Bendix Radio Radars

By Chuck Greenslit

Prologue:

Great opportunities await those who pioneer in a new technology with potential for growth. Bendix Radio had that opportunity during World War II when radar was born. The design and manufacturing experience gained during that period was parlayed into a major product line which sustained the Division for many years.

Principal radar products at the Division divide into two major categories - air defense search radar and those designated for air traffic control purposes. Other radar systems were designed to meet specialized needs but, with the exception of the weather radar for commercial aircraft, their life spans were short.

Air Defense Radars

The story of radar development and manufacture at Bendix Radio involves a unique partnership between government and industry that persisted for some three decades with great benefit not only to the parties involved but also to the security of our country.

During WWII, Bendix Radio was selected by the Signal Corps Watson Labs to design and produce an X-band, gun-laying, coastal defense radar, the MPG-l. Under the leadership of Bob Davis the radar was delivered on schedule - unprecedented at the time and recognized with a government E award.

In 1948 the U.S Air Force, using Watson Labs as its technical arm, accepted a three-page proposal from Bendix to develop an L-band search radar designated FPS-3 with deliveries to start in 1950. Again, under Bob Davis, a state-of-the-art radar resulted. Technology was progressing rapidly not only in electronics but also in aircraft design. The monstrous B-29 aircraft of World War II were giving way to jets with higher speeds and smaller radar cross sections. Higher power search radars were needed and again the Air Force turned to Bendix.

During development of the FPS-3, Watson Labs with all personnel was transferred to the Air Force base at Rome, New York to form the Rome Air Development Center (RADC). Based on a newly developed Litton klystron and the experience of Bob Davis, a new high powered radar, the FPS-20, was conceived. This was developed, first as a GPA-27 kit to upgrade the FPS-3 and later manufactured as the FPS-20, FPS-20a, FPS-66-67, and FPS-100.

In the 1950s the Air Force developed a national computer-based command and control air defense system designated SAGE (Semi-Automatic Ground Environment). Key to the 24 SAGE direction centers was the FPS-20 radar to be supported by smaller S-band gap filler radars. Planning and contracting for the latter had lagged, and Bendix proposed a unique solution to keep SAGE on schedule. A previously developed Bendix airport surveillance radar, ASR-3, would be modified to operate in an unattended mode with a new antenna meeting gap filler coverage requirements and capable of handling the higher power of a new gap filler. Designated FPS-14, the conversion was accomplished at a cost of around $70,000 and production was immediately initiated. Simultaneously, Bendix designed the new klystron powered version designated the FPS-18. Again, a partnership seasoned with years of trust and respect paid off in terms of timely capability.

In addition to the SAGE system, a Distant Early Warning (DEW) line had been constructed across the northern reaches of Canada. An Air Force decision to extend that line across Greenland resulted in a contract with Bendix to design and produce six special UHF radars for that application. Despite the challenges of a hostile environment, those radar sets performed admirably for many years.

Life of the SAGE system was limited as the threat from aircraft was superseded by the ballistic missile and the need to detect small objects in space. Again RADC turned to Bendix Radio to develop phased array radar and, following several developmental programs, the FPS-85 space-track radar evolved as chronicled in a paper by Jim Dalmas. After 25 years of operation, SAGE was decommissioned and the FPS-20 radars turned over to the FAA where they served many more years providing en-route surveillance for our Air Traffic control system.

Rapid deployment of the FPS-20 throughout the world overwhelmed Air Force capabilities for maintenance and support. At their request, Bendix Radio created a field service department to support the radar. This department eventually grew into a subsidiary corporation of Bendix and played a major role in the space program. Over time, other countries came into possession of the FPS-20 and its derivatives either through purchase or transfer of ownership from the U.S. Northern Electric of Canada also produced the radar under license so it became a worldwide standard for search radar. In the 1970s, Radio (Communications) Division launched an effort to sell additional systems or upgrades on the international market. This resulted in the sale of an FPS-100 and an associated height finder to Argentina and upgrades for systems in Thailand, India, and Chile. Bendix Field Engineering also supplied a number of kits to the FAA to adapt the radar to the air traffic control environment. With a waning corporate interest in the radar business, either domestic or foreign, the radar product line was eliminated at the Division.

Air Traffic Control Radars

During WWII, Bendix Radio was selected to produce Gilfillan-designed MPN-1 Ground Control Approach (GCA) radars. Thus was born an interest and capability in air traffic control radar systems. In the post WWII era, Bendix designed and produced a portable S-band search radar, the CPN-18. This was followed in 1950 by two radar contracts with the FAA. The ASR-3 was an S-band airport surveillance set, the first of which was installed at the new Friendship Airport in Baltimore. The second contract with the FAA was for a GCA radar designated PAR-2.

Ground controlled approach for landing aircraft had worked well in WWII where primitive or strange landing strips were common and landings necessary under poor visibility with few if any landing aids available in the cockpit. The post WWII FAA concept was to use the GCA approach at all airports and the PAR-2 was to start that implementation. Commercial airlines and civilian pilots, however, fiercely opposed a mandatory GCA and prevailed in their opposition which orphaned the PAR-2. The FAA's response was to delay acceptance of the manufactured PAR-2 equipment on one pretext or another. Fifteen years elapsed before the last PAR-2 was delivered and no doubt scrapped. Fatigued, exasperated, and financially wounded by the PAR-2 fiasco, Bendix management declared an embargo on doing business with the FAA which essentially ended that sector as a business opportunity.

Despite the civilian rejection of GCA, it remained a viable tool for the military. Bendix received a contract from the Navy in the 1950s to develop the MPN-5 which incorporated both an airport surveillance capability as well as the GCA function. The mobile equipment involved

several trailers for equipment and support. The density and complex nature of the several radars undoubtedly made its operational use difficult and there was no follow-on to this product.

The final effort in radar design for air traffic control was a development for RADC. The siren call for a radar to simultaneously fill the role of en-route and airport surveillance functions was sounded and a new radar the FPN-34 was to perform those functions. As is usual with such ideas, the compromises necessary in the design preclude optimal or in some cases even satisfactory performance for either function. The idea was abandoned.

Miscellaneous Radar Developments

During the years that Bendix reigned as a premier designer and manufacturer of radar equipment, the company became involved in a number of interesting projects as summarized below:

In 1948 the Government of Sweden contracted with Bendix for a few portable search radar systems based on the Western Electric WWII TPS-1D. Some new technology brought the TPS-1D design up to date, and those radars, designated as Bendix LGR-1, served the Swedish military until the mid 1980s. Following delivery to Sweden, the free Chinese, newly established in Taiwan, bought more sets to complete that program.

In 1949 the Signal Corps commissioned the design of a Cloud Base and Top Indicator, TPQ-6, to operate at the newly opened wavelength of 0.86 cm. The government supplied the radio frequency (rf) components including a large supply of coin silver waveguide. Despite unstable performance from the rf units and no test equipment, Bendix produced three fixed-antenna and three steerable-antenna radars.

Despite the lack of follow-on production for the TPQ-6, many valuable lessons in designing radar for weather observation and in the 0.86-cm. Band were learned. This knowledge paid off in design of the RDR-1 Air Weather Radar for commercial and private aircraft. Following design and initial production follow-up in the radar design department, the project leader, George Church, and sales responsibility were transferred to the Avionics Department. The RDR series went on to become a major Bendix product.

In another spin-off from the TPQ-6 experience, the Army's Frankford Arsenal selected Bendix to design a 0.86-cm prototype artillery spotting radar (T-47). In that design the rf instability problems were solved but the prevalent vacuum tube technology did not permit shrinking the overall radar to a size that rendered it portable enough to meet operational needs.

The radar equipments heretofore described were developed by design groups organized into a major department of the Bendix Radio Division. Another department was devoted to research and development and on occasion delved into the field of radar. One such effort was dubbed the APS-50. Designed to be the ultimate in stealth and jamming resistance, it was based on the idea of infrequently emitting a gigantic pulse of energy as opposed to a continuous stream of pulses, returns from which would be integrated to achieve detection. Practical problems proved the APS-50 concept unfeasible.

Another Department 75 project was the SPN-8 landing system radar for use on aircraft carriers. A few of these radars were produced and used operationally but other landing system aids proved more desirable and the SPN-8 phased out.

Epilogue

After thirty years as a major designer and producer of radar equipment, Bendix Radio (and its succeeding organizations following the dissolution of the Bendix Corporation) no longer played a role in that business. Looking at how Bendix got started and subsequently exited, the one factor that stands out is customer relations and confidence. Product quality or technical obsolescence was certainly not an issue since Bendix left the business on the heels of a very successful state-of-the-art radar, the FPS-85. The life blood of the Bendix radar saga was a relationship formed in WWII and continued until time and customer reorganization cut that bond.