**Distant Early Warning Line**

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*"DEW" redirects here. For energy-emitting weapons, see Directed Energy Weapons.*



USAF Distant Early Warning Line and Distant Early Warning System Office Emblem



DEW line station at Point Lay, Alaska.

The **Distant Early Warning Line**, also known as the **DEW Line** or **Early Warning Line**, was a system of radar stations in the far northern Arctic region of Canada, with additional stations along the North Coast and Aleutian Islands of Alaska, in addition to the Faroe Islands, Greenland, and Iceland. It was set up to detect incoming Soviet bombers during the Cold War, and provide early warning of a land-based invasion.

The DEW Line was the northernmost and most capable of three radar lines in Canada; the joint Canadian-US Pinetree Line ran from Newfoundland to Vancouver Island, and the Mid-Canada Line ran somewhat north of this.

**Introduction**

The DEW Line was a significant achievement among Cold War initiatives in the Arctic. A successful combination of scientific design and logistical planning of the late 1950s, the DEW Line consisted of a string of continental defense radar installations, ultimately stretching from Alaska to Greenland. In addition to the secondary Mid-Canada Line and the tertiary Pinetree Line, the DEW Line marked the edge of an electronic grid controlled by the new SAGE (Semi-Automatic Ground Environment) computer system and was ultimately centered on the Colorado command hub of the North American Aerospace Defense Command (NORAD).

The construction of the DEW Line was made possible by bilateral agreement between the Canadian and American governments and by an alliance between the U.S. Department of Defense and the Bell system of communication companies. It grew out of a detailed study made by a group of the nation's foremost scientists in 1952, the Summer Study Group at the Massachusetts Institute of Technology. The subject of the study was the vulnerability of the U.S. and Canada to air attack, and its concluding recommendation was that a *distant early warning line* of search radar stations be built across the Arctic border of the North American continent as rapidly as possible.

**Development and construction**



A rough map of the three warning lines. From north to south: Distant Early Warning (DEW) Line, Mid-Canada Line, and Pinetree Line.



Map of Distant Early Warning (DEW) Line

Improvements in Soviet technology rendered the Pinetree Line and Mid-Canada Line inadequate to provide enough early warning and on February 15, 1954, the Canadian and American governments agreed to jointly build a third line of radar stations (Distant Early Warning), this time running across the high Arctic. The line would run roughly along the 69th parallel north, 200 miles or 300 kilometers north of the Arctic Circle.

Before the job was completed, men with the necessary knowledge, skills and experience were drawn from Bell telephone companies in every state in the U.S. Much of the responsibility was delegated under close supervision to a vast number of subcontractors, suppliers, and U.S. military units.

The initial contract with the Air Force provided for the design and construction of a small experimental system to determine at the beginning whether the idea was practicable. The designs of communication and radar detection equipment available at the time were known to be unsuited to the weather and atmospheric conditions encountered in the Arctic. Prototypes of several stations were designed and built in Alaska and in a rural section of Illinois in 1953. While few of the original designs for either buildings or equipment were retained, the trial installations did prove that the DEW Line was feasible, and furnished a background of information that led to the final improved designs of all facilities and final plans for manpower, transportation and supply.

With the experimental phase completed successfully, the Air Force asked Western Electric to proceed as rapidly as possible with the construction of the entire DEW Line. This was in December 1954, before the route to be followed in the eastern section had even been determined. The locations were surveyed out by John Anderson-Thompson Siting crews covered the area - first from the air and then on the ground - to locate by scientific means the best sites for the main, auxiliary and intermediate stations. These hardy men lived and worked under the most primitive conditions. They covered vast distances by plane, snowmobile and dog sled, working in blinding snowstorms with temperatures so low that ordinary thermometers could not measure them. But they completed their part of the job on schedule and set the stage for the small army of men and machines that followed. The line consisted of 63 stations stretching from Alaska to Baffin Island, covering almost 10,000 km. The United States agreed to pay for and construct the line, and employ Canadian labor as much as possible.

A target date for completing the Line and having it in operation was set for July 31, 1957. This provided only two short Arctic summers totaling about six months in which to work under passable conditions. The bulk of the work would have to be completed in the long, dark, cold Arctic winters.

From a standing start in December 1954, many thousands of people with countless skills were recruited, transported to the polar regions, housed, fed, and supplied with tools, machines and materials in order to construct physical facilities—buildings, roads, tanks, towers, antennas, airfields and hangars—at some of the most isolated spots in North America. The construction project employed more than 25,000 people.

Military and civilian airlifts, huge sealifts during the short summers, cat trains and barges distributed vast cargoes the length of the Line to build the permanent settlements needed at each site. To military and naval units fell much of the job of transporting mountains of supplies to the northern sites. More than 3,000 Army Transportation Corps soldiers were given special training to prepare them for the job of unloading ships in the Arctic. They accompanied the convoys provided by the U.S. Navy and raced time during the few weeks the ice was open to land supplies at dozens of spots on the Arctic Ocean shore during the summers of 1955, 1956 and 1957.

Scores of commercial pilots, flying everything from bush planes to four-engine ships, were the backbone of one of the greatest airlift operations in history. Helping them were U.S. Air Force crews of the “C-124 Globemasters” and “C-119 Flying Boxcars.” Together they provided the only means of access to many of the stations during the winter. In all, 460,000 tons of materials were moved from the U.S. and Canada to the Arctic by air, land and water.

As the stacks of materials at the station sites mounted, construction went ahead rapidly. Subcontractors with a flair for tackling difficult construction projects handled the bulk of this work under Western Electric direction. Prodigious quantities of gravel were produced and moved. Construction work needed to build housing, air strips, hangars, antennas and towers was done by subcontractors. In all, over 7,000 bulldozer operators, carpenters, masons, plumbers, welders, riggers, electricians and other tradesmen from the U.S. and Canada worked at breakneck speed under conditions so difficult it is a wonder the job was completed in such a short time. Concrete was poured in the middle of the Arctic winters, buildings were constructed, electricity, heat and water provided, huge steel antenna towers were erected, airstrips and hangars were built and putting it all together in darkness, blizzards and sub-zero cold.

After the building came the installation of radar and communications equipment; then the thorough and time-consuming testing of each unit individually and of the system as an integrated whole. Finally, all was ready, and on 15 April 1957 - just two years and eight months after the decision to build the Distant Early Warning Line was made - Western Electric turned over to the Air Force on schedule a complete, operating radar system across the top of North America, with its own complete communications network.

The majority of Canadian DEW Line stations were the joint responsibility of the Royal Canadian Air Force (Canadian Forces) and the U.S. Air Force. The USAF component was the 64th Air Division, Air Defense Command. The 4601st Support Squadron, Paramus, New Jersey, was activated by ADC to provide logistical and contractual support for Dew Line operations. In 1958, the line became a cornerstone of the new NORAD organization of joint continental air defense.

USAF military personnel were limited to the Main stations for each sector and performed annual inspections of Auxiliary and Intermediate stations as part of the contract administration; most operations were performed by Canadian and United States contract personnel. All of the installations flew both Canadian and United States flags until they were inactivated as DEW sites, and jurisdiction was transferred to the Canadian Government as part of the North Warning System in the late 1980s and early 1990s.

**Radar system**

In Point Lay, Alaska, the main AN/FPS-19 search radar is in the dome, flanked by two AN/FRC-45 lateral communications dishes (or AN/FRC-102, depending on the date). To the left are the much larger southbound AN/FRC-101 communications dishes. Not visible is the AN/FPS-23 "gap filler" Doppler antenna.

The DEW Line was upgraded with fifteen new AN/FPS-117 phased-array radars between 1985 and 1994, and re-named the North Warning System.

**Operating Characteristics of the An/TPS-1D (Mod c) Search Radar**

* Frequency range 1220–1350 MHz
* Peak power output 160 kW

Average power output -400 W

* Pulse rate 400 pulses/per second

Pulse width 6.0 usec Range 1000 yard to 160 nmi

* Antenna radiation pattern
	+ Horizontal 2.8 degrees
	+ Vertical cosecant (elevation single)
* Receiver noise figure 11.7 db
* IF bandwidth and frequency 5 MHz at 60 MHz
* Required prime power 8.5 KW
* Approximate weight of Radar 4800 lb
* Total volume 1000 ft to the third

Modifications to each operating radar station occurred during the construction phase of the DEW Line system. This was due to the extreme winds, frigid temperatures, and the ground conditions due to permafrost and ice. There were two significant electronic modifications that were also crucial to the functionality of these radar stations within a northern environment. One reduced the effects of vibration in correlation to temperature change, the other increased the pulse rate for 2 to 6 use and began utilizing a crystal oscillator for more stable readings and accurate accounts of movement within the air.

**Operations**

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A DEW station in western Greenland is visible in the distance beyond the snow-drifted equipment pallets in the foreground of this photograph.

The physical part of the DEW Line were the ground stations. It was a “line” only in the sense that overlapping radar beams projected from these stations formed a continuous and invisible screen, miles high, which detected airborne objects the instant they came within range.

There were three types of stations: small unmanned "gap fillers" that were checked by aircrews only every few months during the summer; intermediate stations with only a station chief, a cook, and a mechanic; and larger stations that had a variable number of employees and may have had libraries, movie projectors, and other accommodations. The stations used a number of long-range pulse radar systems known as AN/FPS-19. The "gaps" between the stations were watched by the directional AN/FPS-23 Doppler radar systems, similar to those pioneered only a few years earlier on the Mid-Canada Line. The stations were interconnected by a series of radio communications systems utilizing tropospheric scatter technology.

Like any well-planned community in the U.S., each main station had its own electricity, water service, heating facilities, homes, work buildings, recreation areas and roads. But there the similarity ended. The Arctic dictated what the buildings looked like, how they were built and even in what direction they faced. Instead of a group of separate buildings, the typical main station was essentially two long, low buildings connected by an enclosed overhead bridge, forming the letter “H.” At one end, set on steel stilts, was the Radom - a weather-tight dome covering the radar antenna. Nearby were the huge “reflectors” that provided radio communication with the outside world. Living quarters, recreation facilities, radar and radio equipment and power and heating plants where are all within the main buildings.

For stations at the western end of the line, buildings at a deactivated Navy camp at Point Barrow were converted into workshops where prefabricated panels, fully insulated, were put together to form modular building units 28 feet long, 16 feet wide and 10 feet high. These modules were put on sleds and drawn to station sites hundreds of miles away by powerful tractors. Each main station has its own airstrip - as close to the buildings as safety regulations and the terrain permit. Service buildings, garages, connecting roads, storage tanks and perhaps an aircraft hangar completed the community. Drifting snow was a constant menace. Siting engineers and advance parties learned this the hard way when their tents disappeared beneath the snow in a few hours. The permanent “H” shaped buildings at the main stations were always pointed into the prevailing winds and their bridges built high off the ground

The Early Warning provided was useless against ICBMs and submarine-launched attacks (which would not occur from an Arctic launch platform in any case). These were countered and tempered by the MAD (Mutually Assured Destruction) philosophy. However, the scenario of a coordinated airborne invasion coupled with a limited nuclear strike was the real threat that this line protected against. It did this by providing Distant Early Warning of an inbound invasion force, which would have to appear at the far north hours ahead of any warhead launches in order to be coordinated well enough to prevent MAD. A number of intermediate stations were decommissioned, since their effectiveness was judged to be less than desired and required. The manned stations were retained to monitor potential Soviet air activities and to allow Canada to assert sovereignty in the Arctic. International law requires a country that claims territory to actively occupy and defend such territory.

Because the advent of ICBMs created another attack scenario that the DEW Line could not defend against, in 1958 the US Government authorized construction of the Ballistic Missile Early Warning System (BMEWS), at a reported cost of $28 billion.

In 1985, it was decided that the more capable of the DEW Line stations were to be upgraded with the GE AN/FPS 117 radar systems and merged with newly-built stations into the North Warning System. Automation was increased and a number of additional stations were closed. This upgrade was completed in 1990, and with the end of the Cold War and dissolution of the Soviet Union, the United States withdrew all their personnel and turned over full operation of the Canadian stations to the Canadian military. Costs for the Canadian sector were still subsidized by the US, however; the US flag was lowered (without ceremony) at the Canadian stations and only the Canadian flag remained. The US retained responsibility and all operational costs for NWS Stations located in Alaska and Greenland.

**Perception of the DEW Line**

From the beginning of the DEW Line idea and development Canadian concerns over political perception grew enormously. Arctic historians all agree that there was a perception problem for the Canadian Government over the DEW Line. It began as early as 1949 and has been noted by the famous Canadian Arctic historian P. Whitney Lackenbauer that the Canadian Government saw little intrinsic value in the Arctic, but due to fear of Americanization and American penetration into the Canadian Arctic brought significant changes and a more militaristic role to the north. This shift into a more military role began with a change in the guard. Before the DEW Line system was installed the RCMP managed Arctic defense, the DEW Line system would bring would create a new role for the Canadian Military in defending Arctic sovereignty. This notion is often referred to as active over passive defense. Whitney would coin the term and would outline three key elements to active defense brought about due to the DEW Line system:

1. Minimize the extent of U.S. Presence in the Arctic
2. Canadian Government consent in the DEW Line project and how it is managed
3. Full Canadian participation in DEW Line and Arctic defense.

Funding problems for the DEW Line would also play a determining factor in perception of the project. Once American aid towards building and operating the DEW Line system declined, there was a need for Canada to step up to fill the void. In 1968 this void was not filled as outlined in the Department of National Defense Paper (November 27, 1968) stated no further funding for research on the DEW Line or air space defense will be allocated due in part to lack of commercial activity, The Canadian Government also would limit U.S. air activity, base activity, soldier numbers, contractor numbers, and the overall operation would be considered and called in all formalities a "joint operation".

**Cultural Impact of DEW Line System**

The cultural impact of the DEW Line System is immense and significant to the heritage of Canada. The three key elements to the impact on Canada's culture are 1) Connection of North and South Canada 2) Economic Development of Arctic 3) Protection of DEW Line Sites.

* 1. During the Cold War the social impact of the DEW Line system had not been thought of, or accounted for. Yet important connections between the south of Canada and the north of Canada became apparent. There is an important shared knowledge of place it represents a changing in the thinking of southern Canadians along with the desires and aspirations of northern Inuit. Figuring out values from the DEW Line allows for the heritage and protection of said values.
	2. The construction and operating of the DEW Line provided some economic development for the Arctic region. This provided a movement for further development through research, new communications, and new studies of the area. Although the construction of the DEW line itself was placed in American hands, much of the later development was under direct Canadian direction.
	3. Protection of the DEW Line has been an important topic of discussion lately. The discussion streams from the deactivation aspect of the sites and what to do with the leftover equipment and leftover sites that are still intact. There is a great drive currently by Canadian historians to preserve the legacy of the DEW Line through heritage designation, as a Cold War site. Further research into this discussion is needed.

**Deactivation and clean-up**

A controversy also developed between the United States and Canada over the cleanup of deactivated Canadian DEW Line sites. The stations had produced large amounts of hazardous waste that had been abandoned in the high Arctic. Especially damaging were the large quantities of PCBs. While the United States insisted that it was Canada's responsibility to clean up the sites they had managed, the Canadian government disagreed. In 1996, an agreement was reached that saw the United States contribute $100 million to the estimated $600 million cleanup effort. The cleanup is now underway, site by site. In assessing the cleanup new research suggests that off road vehicles damaged vegetation and organic matter, resulting in the melting of the permafrost, a key component to the hydrological systems of the areas. The DEW Line has also been linked to depleting fish stocks, pilot carelessness in agitating local animals such as the caribou, non-seasonal hunting, has had a devastating impact on the local native subsistence economies and environment.

**Atlantic and Pacific Barrier**

The DEW line was supplemented by two "barrier" forces in the Atlantic and the Pacific Oceans which were operated by the United States Navy from 1956 to 1965. These barrier forces consisted of surface picket stations, dubbed "Texas Towers", each supported by radar destroyer escorts, and an air wing of Lockheed WV-2 Warning Star aircraft that patrolled the picket lines at 1,000-2,000 m (3,000-6,000 ft) altitude in 12- to 14-hour missions. Their objective was to extend early warning coverage against surprise Soviet bomber and missile attack as an extension of the DEW Line.



An Atlantic barrier WV-2 and the radar picket destroyer escort USS *Sellstrom* (DER-255) off Newfoundland in 1957

The Atlantic Barrier (BarLant) consisted of two rotating squadrons, one based at Naval Station Argentia, Newfoundland, to fly orbits to the Azores and back; and the other training at NAS Patuxent River, Maryland. BarLant began operations on 1 July 1956, and flew continuous coverage until early 1965, when the barrier was shifted to cover the approaches between Greenland, Iceland, and the United Kingdom (GIUK barrier). Aircraft from Argentia were staged through NAS Keflavik, Iceland, to extend coverage times.

The Pacific Barrier (BarPac) began operations with one squadron operating from NAS Barbers Point, Hawaii, and a forward refueling base at Naval Station Midway, on 1 July 1958. Planes flew from Midway Island to Adak Island (in the Aleutian Island chain) and back, non-stop. Its orbits overlapped the radar picket stations of the ships of Escort Squadron Seven (CORTRON SEVEN), from roughly Kodiak Island to Midway. Normally 4 or 5 WV-2s were required at any single time to provide coverage over the entire line.

Barrier Force operations were discontinued by September 1965 and their EC-121K (WV-2 before 1962) aircraft placed in storage.