Trigger for Atomic Holocaust
Aircraft Detection on the DEW Line

One of the enduring images of the Cold War in Canada is the isolated radome and billboard antennae of the Distant Early Warning (DEW) Line. Stretching across the 70th parallel from Alaska to Greenland at roughly 80 kilometre intervals, the DEW Line stations were built in the early and mid 1950s, as the northern most bastion of a huge air defence system. In Canada the system included four main stations, 18 Auxiliary stations and 20 smaller Intermediate or I-sites. Two stations, the BAR-1 Auxiliary radar station and the BAR-B I-Site, operated from locations in what is now Ivvavik National Park in the northern Yukon Territory. The cultural research and resource management undertaken on these sites provided an opportunity to evaluate the aircraft detection technology through site investigation and oral history.

The original function of this extraordinary military facility in the arctic was the detection and reporting of transpolar aircraft activity for continental defence purposes. Designed to alert defending fighters and give six hours warning to southern urban centres, the rapid development of military aircraft soon cut the DEW Line's warning time in half. Once the Soviet bomber forces were supplemented with ICBMs in the early 1960s, the warning shrank to minutes and air and civil defence efforts were largely pointless. From this time on the DEW Line was limited to confirming an attack and triggering a massive nuclear retaliation.

The monitoring of air traffic in remote areas offered some unique challenges to detection system designers in the early 1950s. Radar stations in southern areas were usually fairly busy with regular air traffic. In the northern areas, air traffic was infrequent and long periods without any contacts were especially fatiguing for console operators. Frequent staff changes were required. In remote northern locations extra staff to ensure no lapses in air defence coverage were prohibitively expensive. Designers therefore worked to come up with ways to overcome these difficulties on the DEW Line.

To achieve its purpose, the DEW Line was originally equipped with two kinds of electronic detection gear, a powerful gap-filler radar (Raytheon model AN/FPS-19)[1] and a doppler radio detection system known as the "McGill Fence". Both systems contributed to an overlapping coverage guarding the northern approaches to North America.

Developed specifically for the northern reaches of the continent, the "McGill Fence" was an elegant scientific answer to the challenging requirement to monitor air traffic in remote areas. Each station on the DEW Line was equipped with electronic transmitting and receiving gear connected to a set of 100 metre radio masts. Staff needed to run such a station were very limited, usually just two or three. Radio transmissions between stations set up

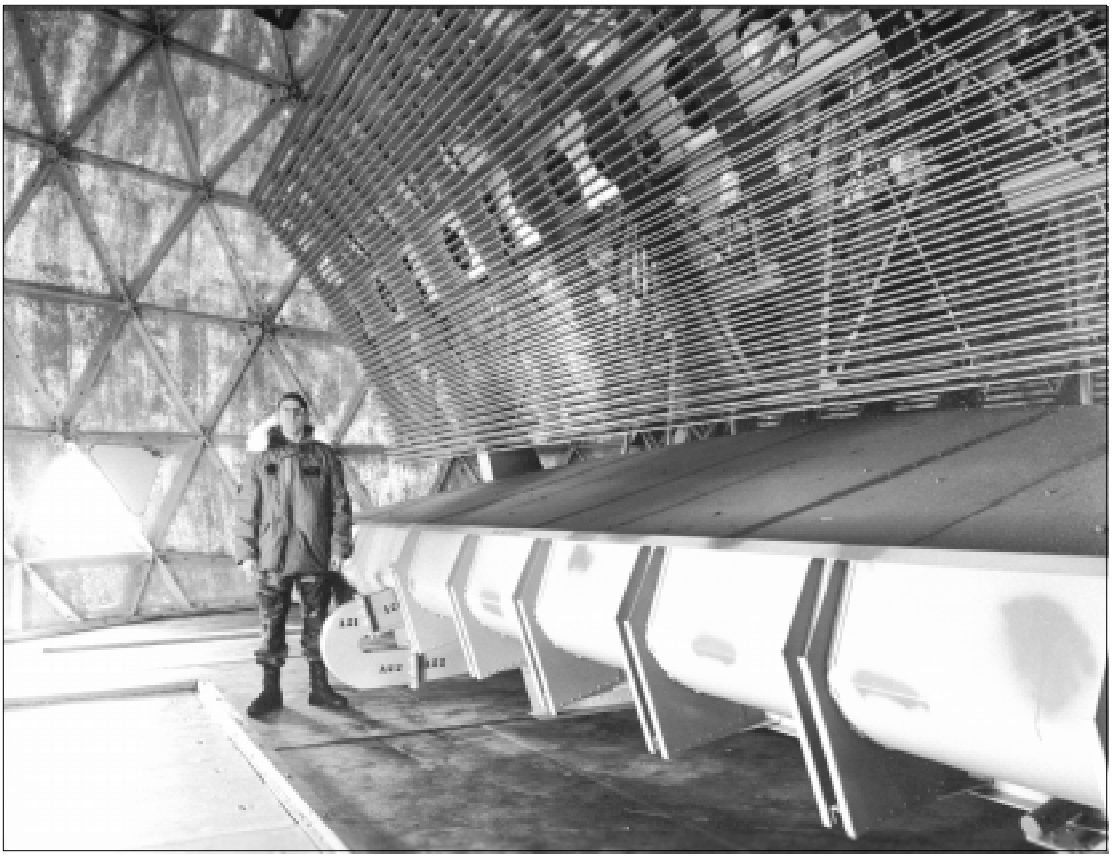
The "McGill Fence" was developed under the leadership of physicist John S. Foster at the Radiation Laboratory of Montreal's McGill University and used to equip both the DEW Line and the Mid-Canada Line, another link in the air defence system, on the 55th parallel. RCAF F/L T.H. Collins stands before the doppler antennae towering over the DEW Line Main Station at the Hall Beach in 1955. DND-CPU-PCN 1660

lobes of electromagnetic radiation. Reaching from the ground to approximately 30,000 metres, hence the “Fence”, the lobes of energy were disturbed by the passage of an aircraft. A recording device at the stations detected this disturbance and thus the aircraft. Although incapable of tracking aircraft, the system provided warning of intrusion and an approximate geographical location and track. It also served as a supplement to radar sightings and covered gaps close to the ground between radar stations. In the large unpopulated spaces of northern Canada with very limited air traffic, the system offered an innovative and inexpensive solution to the need for automatic air traffic notification.

Although theoretically attractive, the “McGill Fence” in practise proved notoriously unreliable. Field reports on the “Fence” as early as 1958, noted that operators were “cancelling the alarm without even inspecting the scope for target presence.” Sam Lightman, a radician (radar technician) responsible for keeping the doppler running in the early 1960s reported; *We either got nothing or we got geese, we never, ever got aircraft. It was a hopeless system. It was also a tremendously temperamental system, it was almost impossible to keep the damn thing running, I don't exactly know why. I think it was because the receivers were hideously sensitive and it was just awful. Those pens were constantly banging themselves off the wall of the limits of their travel, chewing up enormous amounts of thermal paper. Oh God, the doppler radar was a joke.*[2]

As the requirement for aircraft detection diminished in the early 1960s, the doppler systems were taken out of operation. The DEW Line I-sites were all closed in 1963. Two years later, the Mid-Canada Line, which used only the doppler, was also abandoned. On the BAR-1 and BAR-B sites the large antennae and webs of wire used for the “McGill Fence” were removed in the mid-1960s. Today only the small concrete foundation pads which anchored the antennae remain.

In addition to the passive notification provided by the “McGill Fence”, each Main and Auxiliary station on the DEW Line was also equipped with a powerful

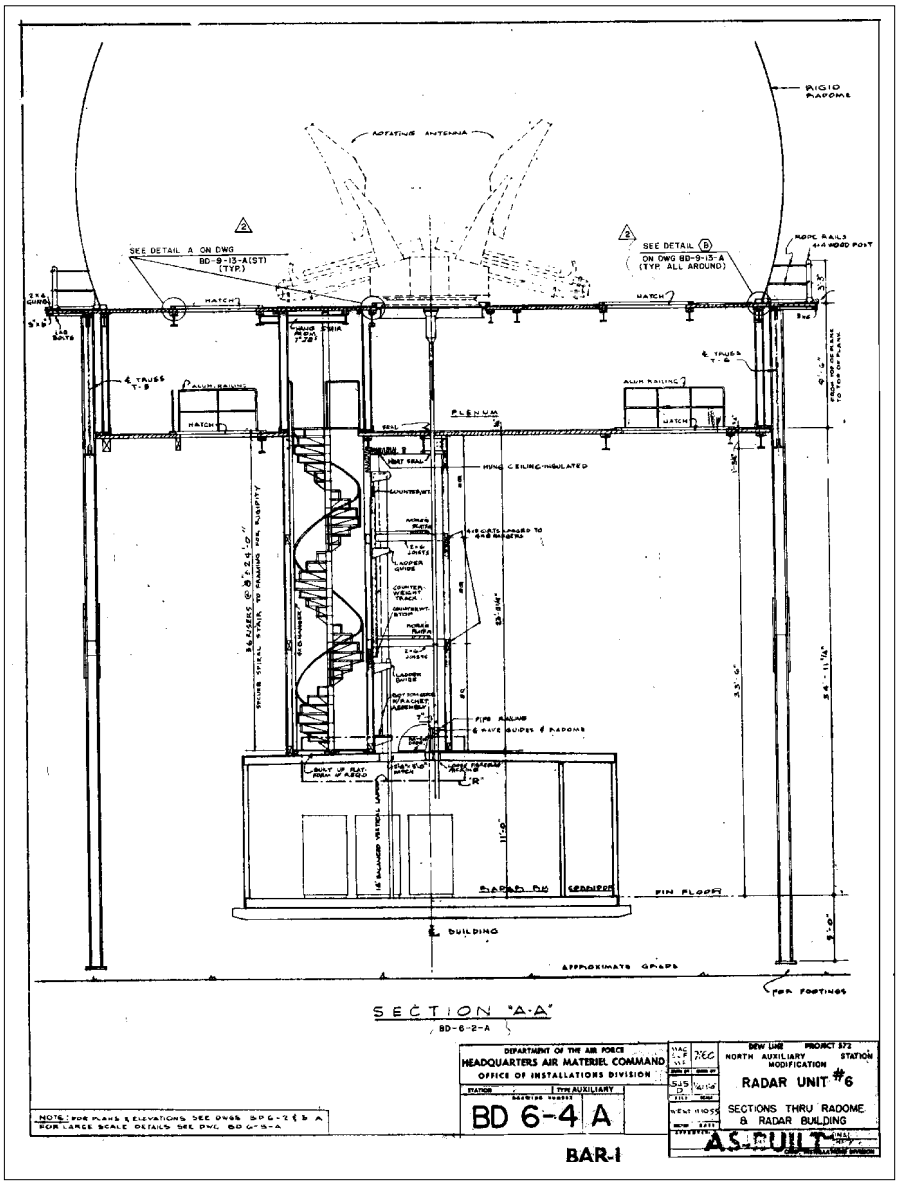


USAF Captain Joseph A. Miller beside the radar array in the geodesic dome, BAR-1, April, 1993.
Johnson collection, Parks Canada.

long-range search radar. Capable of detecting and tracking aircraft to 30,000 metres and almost 500 kilometres away, these units provided overlapping radar coverage.[3] The rotating antennae was sheltered within the protective white hard shelled geodesic radome popularly attributed to Buckminster Fuller and appropriated for the DEW Line. Transmitting and receiving equipment, and the consoles, were housed in the building train immediately below the antennae tower.

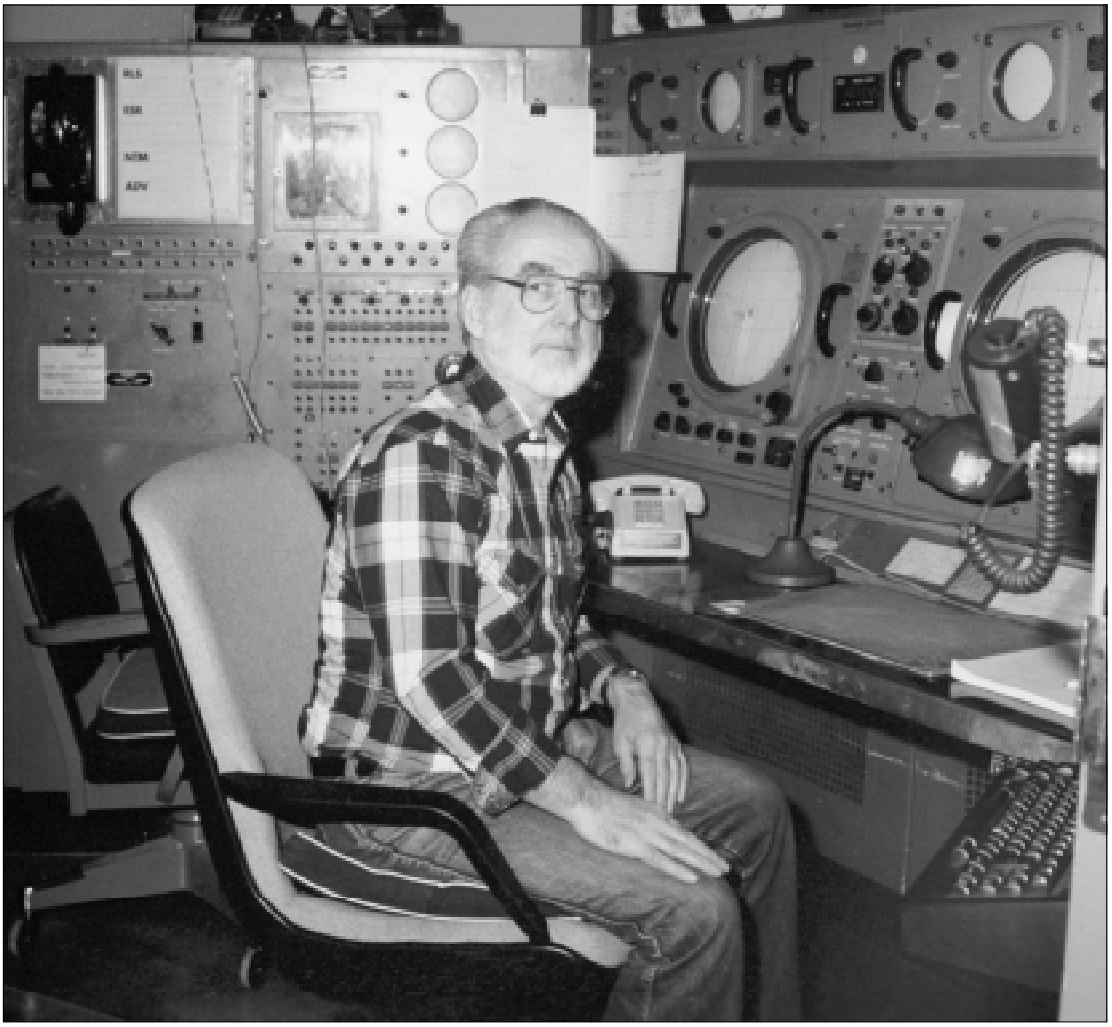
Lightman also described the operation of these radars in the early 1960s: *We had two sets of radars, we had a six degree radar and three degree radar. Inside the big geodesic dome was a huge rotating antenna... And it had twin beams - one aimed at six degrees and one aimed at three degrees to the horizontal. The six degree was called the high beam, it was supposed to detect high flying aircraft, and the three degree was called the low beam. The high beam never detected anything in the year and half that I was there, all business was done on the low beam. That's why there was two screens [at the console], because there was a high beam screen and a low beam screen, nothing ever showed up on the high beam screen so nobody ever looked at it. We use to talk to the U2s [high altitude spy planes] but we never ever saw them. On the other hand on the three degree beam we got everything from the Mounties taking off from Herschel Island [Police aircraft from an outpost 50 kilometres from the station] to KLM 368 [passenger jet] which used to fly over every morning at 4 o'clock, wake up the sleepy headed radar operator who is supposed to be awake, who may or may not have been. And the B-52s [patrolling bombers] that we were really supposed to be communicating with. So, the low beam was where the action was.*

Part of section drawing of BAR-1 radar tower and antennae. BAR-1 DEW Line Collection, Parks Canada.



The radar beam could also be focused on acquired targets to gain more accurate readings and information. This focusing of the normal "pencil beam" was done by making physical changes to the radar antennae array. While the more focused "cosecant beam" reduced the amount of background clutter on the screen, it did not materially improve readings. Further the antennae array would often jam when moving back to the regular pencil beam. Use of the "cosecant beam" demanded considerable additional maintenance and was therefore little used. At BAR-1 it is unlikely to have been used at all in the last 15 years of station operation.[4]

To meet the "empty skies" problem and keep console operators alert, an auto warning system was originally installed with the radar. This device sounded an alarm whenever the radar detected an intrusion and was an important contributor to the reduction of staff needed to monitor the screens. However, it too suffered failings. By the mid-1980s, the system was usually turned off or "blanked" by radicians who felt its sensitivity varied too much. Alarms set



Radician Bob Virgin at the radar console of BAR-1, April, 1993. Johnson collection, Parks Canada.

off by ground clutter were frequent. Ric Stephens, the Station Chief at BAR-1 in 1993 regarded it as "useless."[5]

The application of aircraft detection technologies in the high arctic faced special challenges. Construction engineers had to develop suitable materials and facilities to house and protect equipment and operators in the harsh environment while electronic designers needed to solve the problems of automatic detection to ensure reasonable staff complements. Operators developed their own maintenance and operating techniques to provide the best service possible in their isolated locations. To preserve and interpret this range of historic values, Parks Canada has collected engineering drawings and technical manuals, prepared a photo inventory of the site and completed an oral history project with DEW Line staff. A comprehensive report on the station and its role in the history of the western Arctic is in preparation.

Notes

1. D. Winkler, *Searching the Skies: The Legacy of the United States Cold War Defense Radar Program* (USAF, Air Combat Command, June, 1997) p.83.
2. Report noted in Roy J. Fletcher, "Military radar defence lines of northern North America: an historical geography", *Polar Record* 26 (159):(1990), p. 270 and Sam Lightman interview with D. Neufeld, June 6, 1995, Whitehorse, Yukon.
3. D. Neufeld, BAR-1 field notes, conversation with radician George Bridger, July 18, 1993.
4. Ibid.
5. Telex of 27 Aug 1986 in BAR-1 DEW Line Collection, Parks Canada and D. Neufeld, BAR-1 field notes, conversation with Station Chief Ric Stephens, July 18, 1993.

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