emphasis on using AWACS for command and control in a remote theater and in a limited war situation. Much of the concern at this time was funding rather than mission or technical credibility.

Following the radar source selection in 1972, the development and test of the DDT&E models and the production progressed. The role of AWACS in the remote theater and the limited war situation was demonstrated in the Iraq war. AWACS has also been credited with influencing diplomatic problem resolution. The fact that AWACS can fly high and long and look many miles into remote territory gave adversaries cause to compromise. The original conceptual objectives set in the 1950's seem to have been achieved. The AWACS program continues to evolve with new features and modes of operation. It should be a major influence in command and control and national diplomacy for years to come.

Bob Cowdery was actively involved in the technological development and program management of overland radar activities from the late 1950's until 1975. Bill Skillman was a radar engineer involved in key overland radar developments in the 1950's and was the AWACS chief radar engineer into the 1980's. Both Bill Skillman and Bob Cowdery are proud to be recipients of the 1995 IEEE/AESS Pioneer Award.

We recognize that there were many technological and managerial breakthroughs to make the AWACS program a success. These accomplishments were made by many people. There were a thousand heroes. Bob and Bill are proud to accept the award on behalf of the AWACS TEAM.