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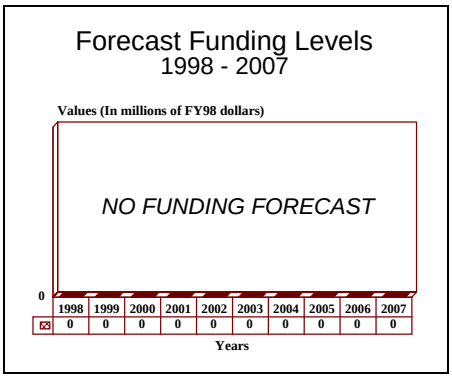
North Warning System - Archived 3/99

Outlook

- All FPS-117 and FPS-124 radars installed
- Limited maintenance and technical support only
- Funding has essentially ceased for this program
- BARRING ADDITIONAL FUNDING, THIS REPORT WILL BE DROPPED IN MARCH 1999



Orientation

Description. The North Warning System (NWS) is a combination of FPS-117 long-range and FPS-124 short-range unattended gapfiller radars that serve as part of the overall North American (United States and Canada) early warning defense system.

Sponsor

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(FPS-124 Components)

Status. Completed delivery and installation of the last FPS-117 and FPS-124 radar's. Ongoing maintenance and support continues at a greatly reduced budget.

Total Produced. A total of 17 FPS-117s have been produced, delivered, and installed (13 to the existing DEW Line, and an additional four along Newfoundland and Nova Scotia coastal sites). The 40 FPS-124s (39 for the NWS and one for training/spares) have all been produced and delivered. No further production related to NWS is expected.

Application. NWS replaces the DEW Line radars that were originally deployed in the late 1950s, with subsequent improvement in performance, closing of coverage gaps and reduced operations and maintenance costs.

Price Range. The FPS-117 radars average around US$7.5 million (in FY94 US dollars), although costs do vary with quantity, options and other contract variables. One estimate has even gone as high as US$17.9 million for the one installed at Sparrevohn AFS in Alaska (SEEK IGLOO facility), which may reflect associated costs. Using strict contract cost averaging, the sale of 5 FPS-117 sets to Romania in 1995 for US$82 million yielded a unit price of US$16.4 million. The FPS-124 unit is estimated at US$9.0 million (in FY94 US dollars).

Technical Data

Design Features

FPS-117. The FPS-117 is a solid state, D-band (one GHz), 3-D system designed to provide accurate long-range aircraft identification and position data for purposes of air defense, navigational assistance and tactical control for both counter-air operations and close air support. The FPS-117 is also available in an L-band variant.

Clutter rejection processing is used to automatically adapt to and reject land, sea, and weather clutter. MTI processing to enhance low beam coverage is used to increase adaptability in siting the radar. Sidelobe nulling is used to eliminate ground clutter for high beam positions. The antenna is a rotating planar array (24 ft x 24 ft) supporting 44 receivers and transmitters which are located directly behind the radiating elements, thus obviating the need for high-power rotary joints and waveguides. Full radar volume is covered through the transmission of electronically steered planar array. An IFF antenna is also included.

Range is 200 nautical miles, with an accuracy of 0.23 nautical miles. Altitude ceiling is 100,000 feet. Frequency range is 1,215-1,400 MHz and agility is 20 frequencies (quasi-random selection beam-to-beam).

The FPS-117 tolerates component failure and continues operating effectively. Maintenance down time is rated at less than five hours/year for corrective maintenance, and less than one day/year for scheduled maintenance. Mean time between failure for each power module is over 300,000 hours with automated maintenance being computer controlled, using built-in fault isolation to replace the unit module. The system MTBF is 1,076 hours.

FPS-124. The 2-D, electronic scan, D-band short- range (70 miles) radars are being added to the long-range FPS-117s to be deployed by the Air Force, fill the intervals in coverage, and supply increased tracking accuracy of such airborne targets as bombers or cruise missiles. The FPS-124 is able to spot smaller targets than the FPS-117 up to an altitude of 15,000 feet.

The Paramax radars supply two-dimensional coverage using 12-foot-tall reconfigurable cylindrical array antennas with electronic scanning for receiving and transmitting radar signals. Because these radars are to be unattended, Paramax has developed a modular design (only 11 moving parts, and all cooling fans for the electronics) with very reliable, functionally redundant components replaceable on-site by maintenance personnel. This results in substantially reduced costs for both operation and maintenance of the system.

The radome-housed antennas are a unique circular design, made up of 12-foot strip-line elements and an automatic switching system that provides 360^0 scanning with a fixed antenna. The strip-line elements are made up of a series of dipole elements sandwiched between a dielectric and sealed off with only the radiating end of the dipole exposed. The units are arrayed in a 5-foot diameter

cylinder, with the electronics for controlling the electronically agile beam located in the center.

The FPS-124s are remotely operated via satellite, with the capability to switch on backup systems if primary systems break down.

Power. All of the radar sites are powered by diesel generators (three at each site) which have been designed specifically for operation in the harsh environment of northern Canada. Only one of the generators operates at a time. Two years' worth of fuel is stored at a time in double-walled steel tanks, with refueling in most cases to be handled by barge during the short arctic summer.

Variants/Upgrades

The FPS-117 has a variant that uses the L-band as opposed to the D-band for search functions. NWS itself is an upgrade to the obsolete Distant Early Warning (DEW) Line.

Program Review

Background. Initially deployed in 1957, the DEW Line was constructed as a response to the growing threat of a Soviet nuclear first strike via long-range bombers flying in low over the polar ice cap. The DEW Line, consisting of FPS-19 and FPS-30 radars, extended from Alaska to Greenland. The warning line provided the National Command Authorities with time for decision making and survival actions, permitted the launch of strategic, retaliatory and command and control aircraft for survival, and alerted air defense fighters to intercept attacking aircraft.

However, as the threat scenario shifted from primarily long-range, land-based bombers to include sea- and land-based cruise missiles, the parameters and responsibilities of the DEW Line began to change. As time passed and technology overtook the capabilities of the vintage system, it became apparent that the new-generation Backfire bombers and the introduction of Soviet cruise missiles had gained the capability to penetrate our northern defenses.

Even the latest version of the DEW Line could be underflown by Soviet-made bombers and cruise missiles due to the numerous gaps that exist at low altitudes and because of marginal radar performance. Because of its age, the DEW Line system became increasingly difficult and costly to operate and maintain.

The objective of the DEW Line modernization, known as the North Warning System, was to eliminate low-altitude coverage gaps and improve radar performance while reducing operational and maintenance costs. The combination and deployment of long-range, minimally attended and short-range, unattended gapfiller radars enable NWS to detect modern aircraft and cruise missile threats of the former Soviet Union.

Operating costs in the Arctic started to be cut by some US$40 million per year with only 8-10 persons needed at each of the manned sites, versus the 700 men needed by DEW's 31 stations. The FPS-117s became operational at the end of 1988, with the decision for transitioning to full production of the FPS-124 being scheduled by the end of 1989, which represented a year's delay from the original schedule due to problems with developing the FPS-124. However, the full-production contract actually was not awarded until October 1990.

Total cost for NWS, including construction, communications and maintenance has been estimated to be US$1.3 billion (in FY94 US dollars), of which the Canadian Government is contributing about US$504 million and the US Government about US$733 million.

Canadian Role. A Canadian/US air defense pact signed in March 1985 provided for a 1989 Canadian takeover of NWS. Also part of the agreement was Canadian participation in the refurbishment of the DEW Line into NWS. Canada's contribution consisted of construction work and communications facilities. Canada was responsible for building 52 new DEW Line stations to replace the then-31 operational sites, although most of the FPS-117s were built atop towers that were part of the original DEW Line.

Fresh data from the radar stations are transmitted to North American Air Defense (NORAD) headquarters at Cheyenne Mountain, Colorado, where, traditionally, a Canadian officer is the Deputy Commander.

Communications Segment. The consortium of Microtel Ltd of Burnaby, British Columbia, and CANAC Ltd of Toronto won the US$193.4-million contract to build the communications segment of the North Warning System (NWS). This part of the system connected all 53 radar stations in the NWS with each other; with central control at CFB North Bay, Ontario (co-located at Canada East and West Regional Operations Control Centers of the North American Aerospace Defense Command); and with the USAF's Barter Island Air Force Station by means of Anik satellites. It is now possible for CF-18 interceptor aircraft

to operate from Forward Operating Locations, which are upgraded airfields in the Canadian North.

The basis of the CANAC/Microtel system is the Spacetel earth station antenna terminal that was developed for BC Telephone for use in remote and undeserved areas. In addition to the ground stations at each NWS site (two satellite dishes), the CANAC/Microtel group provides on-site controllers, slow-scan television equipment, radio beacons and signal-processing equipment. A minimum of 80 percent of the work was carried out by Canadian subcontractors.

FPS-117 Long-Range Minimally Attended Radars. Under the Air Force designation SEEK IGLOO, the Alaskan Air Command had its surveillance and air space control capability enhanced through the replacement of the obsolete system deployed since the 1950s (with a 10-year design life). The FPS-117 was the result of the developmental program.

Requirements were for a minimally attended three-dimensional radar, using current technology, to replace the existing separate surveillance and height finder radars. The new radar was to have integral height finding capability and improved performance in the presence of clutter, and be maintained by significantly fewer personnel than are required in existing systems.

The long-range (FPS-117) radars have been installed in sectors. The Alaskan and Canadian West sectors were installed first, in 1987, followed by the Canadian East sectors (two in Labrador and one on Baffin Island) in 1988. An additional FPS-117 was installed in 1990, at Barter Island in Alaska, although this may have been part of the SEEK IGLOO program.

Another FPS-117 is located at the Sacramento Air Logistics Center in California (McClellan AFB) for logistics support applications. These minimally attended radars are expected to save some US$40 million a year in operating costs while at the same time enhancing radar coverage and the ability to detect low cross-section cruise missiles. The FPS-117s are upgraded versions that feature improved small target detection/tracking capability.

The FPS-117s have performed very well, in fact exceeding the specified MTBF rate of 1,076 hours by 20 percent in Alaska. The three FPS-117s initially installed proved their worth in detecting incursions by then-Soviet Bear long-range reconnaissance bombers (just prior to the collapse of the old Soviet Union), although the data were being fed into the old DEW Line computer system.

FPS-124 Short-Range Unattended Radars. In August 1984, the US Air Force's Electronic Systems Division awarded Sperry Corp (now part of Unisys then Loral and now Lockheed-Martin) a US$79.7 million contract to design, develop and install new short-range radars for the NWS. The 42-month program (known as Phase 2) included the development of three prototype radar stations, and the development and planning of a communications network and a logistics support network required to operate the NWS.

The technical challenge of designing the radar for reliable, unattended operation in the cold and stormy vastness of the North country presented a significant challenge to the design engineers. For example, sites are visited only several times a year. Also, diagnostic and maintenance data are remotely monitored. This means that the data provided have to be extremely reliable since trips bringing spare and replacement parts is long and arduous. An incorrect diagnosis would result in a wasted trip.

Besides the prototype radar development, the contract dictated both the development of a communications system to couple the radars to three existing Regional Operational Control Centers and the development of logistics station support plans. (The three regional control centers are linked to NORAD Command.)

Of the original three prototype radars, one engineering version was installed at the Paramax facility at Great Neck, and two were installed in the North, one at Barter Island, Alaska, and the other at North Bay, Canada. Initial operational testing and evaluation focused on the determination of the effectiveness of the design in detecting low-flying cruise missiles in cluttered environments peculiar to the area, which includes large flocks of migratory birds and ice breakup.

Teledyne Ryan Aeronautical AQM-34L drones, modified to simulate threat cruise missiles, were flown in the summer of 1989 against the two Northern radars, primarily to test the FPS-124's ability to distinguish potential hostile aircraft in the low-level radar clutter posed by ice flow breakup and migrating birds. Further tests followed, using Learjets and Beechcraft C-12s. Some problems were encountered in developing the FPS-124s due to the low-maintenance requirement and the hostile environment that would be faced by the radars.

A production decision was slated for December 1989, followed by a production award the next month. However, the US$328.46 million contract was actually awarded in October 1990, and includes production of 37 new radars, refurbishment of the three prototype radars, ancillary equipment, four remote radar controllers, organic depot hardware and software repair capability, and other required logistics support.

The pre-production FPS-124s were retrofitted to production configuration. USAF's Electronic Systems Division felt that with the expected 4,000-hour mean-time-between-failure only two yearly scheduled maintenance visits would be required, along with minimum

unscheduled maintenance as each unattended radar site has considerable equipment redundancy including a main generator and two backup generators.

The short-range radars process some of the data at the site in contrast to the FPS-117s, which return largely raw, unprocessed data. An interesting development concerning the SRRs was the fact that the USAF considering using airships to handle the ferrying of maintenance personnel to and from the unmanned sites. Airships were thought to come in handy because of the inhospitable and inaccessible terrain where many of the sites are located.

Unisys Corp was selected as the production contractor for the UAR and overall systems engineering starting in FY91. This contract was awarded as a follow-on to design technical competition. The Canadian NWS efforts are managed by a Canadian program office in Ottawa.

Work progressed along during FY92 with support site integration for the Canadian UAR systems, with support site integration for the Canadian and Alaskan UAR systems to commence the following year. Additionally, in October 1991, USAF's Electronic Systems Division issued a Commerce Business Daily (CBD) notice to solicit procurement of a satellite-relayed communications systems for three NWS FPS-124 radar sites.

The system would be for the unattended radar Long Haul Communications Network (LHCN) which would connect three sites in the Alaskan Arctic with the USAF Maintenance Control & Communication Center and the Regional Operations Center, both located at Elmendorf AFB, Alaska. Also, several contracts were awarded for the following areas: communications equipment for three Alaskan sites; construction of Maintenance Control Communications Center; Type 1 Factory Training (participation with industry) to support Canadian depot facility; and an Alaskan facilities construction contract for three sites.

Most NWS efforts throughout FY93 consisted of supporting the deployment, installation, and integration of 19 unattended radars (UAR), with one UAR ahead of schedule. Other work included supporting construction activities for three UAR sites in Alaska. The following years, FY94 and FY95, activity focused on continuing program support for deployment and site integration of the Canadian and Alaskan UAR sites which total 21. The UAR depot maintenance facility was also activated at this time. Trade-offs and final redesign of multiple display and human interfaces at the two MCF centers are slated to be completed by the end of FY97.

Other NWS Activity. US and Canadian officials announced in June 1993 that they were cutting back the operating costs of this Cold War radar system. Under the current plan, funding for the NWS was cut by up to 20 percent, a savings of US$150 million annually. The system was originally built in the 1950s to track incoming Soviet nuclear bombers; by 1994 it had turned into a white elephant. Costs were to be cut through staff reductions at the long-range radar sites.

The US$1.3 billion full radar network currently consists of 17 long-range radars and 39 short-range radars strung along the coasts of Alaska and Canada. Each radar site is linked to a Regional Operating Center that can be used to track aircraft, either military or civilian, which includes airliners and drug smugglers.

As stated, in recent years there has been an attempt to turn this system into some civilian use, such as catching drug smugglers. However, reports so far have indicated that this hasn't worked out as well as hoped. Apparently, those involved in the illegal drug trade fly planes too small and low to the ground to be effectively picked up on radar. The few that have been spotted have proven even more difficult to catch. By the time military jets have been scrambled to intercept, the drug plane has usually disappeared off the radar screen through one pilot tactic or another. The one or two that have met with military interceptors managed to escape because the military jets fly too fast to effectively stay with the prop-driven drug plane. By the time the jet fighter has turned around after its first pass, the drug smuggler has usually disappeared into low ground cover.

Funding

Program Element description is no longer available.

Recent Contracts

Contractor	Award ($ millions)	Date/Description
Lockheed Martin	25.0	Aug 1995 – FFP contract for up to 34 kits to improve the reliability, maintainability, and supportability of the FPS-117 ground-based radar. Contract is expected to be completed by August 1998. (F19628-95-D- 0016)

Timetable

Jul	1979	General Electric awarded a contract for two preproduction prototypes
May	1983	Full-Scale Development Request for Proposal released (Short-Range Radars – SRR)
	FY83	Site surveys in Alaska, Canada and Greenland accomplished
	FY84	Power technology assessment completed
Jan	1984	Revised RFP for SRR released
Aug	1984	Full-scale development contract awarded to Sperry for SRR station design and development
Early	1985	Contract award for FPS-117s
	FY85	Fabrication of two prototype SRRs began, SRR component and subassembly in-plant testing conducted, site surveys accomplished
Mar	1985	Negotiations concluded with Canada concerning NWS acquisition
	FY86	Prototype SRR station facility fabrication began, fabrication of two prototype short-range radars continued, communications equipment procured for long-range radar sites
	FY87	Prototype SRR facility construction completed, fabrication of first two prototype SRRs completed, prototype facility construction completed and Alaskan prototype SRR installed, three FPS-117s installed at existing DEW line sites
	FY88	Eleven LRRs installed, three prototype SRRs delivered and integrated for testing
Sep	1988	Initial Operational Capability achieved, centered on long-range radars, SRR DT&E begun
Nov	1988	Phase I completed
Dec	1988	Initial OT&E commenced
Oct	1990	Production contract for FPS-124 awarded
Jan	1991	Contract for FPS-124 antennas awarded
Oct	1991	FPS-124 contract award, initial production deliveries, installations begun
Nov	1994	Completion of FPS-124 production contract
Aug	1995	Contract for FPS-117 awarded
Aug	1998	Expected completion of FPS-117 production contract

Worldwide Distribution

The North Warning Program is the key element of the North American Air Defense Modernization established by the March 1985 Memorandum of Understanding between the US and Canada. The MoU established a cost sharing relationship of 60/40, with Canada responsible for 40 percent of the total costs. This program is solely a **joint Canadian/US** endeavor.

Forecast Rationale

The North Warning System program replaces the aging DEW Line (which has been in place since 1957) and eliminates low-altitude coverage gaps, improves radar performance, and reduces operation and maintenance costs. NWS provides air surveillance capability and tactical warning of bomber or cruise missile attack against

the North American continent through a Distant Early Warning (DEW) Line extending from Alaska to Labrador. This warning provides the National Command Authorities with time for decision making and survival actions, permitting the launch of strategic retaliatory and command and control aircraft for survival, as well as the ability to alert air defense fighters to intercept attacking aircraft.

The North Warning System has resulted in considerably improved detection of hostile aircraft and cruise missiles. It now enables rapid, direct entry of air defense data into the North American Aerospace Defense Command database by means of satellite communications links. The system also allows direct control of aircraft interceptions by the Region Operations Control Centers (ROCC) of the US-Canadian Joint Surveillance System (JSS). Besides voice and automatic data links to JSS, NWS includes six logistics support stations.

It appears unlikely at this point that any further FPS-124 radars will be procured. The high-reliability design of the enhanced NWS makes even repairs and spare parts a small market.

The long-range FPS-117 radar stands a better chance of being selected for outside applications. In late 1995, Lockheed Martin secured a US$82-million contract from Romania for five FPS-117 radar systems. To be delivered throughout 1997, these radars will help bring the country's air traffic control system in line with western standards of interoperability. Other sales to non-NATO European countries, such as Albania, Slovakia, Hungary, the Czech Republic, Bulgaria, and Macedonia are possible in future years. The Pacific Rim is also beginning to show an interest in this unit, but current costs may prove to be prohibitive.

The FY98 budget no longer carries a Program Element description for the NWS program. It thus appears that the North Warning System program has reached the end of its funding life. While some funding will certainly be spent for maintenance, the amount is so low that it has most likely been placed in a miscellaneous funding category.

Ten-Year Outlook

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