Radar in Scotland

Ian Brown

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Glossary

Admiralty Experimental Station (AES)
The cover name given to Naval radar stations.

Admiralty Signals Establishment (ASE)
The formation developing radar equipment primarily for the Royal Navy.

Advance CH (ACH)
Advance Chain Home. The first of three stages of Chain Home development, ACH consisted of stations with the equipment in huts and aerials on 70, 87, 90 or 105 foot masts.

Airborne Interception (AI)
Radar carried in aircraft used, often in conjunction with GCI, to close in on a target aircraft, usually at night.

Air Ministry Experimental Station (AMES)
The cover name given to RAF radar stations and also used for the designation of individual radar types.

Air Ministry Research Establishment (AMRE)
The formation developing radar equipment primarily for the Royal Air Force. Renamed from Bawdsey Research Station in September 1939 when moved to Dundee.

Air to Surface Vessel (ASV)
Airborne radar for the detection of shipping.

Anti-Aircraft Command (AA Command)
The British Army formation responsible for anti-aircraft guns.

ASB
Airborne radar for airborne interception, detection of surface vessels and bombing purposes. The equipment developed by the US Naval Research Laboratory.

Admiralty Signals Establishment Extension (ASEE)
An outstation of ASE.

Bawdsey Research Station
Located in Suffolk, the formation developing radar equipment primarily for the Royal Air Force. Renamed AMRE when moved from Bawdsey to Dundee in September 1939.

Buried Reserve
Back-up equipment for Chain Home stations, housed in underground buildings, which would go on the air if the main station was put out of action. Aerials were mounted on 120 foot wooden towers.

Canmore
The online database of the National Monuments Record of Scotland.

Carpet
This is a set for jamming German *Würzburg* radars operating around the 50 cm wavelength.

Cathode ray tube (CRT)
An electronic valve in which a beam of high-energy electrons is focused onto a fluorescent screen to produce a visible spot of light. With charged deflection equipment this produces a visual indication of an image or other signal.

Centimetric
Any radar operating on a wavelength of 1 to 10 centimetres. For the equipment referred to in this book, this means 10 cm radars. These had a very narrow beam of radio energy and therefore could pinpoint a target much more accurately than radars with longer wavelengths, such as the 1½ metres of CHL.

Chain Home (CH)
The principal long-range early warning radar used in the UK between 1936 and 1958.

Chain Home Beam (CHB)
These stations used GCI equipment in the early warning role, passing aircraft movements into the reporting organisation, rather than controlling fighters directly.

Chain Home Extra Low (CHEL)
An Air Ministry term for early warning radars operating on the 10 cm wavelength and able to detect very low-flying aircraft and surface vessels.

Chain Home Low (CHL)
A radar, operating on a wavelength of 1½ metres, developed by Air Ministry scientists from a set designed by the Army Cell at Bawdsey Research Station to plot ships. The RAF set up CHL stations to plot aircraft and in particular to provide better coverage against low-flying aircraft than Chain Home stations could provide. CHL also performed well on aircraft at medium and high altitudes and against surface vessels. CHL used aerial arrays which were rotated to 'sweep' over the area around the station. The short wavelength compared to CH gave much better definition, although not as good as that of centimetric radars.

Coast Artillery (CA)
The branch of the Royal Artillery responsible for anti-ship guns and gun batteries, and the equipment operated by it.

Coast Defence (CD)
Any of a variety of radars used for plotting shipping. CD radars were also capable of detecting aircraft and were mostly used for both roles.

Coast Defence/Chain Home Low (CD/CHL)
A radar operating on a wavelength of 1½ metres, similar to Chain Home Low, but to a War Office design and manned by all three services, or combinations of them. Used to plot aircraft and surface vessels.

Coast Defence U-boat (CDU)
Naval version of CHL originally designed to plot U-boats attempting to break out of the North Sea on the surface.

Commander-in-Chief (C-in-C)
The officer holding overall command of a major military formation.

Commanding Officer (CO)
The officer in command of a military unit or station.

Common Aerial Working
As the name suggests, this is using the same aerial for both transmitting and receiving, switching to receiving in between the transmitter pulses.

Educational & Vocational Training (EVT)
Courses for service personnel to help them obtain civilian work after release from the forces.

Final CH
Final Chain Home. The last of three stages of Chain Home development, consisting of stations with protected brick or concrete T & R Blocks and aerials mounted on 350 foot steel towers or 325 foot steel masts for transmitting and on 240 foot wooden towers for receiving.

Gee
A radio navigational aid which relied on the time difference from a series of pulses produced by ground stations to enable a navigator in an aircraft to calculate his position. This was not accurate enough to allow blind-bombing (dropping bombs without being able to see the target, through cloud for example) but was the first radio set to make accurate navigation over enemy territory possible.

General Post Office (GPO)
The organisation responsible during the Second World War for both postal deliveries and the telephone network in the UK.

Gibson Box
A transportable wooden cabin designed for railway transport and used to house the CD No 1 Mk V/ AMES Type 31/ Naval Type 271 radar set.

Ground Control of Interception (GCI)
A radar station used to control fighters directly, rather than passing information to an operations room from where the fighters were directed.

Gun-laying Modified (GM)
A modified anti-aircraft gun-laying radar for use as an early warning radar.

Historical Radar Archive (HRA)
An independent archive established in 1990 to record and preserve the history of radar.

Home Chain
The chain of radar stations surrounding the UK. Not the same as Chain Home which was only one of the many different types of radar that made up the Home Chain.

Hopkins turning gear
Hand-turned mechanism of gears used to rotate CHL aerial array, an improvement on earlier hand-turning equipment which utilised a bicycle chain drive connecting the aerial array to an upturned bicycle frame with the pedals replaced by handles.

HQFC
Headquarters Fighter Command.

Identification Friend or Foe (IFF)
A system which made it possibile to identify friendly aircraft. A transponder in an aircraft would send out a signal when it received a signal from a ground station. The aircraft's signal would then be received on the ground and identify it as friendly.

In Command (i/c)
The designated individual in command of a unit or station, eg NCO i/c.

Intermediate CH (ICH)
Intermediate Chain Home. The second of three stages in Chain Home development, with the equipment in huts and aerials on 240 foot wooden towers.

Line of shoot
In a Chain Home station, this was the direction in which the radio energy was strongest, although radio energy would be radiated 60° either side of the line of shoot. Chain Home Low stations were also allocated a line of shoot. Although CHL aerials rotated, their line of shoot was the direction the aerials would be pointed when they had to be lashed to the ground in high winds.

Mandrel
This set was designed to jam German radars operating at around 2½ metres, such as *Freya*, *Jagdschloss* and *Wassermann*.

Mast
A structure for carrying aerials that is not self-supporting and therefore has to be guyed for support. See tower.

Mobile Base (MB)
The name given to a series of transmitters sometimes used for mobile units but also at fixed stations.

Mobile Radio Unit (MRU)
The name given to a particular type of mobile radar unit with separate transmitter and receiver vehicles and aerials mounted on 70 foot or 105 foot masts.

Moonshine
Equipment which amplified and repeated the signal returned to the German *Freya* radar, making a single aircraft appear to be a large formation.

Motor Torpedo Boat (MTB)
A small, fast military boat equipped with torpedoes and intended to attack and sink larger vessels.

National Grid Reference (NGR)
A system of geographic grid references devised by the Ordnance Survey in Great Britain.

National Record of the Historic Environment (NRHE) **formerly National Monuments Record of Scotland (NMRS)**
The national archaeological database giving information about all known historic and pre-historic sites in Scotland, including radar stations. Accessed via https://www.trove.scot/

Naval Plotting Room (NPR)
The location used for the tracking of the movements of shipping and surfaced submarines.

Non-Commissioned Officer (NCO)
A person appointed from the ranks as a subordinate officer.

Northern Chain
One of several chains of ground stations for the Gee radio navigational aid. There were Southern, South Eastern, Eastern, Western, South Western, Northern, North Eastern and North Western chains, as well as several in Continental Europe following the invasion in 1944.

Oboe
A very accurate blind-bombing system, although limited in range. A bomber would follow the signal from one ground station, flying an arc which would take it over its target. The signal from a second station would intersect the first signal over the target, indicating to the bomber to release its bombload.

Operational Training Unit (OTU)
An RAF unit which gave training to aircrew to prepare them for operational service and prior to their posting to a front-line squadron.

Permanent Echo (PE)
The signal produced by islands, hills, etc., which did not move. These always appeared on a radar screen producing echoes which were there permanently.

Plan Position Indicator (PPI)
A radar display which produced a plan view of responses in the area, rather like a map. This made it possible for the bearing as well as range to be read directly from the radar screen.

Practice Interception (PI)
An interception carried out on a target aircraft by a night fighter under ground control for training purposes.

Radio countermeasures (RCM)
Something used to interfere with, or ‘jam’, radar sets, whether it be complex electronic equipment or strips of metal foil.

Radio Direction Finding (RDF)
One of the cover names given to British radar, until the word radar was adopted in 1943.

Radio Telephony (R/T)
Radio messages sent by speech, like a telephone, rather than by Morse code.

Receiver (R or Rx)
The equipment which receives the radio signal from the receiver aerials.

Receiver Fixed (RF)
A receiver at a fixed radar station, rather than a mobile unit.

Receiver Mobile (RM)
A receiver designed for mobile use, but sometimes used at fixed stations.

Remote Reserve
Back-up equipment for Chain Home stations, housed in surface buildings some distance from the rest of the station, which would go on the air if the main station was put out of action.

Royal Air Force (RAF)
The independent air force of the UK.

Royal Aircraft Establishment (RAE)
The unit created within the RAF to carry out evaluation of aircraft and equipment.

Royal Artillery (RA)
The formation of the British Army responsible for the use of artillery, including anti-aircraft guns.

Royal Canadian Air Force (RCAF)
The air force of Canada, which supported the operations of the RAF during the Second World War.

Royal Naval Air Station (RNAS)
An airfield or other station of the Fleet Air Arm, which was the air arm of the Royal Navy.

Service Police (SP)
The formation responsible for policing British armed forces personnel.

Skiatron
A type of cathode ray tube which could be projected onto a large screen in order that several people could observe the display.

Sub-Filter Room (SFR)
A small filter room which dealt with plots from local radar stations before passing the filtered information to the Filter Room at RAF Fighter Group Headquarters. This avoided congestion at the Group Filter Room.

T & R Block
A single building containing both transmitters and receivers.

Telecommunications Research Establishment
See Air Ministry Research Establishment

The National Archives (TNA)
Formerly the Public Record Office.

Tower
A self-supporting structure (and therefore not guyed) for carrying aerials. See also Mast.

Transmitter (T or Tx)
The equipment which send the radio signals to the transmitter aerials.

Transmitter Fixed (TF)
A hand-built transmitter produced by BRS staff for use at fixed radar stations until CH transmitters could be provided.

Transmitter Mobile (TM)
Prototype CH transmitters hand-built by the staff of the Bawdsey Research Station and used operationally on several stations into the early years of the war.

United States Army Air Forces (USAAF)
The air arm of the US Army, replaced by the US Air Force in 1947.

Valve transmitting (VT)
A transmitter valve.

Window
Tinfoil-coated paper strips which, when dropped from aircraft in large bundles, would produce large responses on the target radars. This could be used to either saturate the radar making all plotting impossible and neutralise the defences, or in carefully controlled amounts to make a small force appear much larger. The latter technique was used by small diversionary forces to attract German night fighters away from the main bomber force, and also to simulate approaching convoys and defending air cover on the night prior to the Normandy landings in June 1944.

Wireless Telegraphy (W/T)
Radio messages sent by Morse code, rather than by speech.

Women's Auxiliary Air Force (WAAF)
The women's branch of the Royal Air Force.

Women's Royal Naval Service (WRNS)
The women's branch of the Royal Navy. Members were known as Wrens.

Yagi aerial
A type of directional aerial invented in Japan in 1926, best known since the Second World War as the type of aerial used for domestic terrestrial television reception.

Note about measurements

All measurements are given in the units in use at the time. This is mostly imperial measurements, but metric for wavelengths. The conversions for the measurements are as follows:

1 inch = 2.54 centimetres
1 foot = 0.3048 metres
1 yard = 0.9144 metres
10,000 yards = 9.144 kilometres
1 mile = 1.60934 kilometres
1 mph = 1.60934 kph

Foreword

At a dinner at the British Camp Hotel in West Malvern, Mr A P Rowe described the first radar demonstration in England in 1935, in which he was the official government observer:[1]

At a range of 13 miles a just perceptible indication was observed from an aircraft – hardly enough to be promising except to the very imaginative. Sir Robert Watson-Watt's greatest contribution was to recognize the possibilities and to put himself willingly out on a limb by endorsing radar development as a sound program for air defence of Great Britain.

Scotsman Watson-Watt was very much the 'salesman' for the new emerging defensive weapon, securing finance for its development and the establishment of an Air Ministry Research Establishment, the famed Bawdsey Research Station. However, it would be A P Rowe who would oversee the exponential growth of the establishment and its management from 1938 until the end of World War Two and the moves from Bawdsey to Dundee, Dundee to Swanage and Swanage to Malvern.

This book does not follow the usual approach to World War Two radar history. Over recent decades we have grown used to the carefully constructed linear timelines employed in attempts to explain the sequence of events which is then used as a framework upon which individual subjects are portrayed. At the other end of the spectrum is the rather myopic local history which concentrates almost exclusively on a single military location, frequently with a long life extending well into the post-war years and where contacts were maintained through reunions.

There have been many initiatives which have attempted to capture the personal experiences from World War Two. However, few of these projects have set out with such a comprehensive array of specific 'target locations' and corresponding personal stories. Some of the projects, such as the Defence of Britain (1995–2001), relied on armies of volunteers, many without having conducted any previous research, but who were given ready access to many official records, added to the archaeological records. The 2004 BBC's People's War project invited contributions from the wider public. In stark contrast, this is a research-led, dedicated self-imposed task carried out over many years without any sponsorship, yet which has brought together

[1] On 6 December 1944, as recounted by Dr John Trump, Director of the British Branch of the Radiation Laboratory.

information from across the globe related to almost every radar site in Scotland.

Arguably, a Gazetteer? Well, yes, but with a tremendous twist, not merely a list of locations but a geographical compendium which incorporates detailed research of historical records and encapsulates the personal experiences of those who served at the great majority of the locations. In summary, a unique blend of technical and social history which embraces the whole of Scotland.

Aside from the rapid evolution and construction of the many ground stations, radar brought a huge social change, not only to those recruited to operate and maintain the technical equipment and to the 'administrative tail' necessary to support and defend these new and most secret stations, but also to the small remote rural communities in the areas surrounding these installations. I recall once being told by a serving Royal Air Force Officer, a Macleod from Brenish in the Hebrides, that one of his most vivid boyhood memories was attending a film show put on by the RAF at the radar site, something never experienced before at that remote location. No doubt there were many similar 'firsts' in the remote coastal and island communities throughout Scotland.

A change in the perceived and actual threats posed, reactions to specific attacks often resulted in rapid deployments. Mobile units often arrived with little or no notice in locations where there was very little infrastructure. Having said that, areas had been visited previously to 'spy out the land' and find suitable locations, not simply for suitable radar vantage points but also to identify the essential local infrastructure and to provide contact information to enable action for land requisitioning, access roads, the ordering of electricity supplies and landlines. In the war years, once a specific location was identified a 'Siting Signal' was prepared, giving the essential information against coded headings from 'A' to 'Q': Station name, Station Number, Grid Reference, Postal Address, Height above Sea Level, Nearest Electricity Power Supply, Nearest Telephone Line, Reporting line to … station, Exchange line to [GPO] exchange, Parent Unit recommended, Billeting or Accommodation available at …, Nearest Railway Station, Road Access, Water Supply, Sanitation facilities, Mean line of shoot recommended, Establishment recommended. The Siting Signal was then submitted for Air Ministry approval and subsequently to trigger actions in the Directorates of Signals, Works and Organisation. Co-ordination was often necessary with other military and civil organisations: seemingly vacant locations were being earmarked for other installations – the Aerodrome Board frequently raised objections to the erection of tall masts and towers adjacent to proposed or existing airfields. Another body that occasionally featured with objections were the War Agricultural Committees who wanted to retain the best agricultural land.

The Directorate of Communications Development (DCD) became involved in the setting up of the static permanent stations, specifying the Technical Buildings required and if stand-by power was needed. Accommodation for the radar station personnel and guards were also serious considerations, often requiring the requisitioning of separate domestic and guard force sites.

Not every station was given a geographically obvious name. Where is Borve Castle? Well, such a castle did exist; however, in 2000, during a visit to Benbecula, I discovered 'Borve Castle' was also the name of the house immediately adjoining the old radar site.

Perhaps the most significant factor that provided a starting point for the collection of the personal stories was the 1990 initiative to hold a World War Two Air Forces Radar Reunion. The invitations to the first event, held in Coventry in 1991, included a career form, and ultimately some 2,400 career summaries were returned from a wide variety of backgrounds. The 1991 event was attended by some 760 radar folk, which total included significant numbers from Canada, Australia, New Zealand and the USA. 'Station Lists' prepared for the event, whilst of great interest to the attendees, provided a stepping-off point for the tremendous effort which has gone into the collection of the personal accounts that shed light on life at the many Scottish radar locations.

Radar only existed at some locations for relatively short periods and with small numbers in the crews, so it is quite exceptional to have been able to gather a multitude of personal accounts, many of which, such as that recorded at the Chain Home Low station at Gaitnip in the Orkneys, provide vital clues as to the nature of the station, the local conditions and dependence on limited transport and billeting in the nearby town. Later in the war, desperate shortages of trained men to meet overseas commitments would result in many station closures, and, where conditions were judged to be suitable, WAAFs were substituted to release men for overseas service. For example, significant numbers of WAAF served at Netherbutton in the Orkneys and on the Gee Radar Navigation Aid (RNA) stations such as Windy Head Hill and Burifa.

There were several initiatives to obtain manpower skilled in electronics from overseas. The Dominions of Australia, Canada and New Zealand were requested to allow their citizens to be recruited and trained before sending them to the UK. Significant numbers were commissioned and commanded RAF units at home and overseas. In the USA we recruited radiomen and many other trades into the Civilian Technical Corps. Another major scheme evolved before the USA became involved in the war, whereby officers of US Army Signal Corps came to Britain for a six-month attachment with the RAF and the Army to receive training and experience on radar – this was the Electronics Training Group. Many of these officers served on ground radar stations throughout the UK.

Squadron Leader Mike Dean (retired), MBE
Founder of the Historical Radar Archive

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Every effort has been made to establish the copyright holder, and obtain their permission, for material used in this book. In some cases this has not been possible. For example, on many stations one person would take a photograph and copies would be distributed to everyone on the unit. One of these copies is later given to the Historical Radar Archive, but not necessarily from the photographer. No one remembers who the photographer was. If this has happened, and you believe you hold copyright for any material reproduced herein, my sincere apologies. Please get in touch in order that due acknowledgement may be given in a future edition.

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PART I

Introduction

'The atomic bomb may have ended the war, but radar won it.' So claimed radar scientists at the Massachusetts Institute of Technology Radiation Laboratory at the end of the Second World War (Brown, 1999: x).

Radar was a relatively new technology at the start of the war. British research only began in earnest in 1935, a mere four years previously. Yet, radar was to be used in every theatre of the war and play a central role in the conflict. Its use was so widespread that no single work can cover the whole history of the development and use of radar in any meaningful detail.

This book tackles one small aspect of the overall radar story, namely ground radar in Scotland during the Second World War. It does not include gun-laying radar used at anti-aircraft gun sites by Anti-Aircraft Command. Such radars were too numerous, and the historical records are too fragmentary, to produce a worthwhile account on a site-by-site basis.

In addition to the ground radar stations, however, this book includes the radio navigational aids operated by the Air Ministry. Although these were not, strictly speaking, radar stations, in many cases they used exactly the same equipment, were manned by personnel who had previously served on radar sites and were the responsibility of the same Royal Air Force (RAF) formation: No 60 (Signals) Group. Perhaps most importantly of all, many of the navigational aids were located within the compounds of existing radar stations. It is for these reasons that the radio navigational aids are included here.

This may seem a strange assortment of various different types of signals installations. However, with the exception of the Coast Artillery (CA) radars which were purely Army bases, all the other sites listed here were to some degree the responsibility of No 60 (Signals) Group, RAF. Even the Army Coast Defence/Chain Home Low (CD/CHL) stations would eventually be transferred to Air Ministry responsibility, as would the Admiralty's Coast Defence U-boat (CDU) stations. The CA fire control radars have, however, been included because they were the successors of the CD/CHL stations and it would be absurd to exclude them.

This, then, is primarily the story of No 60 Group and the Wings within that Group which were responsible for the stations in Scotland: Nos 70, 71 and 72 (Signals) Wings. They were an odd mix of service personnel and civilian scientists, but they played a vital role in maintaining Britain's warning and control systems in peace and war and we all owe them a huge debt of gratitude.

The source material for this book is drawn mainly from the official records of the stations, held at The National Archives (TNA) in Kew, supplemented by additional original documents held by the Historical Radar Archive (HRA). These records have been humanised by first-hand accounts from numerous men and women who served on these stations all across Scotland, many of whom were sent from Commonwealth countries to help defend the UK. Radar was secret and photographing radar stations or equipment was a serious offence for both military and civilian personnel. It is amazing, then, that so many photographs exist, mostly drawn from private collections held by former radar servicemen and -women and now in the HRA. Most of the photographs reproduced in this book are not official ones taken by professional photographers, and sometimes they are not the highest quality images. However, the decision has been taken to include them because of their historic value in recording these secret sites.

Also included in this book are a very few site plans for some of the radar and radio navigational aid stations. Sadly, there are only a few because there are not many that survive. Almost every single UK airfield has one or more site plans preserved in the RAF Museum in London, but with radar stations these have mostly been destroyed. Some surviving radar site plans only show drainage installations and are not included as they add little to an understanding of the role and layout of the radar station. Most of the others are included here to show how these sites were laid out, and perhaps help with interpreting remains at those sites for which no plan survives.

The radar stations in Scotland were, of course, only part of a wider chain, which at the start of the Second World War in September 1939 covered most of the east and south coasts of the UK and by the end of the war provided almost unbroken coverage around the entire UK coastline. There is not space here to look at the history of the entire UK radar chain, which has already been outlined in considerable detail both in the official history (Air Ministry, 1950 (1)) and a more recent, exhaustively researched book (Bragg, 2002).

This book is divided into two parts. Part I consists of this introduction and three chapters, with Chapter 1 giving an overall history of the development of the radar chain in Scotland and the part it played during the Second World War. This is followed in Chapter 2 with a description of the Control and Reporting System in Scotland, explaining how the radar information was used. It was the integrated use of radar information within the air defence system of the UK that made radar so valuable, and this chapter looks at how this information was used and where it went to, both for air defence and the vital protection of shipping.

Chapter 3 describes each of the different radar systems, including the architecture of their structures, how they were built and what the stations themselves looked like. This should help with an understanding of surviving remains when visiting (with the landowner's permission) any of these sites.

Part II is the main body of this book, containing histories of each individual radar station, radio navigational aid station and research establishment in Scotland. The entries all begin with a summary, giving the type of site and types of radar which were installed at the station, by name and type number where relevant; the pre-1975 local authority area within which the station was located, or the island within this local authority area where relevant (and the current local authority area as at 2020); the national grid map reference, accurate to 100 metres where a six-figure reference and to 10 metres where an eight-figure reference; the National Monuments Record of Scotland (NMRS) site number, which can be used to access further information about the site and its current state via the Trove database at https://www.trove.scot/; and lastly the dates the station opened and closed where known. Some of this information will be repeated within the site history, but a quick-reference summary may be useful.

The aim of this book is to provide a detailed and accurate description of the radar stations, radio navigational aid stations and radar research establishments in Scotland between 1938 and 1946, with an obvious focus on the Second World War. It is hoped this book will be of value to military historians, local historians, genealogists, historians of technology, historians of the Second World War and historians of modern Scottish history. All will, it is hoped, find something of interest within this book, the first to tell the story of each individual radar station in Scotland based mainly on primary sources and first-hand accounts, and illustrated with many photographs of these stations, most of which have never been published before. This book was written as a result of 35 years of research into this subject, prompted by almost every book on the subject having numerous errors, due to lack of primary research. It is hoped this book finally tells an accurate story of British radar during the Second World War, in this case in the context of sites located in Scotland, and that it will be of interest even to those whose curiosity on this subject is not limited to the geographical area of Scotland.

Chapter 1

Radar in Scotland 1938–46

The Scottish connection with radar goes back to the very origins of the technology, and the work of the Scot James Clerk Maxwell. In 1864 he calculated the theoretical existence of radio waves (Dummer, 1978: 53), which were not actually discovered until the experimental work of Heinrich Hertz in 1887 (Dummer, 1978: 61). However, it took the Italian Guglielmo Marconi to demonstrate that radio had a practical application, culminating in his transmission across the Atlantic in 1901 (Dummer, 1978: 63). Three years later a German, Christian Hülsmeyer, patented an obstacle warning device known as the Telemobiloscope, which bounced radio waves off objects in front of a ship. This would ring a bell, warning of the presence of the object. Sadly, the Telemobiloscope was a commercial failure (Pritchard, 1989: 13–20). This was not the end of the story in Germany, where the first true radar – which could not only detect an object but locate it as well – was demonstrated in Kiel Harbour in May 1934 (Kroge, 2000: 23).

In Britain, the theories of radio propagation were well known. In 1924 Edward Appleton was able to calculate the height of the Heaviside layer of the upper atmosphere by bouncing radio waves off it (Clark, 1971: 42). Appleton, however, used continuous waves, whereas British radar would eventually be developed using pulses, which made the calculation of range much easier. Consequently, although Appleton was ranging with radio waves, his work was not a direct ancestor of British radar, which did, nonetheless, have its origins in atmospheric radio research (Watson-Watt, 1957: 90–2). However, although the technology existed, there was no drive towards developing radar until the rising political threat from Germany prompted the Air Ministry to take action. Concerned that there was no effective form of air defence, in December 1934 the Committee for the Scientific Survey of Air Defence was set up to investigate all possible applications of science to this problem (Bragg, 2002: 22).

Prior to its first meeting, Harry Wimperis, Director of Scientific Research and a member of the committee, made an informal approach to Robert Watson Watt of the Radio Department of the National Physical Laboratory. Wimperis was aware of all the imaginative claims that had been made for death rays over the years, but wanted Watson Watt's opinion on whether a radio death ray was possible.

Calculations confirmed that a death ray was completely impracticable, but Watson Watt suggested that perhaps radio could be used for detection. Further calculations confirmed that sufficient energy would be reflected to make detection possible. Money would be required for development and approval for this would be needed from the Air Member for Research and Development, Air Marshal Sir Hugh Dowding. Dowding wanted an experiment to prove the mathematics, and consequently, on 26 February 1935, a demonstration was carried out which used a receiver in a small van, a Handley Page Heyford bomber as the target and the BBC transmitter at Daventry. This has since become known as the Daventry experiment. Its success convinced Dowding to approve the £10,000 requested for research (Bragg, 2002: 23–33).

By July 1935 ranges of 40 miles were being achieved (Bragg, 2002: 38) and Watson Watt was talking about a chain of stations at 20 mile intervals around the country. On 30 November 1935 Wimperis submitted a proposal to the Treasury for a chain of five radar stations providing coverage over the Thames Estuary and the approach to London, at a cost of £68,000. This was approved on 19 December (Bragg, 2002: 49–50) and the first of these stations, at Bawdsey in Suffolk, was handed over to the RAF in September 1937.

The story of the radar defences of Scotland begins at a meeting on 30 June 1937, when the Air Staff requirement for radar coverage in the UK was outlined. Coverage sufficient to provide warning of aircraft approaching at a minimum height of 3,000 feet at a distance of 40 miles was to be provided between the Isle of Wight and Lowestoft; between Lowestoft and St Andrews the Air Staff would be satisfied with detection of aircraft at 5,000 feet at 35 miles. However, in the coastal areas of the Forth, Tyne, Tees and Humber, coverage of the same standard as required for the Isle of Wight to Lowestoft area was stipulated. The Forth, Tyne, Tees and Humber were to be given the greatest possible radar coverage because of the great naval importance of these rivers, indicating that they were just as important as the defences of London and the aviation industries in the Midlands. Rosyth Naval Base in the Forth had already been selected as the main base for the Home Fleet and was clearly a facility of major importance (Air Ministry, 1950 (1): 29).

The first stage in the provision of this coverage was the selection of approximate positions for the stations. Such locations were chosen at St Abb's Head/Fast Castle, St Andrews (Strathkinness) and St Cyrus. These proposed sites had been selected using maps to give spacings of about 40 miles, this being considered the optimum distance between stations. However, relying on maps meant that when survey teams went to the locations, they found many of the sites were unsuitable (Air Ministry, 1950 (1): 31–2).

No further progress was made towards the provision of radar cover in Scotland until the wider political situation intervened. With the growing international crisis due to German territorial claims over the Sudetenland, on 16 September 1938 the Deputy Chief of the Air Staff and Director of Operations and Intelligence at the Air Ministry, Air Vice-Marshal Richard Peirse, ordered that mobile equipment should immediately be set up at Drone Hill near St Abb's Head, Ravenscar in Yorkshire and West Beckham in Norfolk. These three stations were set up with equipment which had been planned for use overseas, and the scale of the urgency can be gauged from the fact that Drone Hill was on the air 12 days later. This was the first new radar site erected since the five-station chain had been built round the Thames Estuary and demonstrates the importance of providing early warning coverage for the Forth–Clyde area and, in particular, the vital naval base at Rosyth (Air Ministry, 1950 (1): 45; TNA, AVIA 7/299).

On 19 January 1939 Peirse held a meeting to discuss extensions to the radar chain, and it was decided to extend it northwards towards Scapa Flow. Early warning of an attack on the Home Fleet base at Scapa Flow was to be given by a station at Kirkwall and one at Stonehaven (Air Ministry, 1950 (1): 60). It was that same month that the Home Fleet selected Scapa as the Main Fleet Base instead of Rosyth (Hewison, 1990: 233) and, despite the shortage of equipment, radar coverage was immediately allocated for Scapa Flow. In fact, the defence of Scapa Flow had such a high priority that the radar station there had to be equipped on an emergency basis. New wooden huts were ordered, but the necessary towers came from Drone Hill and the transmitter, receiver and aerial systems from Ravenscar. As a result of these emergency measures, Netherbutton (the station at Scapa Flow) became operational on 2 June 1939 (TNA, AVIA 7/308) and Schoolhill (the station near Stonehaven) in November 1939 (TNA, AVIA 7/303).

By that time, another station had become operational. This was Douglas Wood, which went on the air on 10 March 1939. It appears that this station, besides acting as another link in the Home Chain, was to provide additional coverage over the approaches to the Forth. This improved coverage was possible by virtue of Douglas Wood working as an Intermediate Chain Home (CH) station before Drone Hill Intermediate CH became operational later that spring (TNA, AVIA 7/302).

By the outbreak of war on 3 September 1939 the continuous east coast radar coverage extended as far north as Dundee, with a station operating in isolation on Orkney. However, the Home Chain was far from complete, and there were a number of additional strategic requirements, one of which was raised at a meeting between Admiralty and Air Ministry personnel on 2 October 1939. At this meeting Vice-Admiral Sir James Somerville, appointed on special service at the Admiralty with responsibility for the co-ordination and development of radar for the Royal Navy, stated that warning cover should be given in Orkney of the approach of hostile aircraft from the south and west. The possibility of converting Netherbutton into an 'all-round looking' station, with four lines of shoot at right angles to each other, was discussed, as was the erection of a mobile station near Wick (TNA, AVIA 7/308); the latter was not completed until February 1940 (Hubert Nettleton, pers comm).

Plans were also being implemented for the erection of a station at Hillhead, to plug the gap between Schoolhill and Netherbutton. Here again naval considerations were overriding: it had originally been intended to give Hillhead a line of shoot of 30°, but this was changed to 45° at the insistence of Air Marshal Sir Philip B Joubert de la Ferté. Joubert was on Special Duties, RDF (Radio Direction Finding), and thus closely involved with the development of radar in the RAF. The change to Hillhead's line of shoot was made in order to give longer-range warning on raids approaching Scapa Flow from the south-east, despite the fact that this reduced the coverage of the Moray Firth (TNA, AVIA 7/304).

By the time the Advance CH station at Hillhead became operational in December 1939, a number of developments, both strategic and technical, had taken place which affected the Home Chain in Scotland. The most

1 Map of radar stations in Scotland, September 1939.
(© Historic Environment Scotland)

2 Map of radar stations in Scotland, August 1940.
(© Historic Environment Scotland)

important of these was the introduction of the technically more advanced Chain Home Low (CHL) stations. This equipment came from work being carried out by War Office scientists attached to the research team at Bawdsey Research Station under Robert Watson Watt. The Army 'cell' was working on equipment to track ships for the needs of coast artillery, and by 1939 this had reached an advanced stage. Aware of the Army's work, the Air Ministry took over the Coast Defence (CD) equipment for their own needs and pressed it into service as CHL. Operating on a wavelength of 1½ metres, as opposed to the 5 to 13½ metres of CH, meant that CHL produced a narrower beam which could be mechanically swept over an arc. More importantly, the vertical coverage was of a lower angle than CH and therefore extended farther at lower altitudes. For the Air Ministry, this meant CHL could detect low-flying aircraft at much greater ranges than was possible with CH and was therefore of great importance to the radar defences; in particular it was to prove invaluable in combating the menace of low-flying minelaying aircraft (Bragg, 2002: 133–5).

The urgency of the requirement for low-level coverage was such that the prototype equipment, which had been undergoing trials at the Air Defence Experimental Establishment operated by the War Office at Christchurch, was pressed into service as the first operational station. However, this first site was to be an Admiralty, not Air Ministry, station. Vice-Admiral Somerville had devised a scheme for the deployment of CDU stations (the Admiralty term for CHL stations operated by the Navy) in the Orkney and Shetland Islands. This scheme would make it possible to detect U-boats passing through the Fair Isle Channel into the Atlantic. However, the torpedoing of HMS *Royal Oak* in Scapa Flow by U-47 on 14 October 1939, and the subsequent withdrawal of the Home Fleet, meant that provision of CDU cover for the Forth was given the highest priority. As a result, the Christchurch prototype was sent to Edinburgh instead of Shetland and was operating at Anstruther a few days after test flights were carried out on 17 November 1939 (Clifford Evans, pers comm). As soon as additional equipment became available, a CDU station was set up at Sumburgh Head and two stations on Fair Isle. It was originally intended to site a station on one of the northern Orkney Islands, but this plan was abandoned. Nonetheless, the Sumburgh station became operational on 27 December 1939 and the two Fair Isle CDUs were operating by 1 March 1940 (HRA, Naval Shore Radar).

By that time, the Air Ministry had implemented the first 'crash' programme of CHL construction, producing sufficient sets to erect a number of stations in areas urgently requiring coverage against low-flying aircraft. As a result, Cockburnspath CHL became operational on 26 January 1940 and was followed by a number of stations set up under the second 'crash' programme, at St Cyrus, Doonies Hill and Rosehearty, all of which were operating before the end of February 1940. Although these urgent CHL construction programmes had placed a considerable strain on No 2 Installation Unit, which was responsible for the erection of the radar chain, the result of the effort was that, by the early spring of 1940, low-flying aircraft could be detected along the east coast of Britain as far north as Kinnaird Head, and the Fair Isle Channel was covered against U-boats attempting to pass through on the surface (Air Ministry, 1950 (1): 84–5).

However, by early 1940 German aircraft were increasingly flying farther into British airspace over the west coast and the Irish Sea, and a number of other gaps in the radar coverage were identified. As a result, in January 1940 the highest priority was given to the provision of coverage in the Firth of Clyde, Cromarty Firth, Central Scotland and the Shetland Islands. Consequently, CH stations were set up at Skaw, Noss Hill and Whale Head, with increased CHL coverage in the area of the Orkney and Shetland Islands in the form of stations at Gaitnip, Tannach, Saxavord, South Ronaldsay and Dunnet Head. Cromarty CHL, covering the Cromarty Firth, became operational in August 1940. By the time most of these stations became operational, the German invasion of Denmark and Norway on 9 April 1940, followed by the British evacuation of southern Norway in early May 1940, meant that the Germans were in possession of an extensive coastline facing the north-eastern coast of Britain, and within close striking range of the Home Fleet base at Scapa Flow. The threat to the northern coast was clear (Air Ministry, 1950 (1): 124).

This threat was to be realised in March and April 1940, when a series of air attacks were launched against Scapa Flow. These were an attempt to destroy the Home Fleet at harbour, much as the Japanese were to attempt at Pearl Harbour some 18 months later (HRA, Naval Shore Radar). An estimated 15 aircraft attacked on 16 March and the cruiser HMS *Norfolk* was hit and damaged (Hewison, 1990: 292–3). Larger attacks were launched on 8 April, by around 25 aircraft (Hewison, 1990: 298), and on 10 April, with a mass raid of around 60 bombers (Hewison, 1990: 301). The attacks on 8 and 10 April were detected by the CDU stations at Sumburgh and Fair Isle and the CH station at Netherbutton, providing sufficient warning for the defences to be prepared (HRA, Naval Shore Radar). On 10 April the effective deployment of anti-aircraft barrage fire over Scapa Flow, with 1,700 rounds of heavy anti-aircraft ammunition being fired, broke up the attack, with only minor damage caused to the cruiser HMS *Suffolk* (Hewison, 1990: 300–1), and contributed to the destruction of 6 enemy aircraft (Ramsey, 1987: 77). The defeat of these attacks, without serious loss to the Royal Navy, demonstrated the value of the radar defences in the northern isles. In particular, had the bulk of the Home Fleet not sailed from Scapa Flow on 7 April (Roskill, 1954: 159), and the mass raids on 8 and 10 April been successful and inflicted a heavy blow on the Home Fleet, the consequences might have been catastrophic. The serious damage to British naval power could have resulted in defeat in the Battle of the Atlantic, and the war overall.

However, it was events not only in Norway, but also in France, which were to have important consequences for the radar chain in Scotland. As a result of the fall of France in June 1940, and therefore German possession of the French Channel ports, British shipping was transferred almost immediately from the English Channel to the North Channel. Consequently the scale of attacks on shipping in the Irish Sea and North Channel grew alarmingly. It was therefore urgent to increase both high- and low-level coverage in this area, with additional stations in Northern Ireland, Islay and the Isle of Man being proposed (Air Ministry, 1950 (1): 142); as a result 11 new stations became operational in late 1940 and early 1941 (Air Ministry, 1950 (1): 549). Included amongst these was the Mobile Radio Unit (MRU) sent to North Cairn on 26 June 1940. Such installations, with additional stations such as Sango CH to protect the large amount of shipping sailing round the north of Scotland, proved essential in the battle to protect shipping in coastal waters during the early part of the maritime war. It was also naval considerations which led the Commander-in-

Chief, Rosyth, to request in January 1941 a station in the Glasgow area to protect Rosyth Naval Base from air attack from the west. In consequence, an MRU was set up at Kilmacolm, west of Glasgow, before the end of the month (TNA, AVIA 15/256).

The naval war was intensifying, as a result of the order issued by Adolf Hitler on 6 February 1941 that the German forces should direct their full strength against Britain's overseas supplies (Roskill, 1954: 338). In response, on 6 March 1941 Prime Minister Winston Churchill issued a Directive to the Chiefs of Staff to the effect that it must be assumed that the Battle of the Atlantic had begun, and that improved radar coverage for the defence of shipping was to be given the highest priority. In order to improve radar coverage over the north-western approaches, CHL stations were to be sited on the Faroe Islands and Iceland (Air Ministry, 1950 (1): 151–3). This coverage was to be supplemented with a number of new CHL stations in the Shetland Islands, Western Isles and the west coast of Scotland (Ben Hough, Carsaig, Clett, Eorodale, Greian Head, Islivig, Kendrom, Point of Stoer, Rodel Park, Sango and Watsness), which were known as the Battle of the Atlantic stations. Other stations were proposed, but later rejected, for St Kilda, Rona and the Flannan Islands. The Prime Minister also suggested the erection of stations on Rockall, Tory Island, the hills south of Lough Erne and one of the islands off County Kerry, although these too were rejected (Churchill, 1950: 664).

Another development of early 1941 was the introduction of Ground Control of Interception (GCI) equipment, with mobile stations being set up at St Quivox and Dirleton in April 1941. This equipment arrived just as the night blitz was at its height, and at least two German bombers attacking Clydeside were destroyed by aircraft under the control of St Quivox GCI (TNA, AIR 26/103).

The year 1941 was also to see further development of CHL equipment. The hand-turned twin-gantry stations suffered severe problems in high winds, when it became impossible to rotate the aerials and they had to be lashed to the ground in a fixed position. Clearly this was undesirable since any such station was only watching in a single direction and might not detect an incoming attack. Proposed ways of dealing with this included building screens around the aerial arrays, but eventually the problem was solved with the introduction of what was known as the 1941 Type CHL. This was a technical improvement on the original equipment, with a single power-turned aerial array for both transmitting and receiving, and a single combined T & R Block, made usually of brick, to house the equipment. These stations were built in Scotland during 1941 and 1942, and were responsible for a great improvement in the CHL coverage (Bragg, 2002: 261–2).

At about the same time, the War Office was also introducing its own early warning chain. The CD equipment which the Air Ministry had used for CHL was developed into CD/CHL for War Office use. Fears of a German invasion of Britain with the onset of spring in 1941 led to the construction of a chain of CD/CHL stations to warn of approaching landing craft. This chain would be extended around the major part of Britain's coast throughout 1941 and 1942, to provide radar coverage of naval movements and to pass such information to Naval Plotting Rooms (NPRs) and thence to coast batteries (Air Ministry, 1950 (1): 137–9). CD/CHL stations at Gin Head, The Law, Westburn and Crannoch Hill became operational in mid-1942 (TNA, AIR 26/100, AIR 26/103).

Despite this improving coverage, by early 1941 the German Air Force was increasingly making low-level attacks on shipping along the eastern coast of Scotland (Air Ministry, 1950 (1): 139). German aircrews were clearly aware that aircraft could fly in under the radar cover and remain undetected on their approach to the coast. This problem was not to be solved until the introduction from 1942 onwards of stations operating at centimetric wavelengths. Thus, by 1 January 1943 there were five low-power 10 cm stations operational in Scotland – South Ronaldsay, Dunnet Head, Rosehearty, May Island and Lamberton Moor) (Air Ministry, 1950 (1): 578).

The improved performance possible with centimetric radar was also appreciated by the War Office, which introduced CA radars not only to plot vessels but also to observe fall of shot and provide aiming corrections. Although the CA radars in Scotland did not have any hostile targets presented to them, they nonetheless demonstrate the importance the War Office attached to the provision of such coverage (Sayer, 1950: 140–3).

By the end of 1943 the great expansion in the number of radar stations, both in the Home Chain but especially overseas, had placed a tremendous demand on the numbers of trained personnel to operate and maintain these installations. In fact, demand was beginning to outstrip supply at the same time as there was a decreasing threat to Scotland. A review of the situation was made by Fighter Command in November 1943, as a result of which it was decided to implement economies in the Home Chain to release personnel for service overseas. Consequently, nationally 13 stations were to be dismantled, with another nine to be placed on care and maintenance. A number of other stations were reduced to operating on a part-time basis (Air Ministry, 1950 (1): 516). Further contractions of the Home Chain took place in 1944 with the closure of another eight stations, and by March 1945 most of the stations on the west coast had been reduced to a care and maintenance basis (Air Ministry, 1950 (1): 636–8).

At 4.30 pm on 15 March 1946, No 13 Group Filter Room in Inverness closed down, and all remaining radar stations in Scotland went off the air. This was the end of eight years of radar coverage, and it would be several years before Scotland's radar screen would be reactivated in the face of the increasing threat from the Soviet Union (TNA, AIR 26/93).

However, although the last radar stations in Scotland closed down in 1946, it was not the end of the story. Scotland also had several chains of radio navigational aids assisting aircraft in the area. The story dates back to 1941, when it was realised that only one-tenth of Bomber Command aircraft were dropping their bombs within 5 miles of their targets in the industrial area of the Ruhr, never mind hitting them. An idea from the previous year was developed, producing the system known as Gee. The ground element of this was AMES Type 7000, or Type 7K. The time difference in the signals between a master and several slave stations enabled the navigator in the aircraft to determine his position in a grid of parabolic curves. Several chains of stations were built in Britain, with the Northern and North Western chains providing navigational assistance to transatlantic ferry aircraft, for operational missions across the North Sea towards Norway and to the Continent, and for long-range maritime and meteorological reconnaissance missions (TNA, AIR 29/147, AIR 29/167).

The United States developed a similar system, known as Loran, with the Eastern Atlantic Chain having stations in Iceland, in the Faroe Islands and at Mangersta on Lewis. This

3 Map of radar stations in Scotland, August 1942.
(© Historic Environment Scotland)

4 Map of radar stations in Scotland, March 1945.
(© Historic Environment Scotland)

5 Map of radar stations in Scotland, March 1946.
(© Historic Environment Scotland)

6 Map of Northern Gee Chain stations.
(© Historic Environment Scotland)

chain was part of a wider network, providing navigational assistance for Atlantic convoys as well as Coastal and Ferry Command aircraft across the length of the Atlantic (Air Ministry, 1956: 205–8). A version of Loran called Skywave-Synchronized, or SS Loran, relied on the signal being bounced off the atmosphere to synchronise two widely separated ground stations. The SS Loran station at Port Errol was linked with a mobile unit in Bizerta, and this system was used for navigation over Europe and certainly for navigation on several bombing raids (Air Ministry, 1956: 202).

Although their military role declined with the ending of hostilities in 1945, radio navigational aids remained operational in Scotland long after the closing of the last wartime radar station in 1946, and they were the forerunners of the modern satellite Global Positioning System (GPS) that still allows aircraft and other vessels to locate their position accurately.

Chapter 2

The Control and Reporting System in Scotland

The Control and Reporting System was the organisation set up to defend Britain from air attack and was gradually developed and perfected from 1936 onwards. In operation the system started with the early warning radar stations detecting an incoming air raid. This information was reported to a filter room, where it was used to produce an estimated true picture of aircraft movements. This true picture was passed from the filter room to the operations rooms at Fighter Command Headquarters, Group and Sectors simultaneously. In the operations room, decisions were made on how to deal with the attack and instructions would then be given to the fighter squadrons to take off and intercept the raid, or 'scramble'. The fighters would be directed from the operations room until the hostile aircraft were spotted visually, at which point the fighter leader would give the instruction 'Tally ho', signalling that the enemy had been sighted and that instruction from the ground would cease (Mason, 1969: 95).

This system of control worked well during daylight and good weather, when fighters could see individual bombers some distance away. However, at night it was necessary for fighters to get much closer to their target before they could make visual contact, and in fact they had to get closer than filtered plots could provide, with all the delays inherent in processing the information. Consequently, at night, fighters would be controlled directly from GCI radar stations and directed on to individual enemy bombers until within range of the fighter's airborne radar, when the fighter would close on its prey until near enough to identify it as a hostile and open fire (Robinson, 1988: 33–5).

The foregoing is a summary of how the UK Control and Reporting System worked by day and by night. In the context of radar, it is the filtering element of this system which is of primary interest. The work of the filter room was highly skilled and involved the use of a map table marked with the locations of radar stations, with range arcs radiating outward from each station at 10 mile intervals. Plotters would place coloured counters on the table in the grid location given to them over the telephone line by the Radar Operator (each radar station having a different colour for the counters used for its plots). It was the job of the filterers to look at these lines of counters, ideally plotted by several stations, and estimate the true position of the aircraft, placing an arrow with its tip indicating the location and heading of the aircraft. The grid reference at the tip of the arrow then became the true plot (Flint, 1996: 14–15), and this was passed to the Group and Sector Operations Rooms, other Group Filter Rooms and Fighter Command Operations Room (HRA, RDF in Northern Scotland and the Islands).

A good impression of the work carried out by filter plotters is given in the following account by Alison Catto (Manson) of her time at No 14 Group Filter Room, Inverness:

We tracked aircraft over land and sea by CH and CHL radar stations, comparing responses given by these stations – distance, height, direction, average speed, number of aircraft and whether friend or foe. We were supervised and watched by the RAF officers upstairs. When not busy we spoke to the boys who manned those stations – even made dates with them and met them later. We wrote letters, did knitting, sewing. Duties were to keep our Rest Room clean and tidy. Floors swept with wet, used tea covers to keep dust down. During a watch period we had so long off duty for tea/coffee break. (Alison Catto, pers comm)

Another of the plotters at Inverness was Joy Moore (Wallden), who was a Clerk SD (Special Duties) there in 1944. She recalls:

plotting could be one or two radar stations at the same time, and usually different each watch … There were RAF and WAAF plotters – I think one or two relieving. Plotters on the table would say, 'Inverness changing over,' and the relief would plug in her headset to your socket on the table and say, 'Inverness changed over.' I think the breaks were about twenty minutes; there was a small rest room with a tea/coffee bar and buns. On our watch it was always the same RAF bod who served in there, but on other watches it varied.

Numbers on watch – cannot be absolutely certain but I think about twenty plus. There were plotters on the radar table, the observer corps table plus four–six in the balcony (MLS – FC etc.) [Movements Liaison Section, keeping track of friendly aircraft movements, Fighter Command and others] plus two or three relieving … I think two [filter officers were on duty each watch] on the table, but not necessarily at one time. We sometimes saw the same officers on watch … we didn't get to know them well …

[There was little hostile activity at that time, but it included] regular German met flight off the coast of Norway. Attacks on Scapa? No, only panic when I plotted in the wrong square once! [We plotted] anything that flew – sometimes flocks of birds until the radar stations realised what the blips were … I also worked in MLS. Airfields rang up with estimated time of departure, number of aircraft, height and estimated time of arrival. Aircraft also showed IFF [Identification Friend or Foe]. (Joy Moore, pers comm)

The full story of the filtering system in Scotland is somewhat more complex than the outline given above, not least because it evolved throughout the war in the face of the changing demands placed upon it. When the first radar station in Scotland, Drone Hill, became operational in September 1938 it acted as its own filter room (Air Ministry, 1950 (1): 46) until Stanmore Filter Room, at Headquarters, Fighter Command, at Bentley Priory in Middlesex, became operational on 8 November 1938 (Wood with Dempster, 1990: 89). Stanmore Filter Room was the centre of the national air reporting system, receiving plots from radar stations throughout the country. However, it was quickly realised that as the Home Chain expanded, the flow of information to Stanmore would also increase, eventually becoming too much for Stanmore to cope with. It was recommended in 1940 that decentralisation of filtering should take place and each Fighter Group should have its own filter room (Air Ministry, 1963: 16–17).

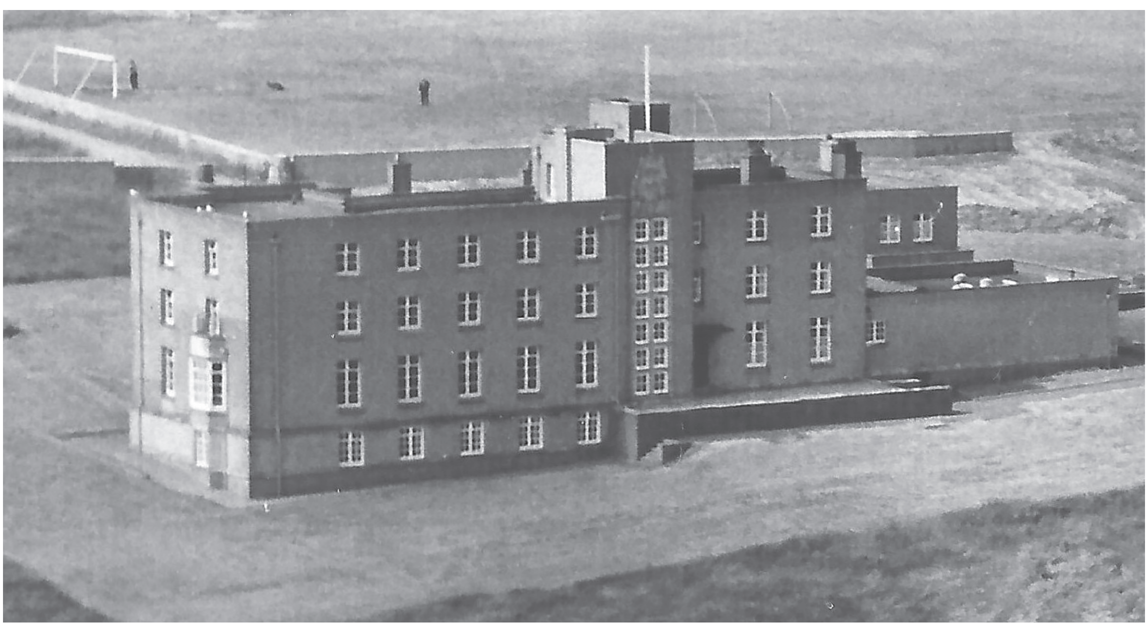
To an extent, this decentralisation was pioneered in Scotland. The decision was taken that Netherbutton CH, which became operational in June 1939, would not 'tell' (pass plots) to Stanmore Filter Room, but would instead report to a local filter room where the information would be of direct use. The plots would then be passed for information purposes to Stanmore. The local filter room was set up at Wick, although the Sector Station there did not become operational until December 1939. Netherbutton was, therefore, the only station not plotting directly to Stanmore at the outbreak of war. Plots continued to be passed by Netherbutton (and later Thrumster and Hillhead) to Wick until 25 September 1940, when Kirkwall Filter Room opened. This was attached to the Sector Operations Room and remained in operation, latterly as a Sub-Filter Room (SFR), until 25 July 1945 (TNA, ADM 116/5790, AIR 26/92).

Decentralisation of filtering continued with the opening on 13 August 1940 of the North Western Filter Room at Preston within No 9 Group, to which North Cairn (and three other stations outwith Scotland) immediately began plotting. By September 1941 North Cairn, Port Mor, Saligo and Kilchiaran were all plotting to Preston, the last three via wireless telegraphy (W/T) to North Cairn and by landline from there to the filter room. However, September 1941 saw the new Fighter Group in Northern Ireland, No 82 Group, become operational along with its filter room on the 25th. From that date the four Scottish radar stations began plotting to Dundonald Filter Room instead of Preston (TNA, AIR 29/141).

Following the decision to set up filter rooms within each Fighter Group, No 13 Group Filter Room opened in Newcastle on 5 September 1941 (TNA, AIR 26/103) and No 14 Group Filter Room in Inverness in October 1941 (TNA, AIR 26/92). Douglas Wood CH station was almost on the dividing line between the two group areas and was instructed to pass plots below the line to Newcastle and above the line to Inverness (TNA, AIR 26/100). It was not, however, as simple as drawing a line between the two groups. No 14 Group covered a huge area, extending from the northern approaches to the Shetland Islands to approximately the River Tay in the south, and from the approaches to the Western Isles to the approaches to the east coast of Scotland. This area included around 45 radar stations, many of which were distant from Inverness Filter Room, and in order to avoid the filter room becoming congested, sub-filter rooms (SFRs) were established at Kirkwall, Lerwick, Stornoway, and Tiree. Kirkwall and Lerwick SFRs handled plots from stations in Orkney and Shetland respectively. Stornoway SFR received information from stations in Lewis and Harris (Eorodale, Habost, Islivig, Brenish, Broad Bay and Rodel Park), Borve Castle on Benbecula, Kendrom on Skye, and Point of Stoer and Sango on the mainland. Benbecula SFR. Tiree SFR handled information from Port Mor, Kilkenneth, Ben Hough and Barrapol on Tiree itself, as well as Carsaig on Mull, Greian Head on Barra, and Saligo and Kilchiaran on Islay (TNA, AIR 26/92, WO 199/534).

Information from the filter rooms was passed to Group and Sector Operations Rooms, from where decisions were made about what action to take, fighter aircraft to be ordered to take off to intercept and so on (Mason, 1969: 95). The role of the Sector Station, and in particular the Sector Controller, in deciding how to respond

7 Aerial view of Raigmore, with Inverness Filter Room under construction in the clearing in the trees at top right of the photograph, taken on 9 May 1942.
(© Historic Environment Scotland)



8 Boy's Hostel, Lerwick, used as Lerwick Fighter Sector Headquarters and between January 1941 and August 1945 for Lerwick SFR.
(© Dennis Coutts)

to the information and which units to allocate was therefore of great importance in the air defence system. Fighter Sector Headquarters operated at Sumburgh (January 1941–January 1942), Lerwick (January 1942–August 1945), Kirkwall (October 1940–March 1946), Wick (February 1940–October 1940), Tain (October 1941–November 1942), Peterhead (May 1942–July 1944), Dyce (May 1940–May 1942), Turnhouse (September 1939–April 1946), Prestwick (January 1941–April 1941), Ayr (April 1941–May 1943), Ouston (March 1941–July 1943) and Usworth (September 1939–March 1941). Additional information on these stations, as well as the fighter stations and units under their control, is given in Smith (1983) and Rawlings (1993).

A reorganisation of Fighter Command led to No 13 Group being amalgamated with No 14 Group, and Newcastle Filter Room closing on 15 July 1943 (although it remained in use for other purposes). No 13 Group Headquarters were established at the former 14 Group HQ in Inverness, and Inverness Filter Room was responsible for plotting aircraft across Scotland and its sea approaches. On 15 March 1946 Inverness Filter Room closed down (TNA, AIR 26/93).

In addition to radar stations passing aircraft plots to the filter rooms, CHL (including CDU) and centimetric stations were also passing on information on ships and surfaced submarines. For stations in Shetland, Orkney and the north of Scotland, this was via W/T to the destroyer depot ship HMS *Greenwich* at Lyness in Scapa Flow (HRA, Naval Shore Radar). Later, dedicated Naval Plotting Rooms (NPRs) at Aberdeen, Invergordon, Lerwick, Lyness, Pitreavie and Stornoway all received radar information from Scottish radar stations, as did Belfast NPR, to which Kilchiaran plotted from July 1943 until 8 June 1945. Ships were plotted in the NPRs from information passed directly from the radar stations, with no filtering of plots taking place (TNA, AIR 26/92).

Filter rooms receiving plots from Scottish radar stations

Stanmore Filter Room
Unit Fighter Command Headquarters
Region Middlesex
NGR TQ 1549 9353
In use 8 November 1938 – April 1968[2]

Preston Filter Room
Unit No 9 (Fighter) Group Headquarters
Region Lancashire
NGR SD 521 361
In use 13 August 1940 – 25 September 1941[3]

Newcastle Filter Room
Unit No 13 (Fighter) Group Headquarters
Region Northumberland
NGR NZ 2121 6687
In use 5 September 1941 – 15 July 1943

Wick Filter Room
Unit Wick Sector, No 13 (Fighter) Group, December 1939 – 1 September 1940
Unit Wick Sector, No 14 (Fighter) Group, 1 September 1940 – 25 September 1940
Region Caithness
NGR ND 3655 5151
NMRS ND35SE 223
In use December 1939 – 25 September 1940

[2] The date Stanmore Filter Room closed down.
[3] The date Scottish stations ceased plotting to Preston and began plotting to Dundonald.

Kirkwall Filter Room
Unit Wick Sector, No 14 (Fighter) Group, 25 September 1940 – 17 October 1940
Unit Kirkwall Sector, No 14 (Fighter) Group, 17 October 1940 – 22 October 1941
Region Orkney
NGR HY 4540 0996
NMRS HY40NE 41.01
In use 25 September 1940 – 22 October 1941

Inverness Filter Room
Unit No 14 (Fighter) Group Headquarters, 22 October 1941 – 15 July 1943
Unit No 13 (Fighter) Group Headquarters, 15 July 1943 – 15 March 1946

Inverness (Drummossie Moor)
NGR NH 7052 4286
NMRS NH74SW 19
In use 22 October 1941 – 28 February 1943

Inverness (Raigmore)
NGR NH 6826 4560
NMRS NH64NE 642
In use 1 March 1943 – 15 March 1946

Benbecula SFR
Region Benbecula
NGR NF 7791 5546
NMRS NF75NE 4
In use dates unknown

Kirkwall SFR
Region Orkney
NGR HY 4540 0996
NMRS HY40NE 41.01
In use 22 October 1941 – 29 January 1944

Kirkwall SFR
Region Orkney
NGR HY 4604 0970
NMRS HY40NE 28
In use 29 January 1944 – 25 July 1945

Lerwick SFR
Region Shetland
NGR HU 4806 4081
NMRS HU44SE 105
In use 17 January 1942 – 5 August 1945

Stornoway SFR
Region Lewis
NGR NB 4381 3320
NMRS NB43SE 60
In use November 1941 – 1945

Sumburgh SFR
Region Shetland
NGR HU 3904 1101
NMRS HU31SE 34.04
In use 29 January 1941 – 17 January 1942

Tiree SFR
Region Tiree
NGR NL 9956 4449
NMRS NL94SE 54
In use April 1942 – 27 May 1943

Dundonald Filter Room
Unit No 82 (Fighter) Group Headquarters
Region County Down
NGR NW 526 300
In use 25 September 1941[4] – date unknown

Naval Plotting Rooms receiving plots from Scottish radar stations

Aberdeen NPR
Region Aberdeenshire
NGR NJ 965 056
NMRS NJ90NE 22
In use 1942 – 26 May 1945

Belfast NPR
Region County Antrim
NGR NW 4582 3473
In use July 1943[5] – 8 June 1945

4 See note 3.
5 The date Kilchiaran started plotting to Belfast NPR.

Invergordon NPR

Region	Ross and Cromarty
NGR	NH 8086 6706
NMRS	NH86NW 11.01
In use	1942 – circa 1945

Lerwick NPR

Region	Shetland
NGR	HU 4761 4156
NMRS	HU44SE 3
In use	May 1942 – 12 June 1945

Lyness NPR

Region	Orkney
NGR	ND 2940 9446
NMRS	ND29SE 2
In use	1942 – 19 February 1945

Pitreavie NPR

Region	Fife
NGR	NT 1172 8483
NMRS	NT18SW 9.06
In use	late 1940 – 26 May 1945

Stornoway NPR

Region	Lewis
NGR	NB 4200 3317
NMRS	NB43SW 49
In use	date unknown – June 1943

Chapter 3

Architecture of radar

All radar systems comprise essentially three elements: transmitter, receiver (and their associated aerial systems) and power supply. The architecture of radar stations necessarily reflects this. Most of the permanent stations in Scotland were powered from the National Grid, but were nonetheless provided with electricity generators to cover any interruption in the mains supply. Stations north of Loth, as well as those in Orkney, Shetland, the Western Isles and other offshore islands, were not connected to the Grid and thus had both main and stand-by generators.

Chain Home

The backbone of the early warning system in Scotland between 1938 and 1946 was Chain Home. This was a long-range early warning radar, based on radio equipment developed for atmospheric research, and the first station, at Bawdsey in Suffolk, was handed over to the RAF in September 1937. CH operated by sending pulses of radio energy at a wavelength of around 10 to 13 metres, with a back-up wavelength of 6 to 7 metres (Swords, 1986: 196). The dipole aerials were half the length of the wavelength, ie for CH the aerials were up to 6½ metres long. This floodlit an area in front of the station through an arc of around 60°, centred on a bearing known as the line of shoot. The re-radiated or reflected radio energy would be received and the time taken for the pulse to be transmitted, re-radiated and received meant that the range could be calculated. Height and bearing of the target was calculated by comparison of the signal received at different aerials. Measurement of distance, range and bearing allowed for the position of the target to be pinpointed. More detailed information on the technical details of CH and other British radars can be found in Swords (1986).

Although CH had been designed and introduced into service before the outbreak of war in September 1939, development continued throughout the war to give increased range, improve definition, fill gaps in the coverage of individual stations, limit the effects of jamming and so on.

As the Home Chain was being hurriedly set up in the period before and after the outbreak of war, it was necessary to provide radar cover quicker than a full permanent, protected CH station could be built. This resulted in sites developing over time as rushed emergency cover was gradually replaced with the permanent stations appearing. There were three stages in the provision of CH stations: Advance, Intermediate and Final, although it should be emphasised that not all stations had all three stages; some started life as Intermediate stations, whilst some went straight from Advance CH to Final.

Advance Chain Home

Advance CH stations were the first of the three stages of CH stations and were usually set up under hurried circumstances when cover was urgently required in a particular area. They came in several different forms, and there was no 'standard' Advance CH. The first one set up in Scotland was the emergency station at Drone Hill in September 1938, which had the equipment in wheeled trailers and used telescopic 70 foot Merryweather towers. Generally, however, most Advance CH sites had the transmitter and receiver housed in wooden huts with aerials mounted on a variety of different masts, usually 70, 87, 90 or 105 foot.

Intermediate Chain Home

The Intermediate stage used wooden huts for the equipment, as Advance CH stations did, but the aerials were mounted on two 240 foot wooden towers, one for the transmitter aerials and one for the receiver. Both towers would then be used as receiver towers when the Final CH station replaced the Intermediate. Broad

9 A 70 foot transportable tower made by Merryweather, with a receiver trailer behind. (© Frank Roberts)

Bay is an example of a site which reached the Intermediate CH stage but was never replaced with a Final CH station. More unusual was Brenish, which was an Intermediate CH but had the aerials mounted on two 120 foot towers.

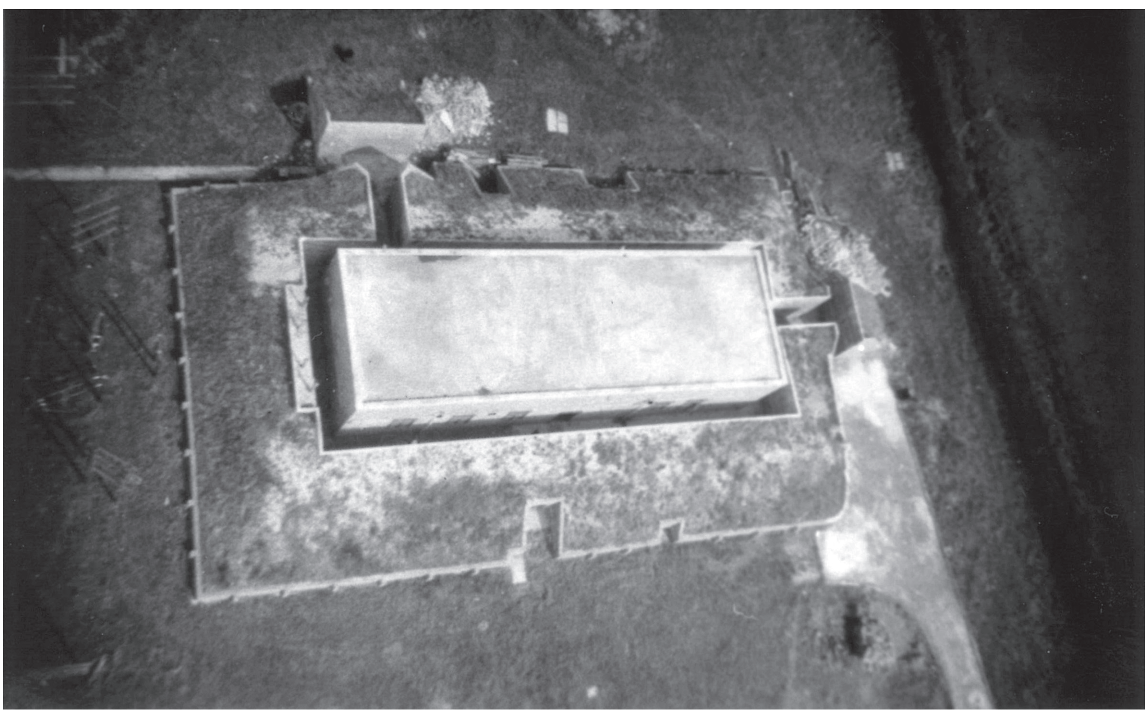
Final Chain Home

Final CH was the ultimate development of the CH system, with equipment housed in protected brick or concrete buildings and the aerials on large steel or wooden towers or masts. There were two different types of CH station which determined the structures and layout which would appear on the Final station. These were East Coast and West Coast stations, although these terms are not entirely geographically accurate, since some West Coast stations were actually on the east coast of Scotland. The descriptions given for the two refer to Final CH stations, since Advance and Intermediate stations were the same for both East Coast and West Coast types.

East Coast Chain Home

The East Coast stations were built on the pattern of the first station at Bawdsey. As such, these stations had two transmitters housed together in a single brick Type A Transmitter Block with two receivers in a Type A Receiver Block. These blocks were protected brick buildings, surrounded by revetted blast walls and with a 5½ foot thick layer of shingle enclosed within the roof in order to dissipate the shock of a direct hit bomb blast.

Transmitter aerials were suspended from steel towers, four of which ran in a line in front of the Transmitter Block, spaced about 180 feet between centres. The towers themselves were built by three different companies, Blaw Knox



10 A Type A Transmitter Block, from above, taken in 1945.
(© Murray Cass)

Ltd, Radio Communication Company Ltd and JL Eve Construction Company Ltd, and each company's towers were slightly different in design. The Blaw Knox towers were 358 feet 2 inches high, those of RCC were 358 feet high and the JL Eve towers were 357 feet 11¾ inches high. Each had cantilevered platforms at 50 feet, 200 feet and 350 feet, and these generally were known as 350 foot towers.

The receiver aerials were mounted on 240 foot wooden towers, the four towers forming a rhombus centred on the Receiver Block. Although there were four transmitter towers and four receiver towers, not all of these carried aerials. It was originally planned for CH to be able to operate on any one of four different frequencies in order to make it difficult to jam the stations – if jammed, they would simply switch to a different frequency. Each tower would have carried the aerials for one of the frequencies, hence four frequencies and four transmitter and four receiver towers. However, it was decided that four separate frequencies were not required and only two were ever used. This meant that only two of each of the towers were used. However, this did not remain the case. From mid-1941 onwards, new transmitter aerial arrays were erected which, rather than being suspended between the platforms on individual towers, were strung like a curtain between towers, and hence were known as curtain arrays. Since these were slung between towers, it required three towers to carry the two different arrays. Most of the stations retained their towers as originally constructed, even though one 350 foot and two 240 foot towers were, essentially, redundant.

The East Coast CH stations in Scotland (Drone Hill, Douglas Wood, Schoolhill, Hillhead and Netherbutton) all followed this pattern, with one exception. Although Hillhead had the two Type A blocks and four 240 foot receiver towers, it had four 325 foot guyed transmitter masts normally found on West Coast stations.

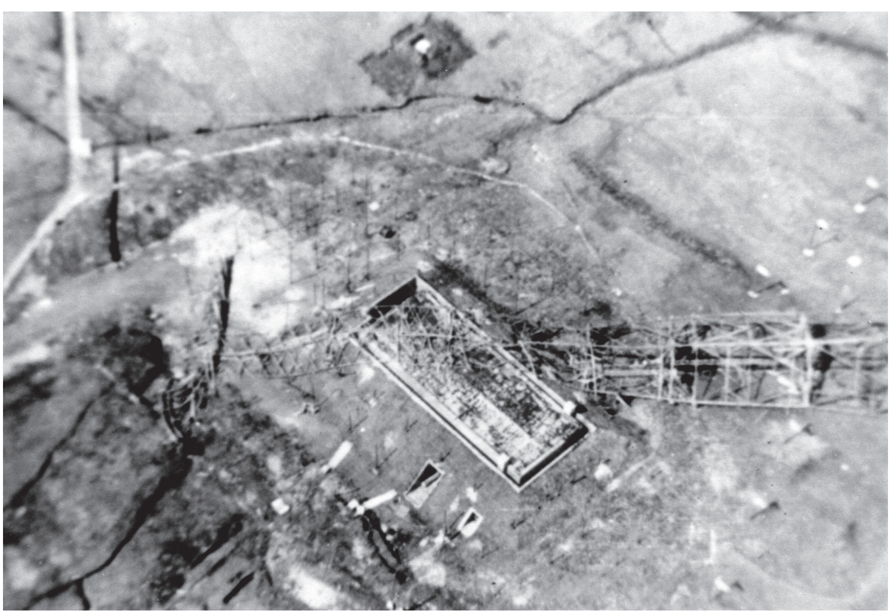
11 A typical East Coast type Final CH station, with the four 350 foot steel transmitter towers on the left and the four 240 foot wooden receiver towers on the right.
(© Historic Environment Scotland)

Scotland, unlike the rest of the UK, also had a group of non-standard East Coast stations which had technical buildings like the Type A of standard East Coast stations, but to a new 1940 design, known as Type A1. These stations (Noss Hill, Skaw, Tannach and Whale Head) had one Type A1 Transmitter Block and one Type A1 Receiver Block. Transmitter aerials were carried on two 350 foot towers (except at Tannach, which had 325 foot guyed masts) and receiver aerials on two 240 foot towers. Interestingly, the six 350 foot steel towers used at Noss Hill, Skaw and Whale Head had been removed from CH stations in England where they were spare, and re-erected at these three sites. The two towers at Noss Hill came from Great Bromley and Staxton Wold, the two at Skaw from Pevensey and Ventnor, and those at Whale Head from Poling and Rye.

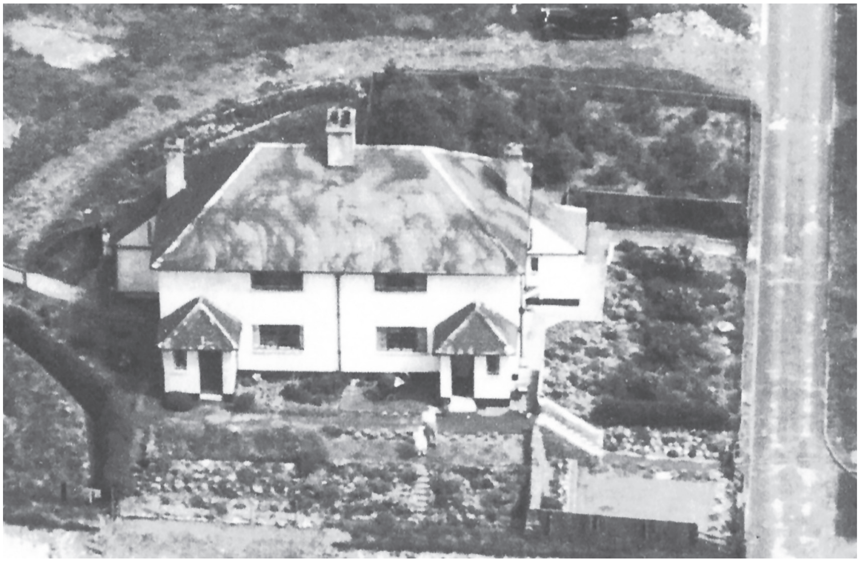
Another distinctive structure found on East Coast CH stations was the Warden's Quarters. Security of the stations pre-war was provided by two civilian wardens who were accommodated in two semi-detached houses built on the station. Later, these houses would be used by the RAF for other purposes, often as quarters for the Station Commanding Officer.

West Coast Chain Home

The West Coast CH stations marked a crucial change in policy with the belief that dispersal was the best form of protection. Thus, instead of having a single Transmitter Block containing two transmitters, and a single Receiver Block containing two receivers, West Coast stations had two Transmitter Blocks and two Receiver Blocks, each containing one set. Buildings were either Type B or Type C. The former was similar to the Type A but without the protected roof. The only station in Scotland with Type B buildings (only one Transmitter Block and one Receiver Block) was North Cairn, which was also unusual for a West Coast station in that it had two 350 foot steel transmitter towers, with two 240 foot wooden receiver towers. The other West Coast stations in Scotland (at Kilkenneth, Loth, Saligo and Sango) each had Type C buildings: two for transmitters and two for receivers. The Type C building was, unlike



12 A Type A1 Transmitter Block from above, taken in 1947. (© Andrew Laurenson, via Leslie Smith)



13 Warden's Quarters.
(© Jim Corbett Collection)

all the other types, constructed from reinforced concrete, rather than brick. The buildings at Sango were completely earthed over for extra protection, but those at Kilkenneth, Loth and Saligo were not.

The aerial structures were also largely different on the West Coast stations. Transmitter aerials were slung in a curtain between four 325 foot guyed masts, arranged in two pairs, one pair to each curtain array. Receiver aerials were mounted on two 240 foot wooden towers. There were, of course, exceptions to this: North Cairn as already mentioned had 350 foot transmitter towers. Loth was even more unusual in that the transmitter aerials were mounted on two 180 foot towers and the receiver aerials were on two 120 foot towers.

14 A typical West Coast type Final CH station, with the two 240 foot receiver towers at centre left and the four 325 foot transmitter masts in the centre and right of the photograph.
(© Historical Radar Archive)

15 Type C Transmitter Block at Saligo, taken in 1996. (© Historical Radar Archive)

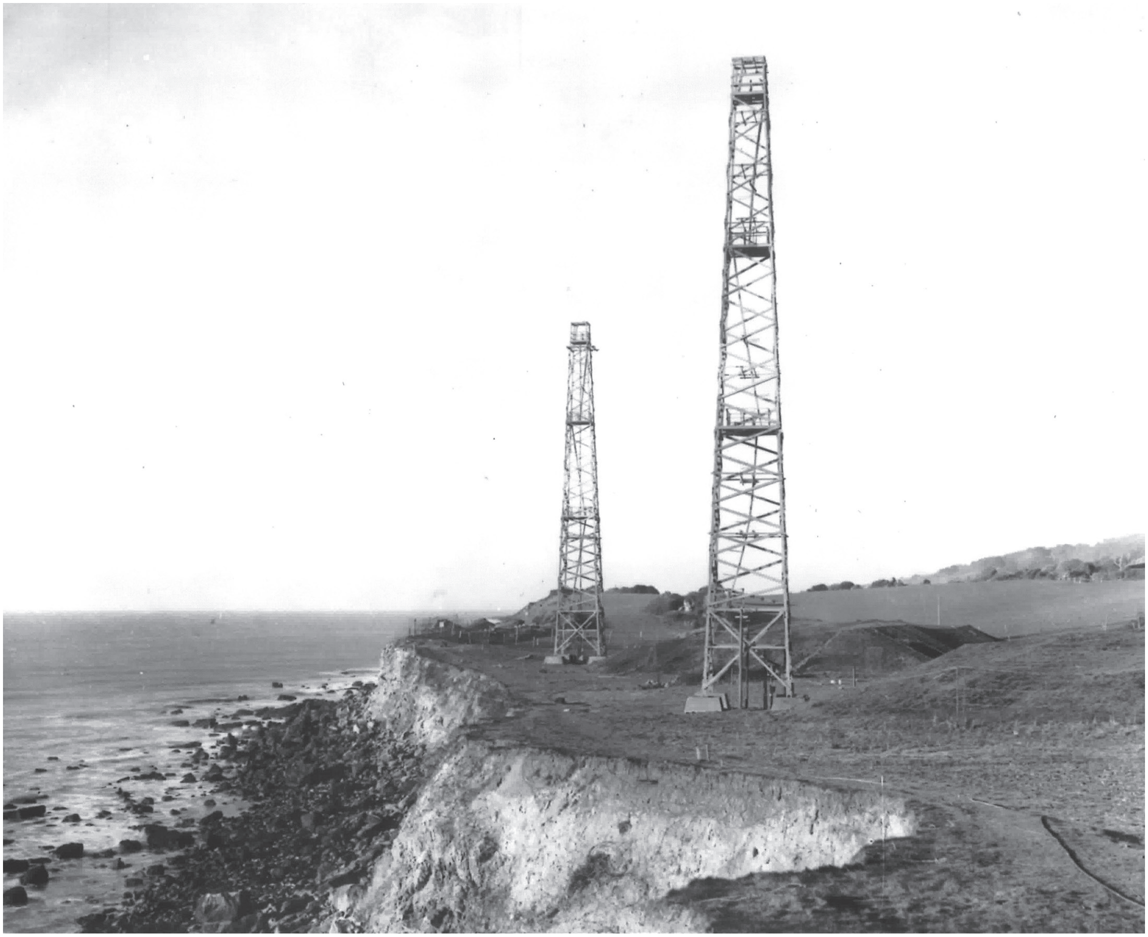
Buried Reserve

In order to provide back-up should the main station go off the air, the decision had been made to construct underground buildings housing stand-by equipment. This programme was accelerated following air attacks on radar stations in the south of England on 12 August 1940. Type E buildings, which were built below ground from brick, were constructed at Drone Hill, Douglas Wood and Netherbutton, and these Buried Reserves would have one building for the transmitter and one for the receiver. At Drone Hill and Douglas Wood these were at opposite ends of the station, next to their respective surface sites, ie the Buried Reserve transmitter was next to the transmitter site on the surface, and the same with the receivers. At Netherbutton, the two Buried Reserve buildings were together on a separate site a little distance from the main station. Similar buildings made of reinforced concrete, known as Type F buildings, were constructed at Schoolhill, which, like Netherbutton, had a separate Buried Reserve site, although at Schoolhill it was adjacent to the surface station. The Buried Reserves had two 120 foot wooden towers, one for the transmitter aerials and the other for the receiver aerials. The four stations named above were the only ones in Scotland to have underground Buried Reserves. The scheme was eventually abandoned because it was very difficult to keep these underground buildings free from water.

Remote Reserve

The simpler alternative to constructing underground Buried Reserves was to construct surface buildings which were located some distance from the main station and therefore likely to escape any attack on the main site. These were known as Remote Reserves, which consisted of two Type C buildings with two 120 foot towers. Hillhead, Loth, Noss Hill, Skaw, Tannach and Whale Head all had Remote Reserve sites.

Brenish, Broad Bay, Kilkenneth, North Cairn, Saligo and Sango were the only CH stations in Scotland to have no reserve site of either type (TNA, AVIA 7/334).



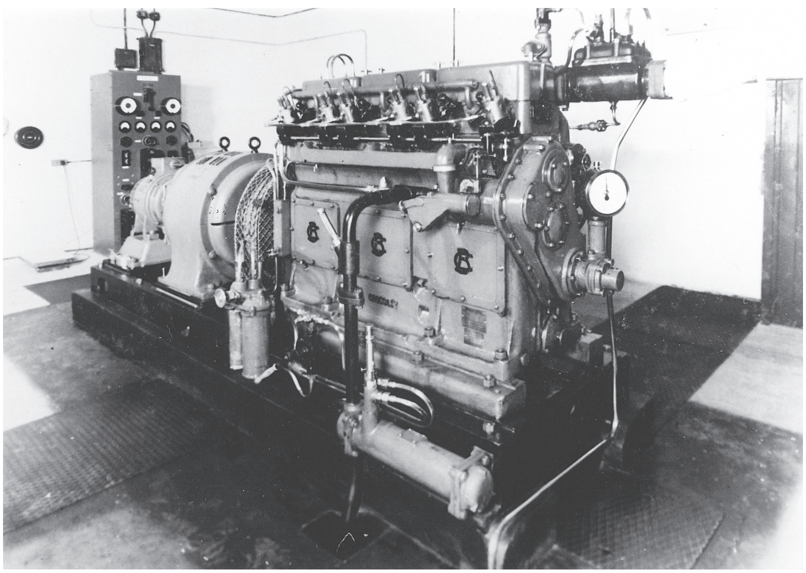
16 A typical Remote Reserve site, with two 120 foot towers and the technical buildings hidden under camouflage netting.
(© Imperial War Museum London CH15174)

Power House/Stand-by Set House

The other principal structure found on CH stations was the Stand-by Set House, which housed an electric generator, usually diesel-driven, to provide sufficient power to maintain technical operations if there was an interruption to the mains supply. The Stand-by Set House was a protected brick building with earth traverses, but was distinctive internally by the shelf which supported the generator coolant header tank.

For stations north of Loth, and on the islands, there was no mains supply and a Main Power House would be provided, in addition to a Stand-by Set House. Whereas the Stand-by Set House was usually located relatively close to the Transmitter Block so that, in the event of a failure in the power supply, Radar Mechanics could quickly start up the generator and get the station back on the air, the Power House could be some distance away. Since the Power House was operating 24 hours a day, there would be no rush to start it up; it was running all the time.

17 A typical East Coast CH Stand-by Set House.
(© Historic Environment Scotland)



18 A Crossley electric generator inside a Power House.
(© Historical Radar Archive)

Mobile Radio Unit

Associated with CH was the MRU, designated AMES Type 9. This was a transportable radar unit originally intended as a reserve for CH stations and eventually used overseas. They were used to provide temporary radar cover prior to, or instead of, construction of a full CH station.

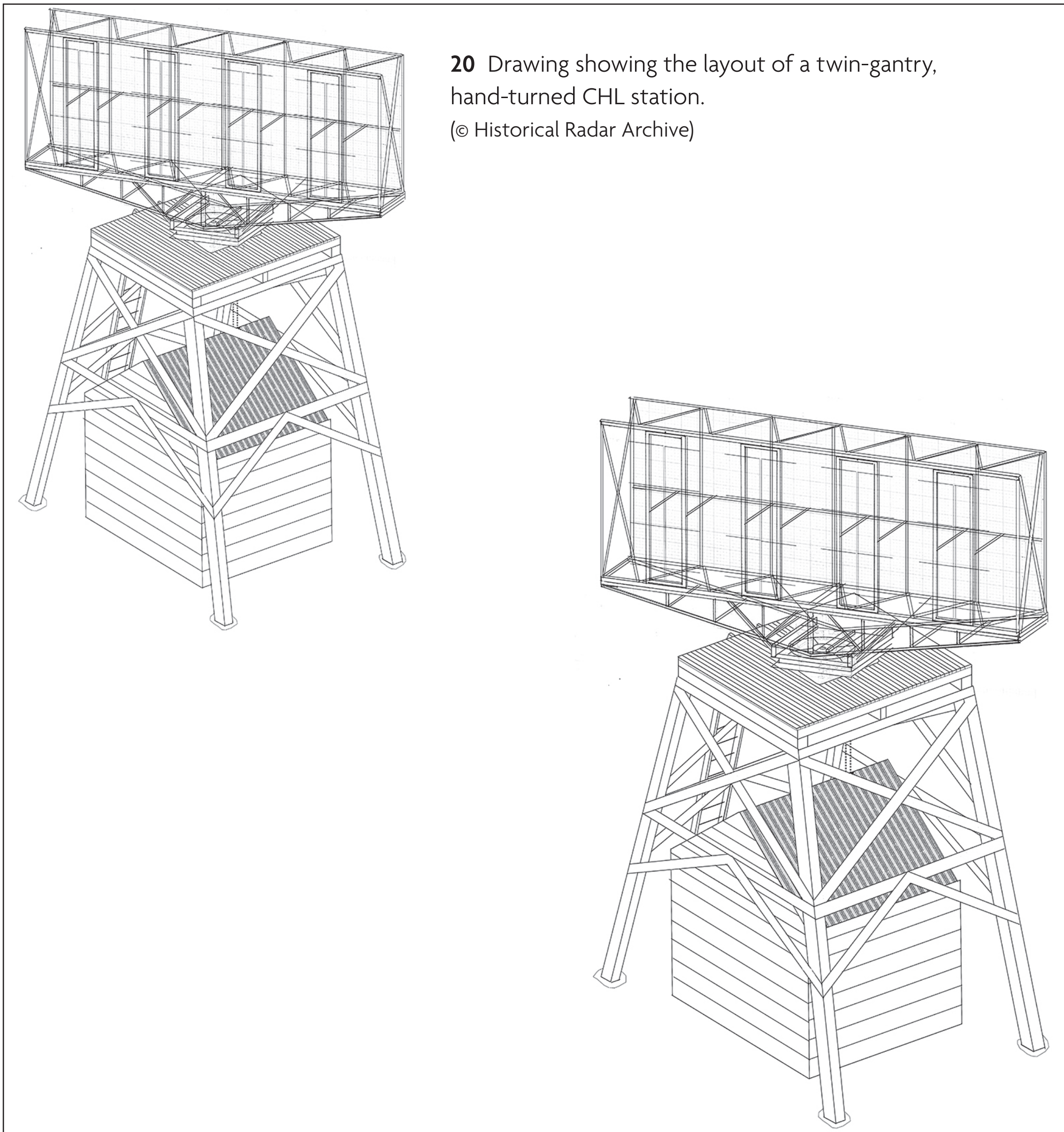
Chain Home Low

CHL grew out of the work by the Army team at Bawdsey who were developing a radar known as CD, or Coast Defence, for plotting shipping. The Air Ministry saw the value of this equipment and most of the sets were used to supplement the coverage given by CH, providing improved detection of low-flying aircraft in particular. The Admiralty also appreciated the usefulness of the equipment

19 A Mobile Radio Unit.
(© Imperial War Museum London CH15200)

and set up several stations in Orkney, Shetland and northern Scotland for tracking U-boats attempting to break out of the North Sea. The equipment operated on a wavelength of 1½ metres, much shorter than the 11 to 13 metres of CH. This gave a narrow 'beam' which allowed for the aerials to be rotated, described as a 'radio lighthouse' (Swords, 1986: 236). This allowed for more precise plotting of targets, particularly when the Plan Position Indicator (PPI) map-like displays were introduced, although CHL and CDU had no provision for determining the height of an aircraft. The main advantage with the shorter wavelength was that it provided coverage at lower heights than was generally possible with CH, allowing for earlier detection of low-flying aircraft and also for the detection of ships and surfaced submarines.

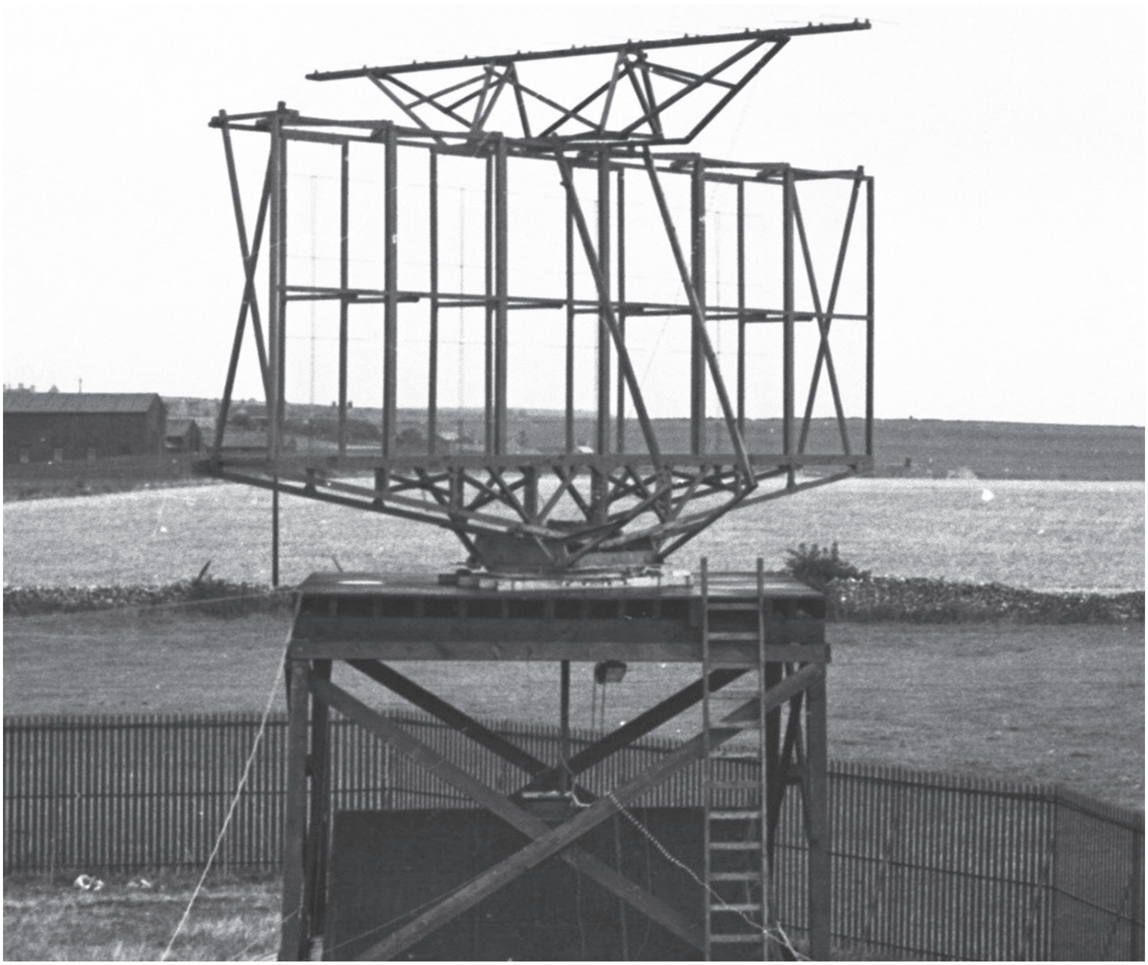
The first CHL and CDU stations were built from November 1939 onwards and were twin-gantry stations, with separate aerial arrays for transmitting and receiving. These gantries, which were 20 feet high, each straddled a hut containing the transmitter or receiver, and were located between 100 and 200 feet apart. At CHL stations the Transmitter Hut measured 18 feet by 15 feet; the Receiver Hut measured 20 feet by 18 feet and was larger because it housed not only the receiver but also the plotting table and telephone switchboard. In the case of the CDU stations the Transmitter Hut and Receiver Hut were the same size, both 14 feet square. The first stations (Anstruther, Sumburgh and Fair Isle) employed wooden huts, but the later stations had huts made of concrete (Saxavord) or brick (South Ronaldsay and Dunnet Head) to withstand the weather.



20 Drawing showing the layout of a twin-gantry, hand-turned CHL station.
(© Historical Radar Archive)

Sumburgh and Fair Isle eventually had their wooden huts encased in concrete shells.

In both CHL and CDU stations, the aerials were turned by hand using a modified bicycle frame, upturned and bolted to the floor, with the pedals replaced by wooden handles. This mechanism was linked to the aerial array shaft by a chain which ran up through a hole in the roof. This drive was later replaced by Hopkins turning gear which used toothed gears to drive the array from a steering wheel. Eventually hand turning was replaced by power turning. Many of the twin-gantry stations later converted to using only one of the gantries, either with the receiving array having a single transmitting Yagi aerial mounted on top, or with the aerials in the array itself divided between transmitting and receiving. This was an intermediate step



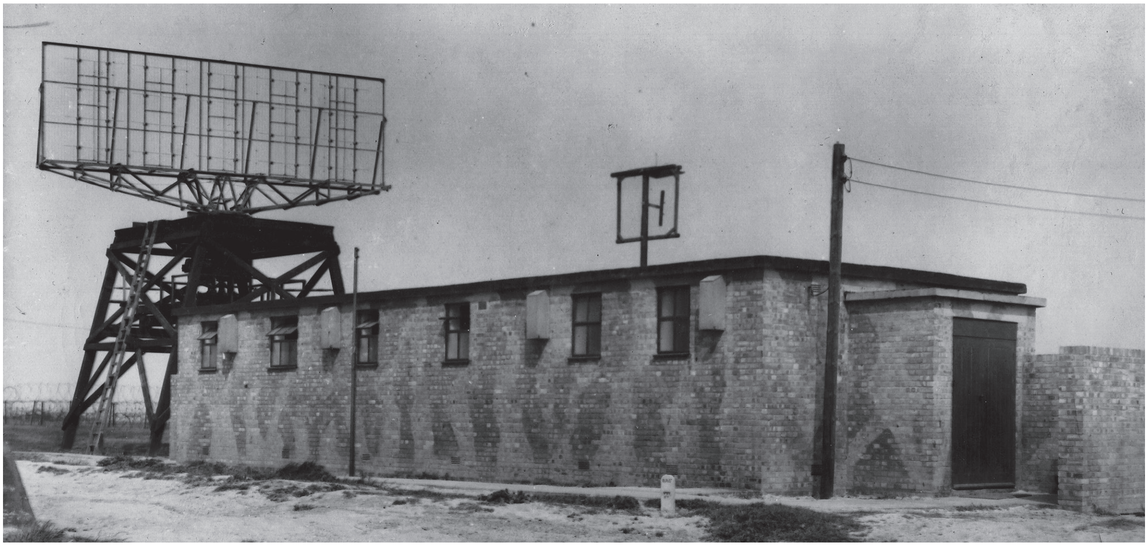
21 A single-gantry CHL with a Yagi transmitter aerial mounted on top of the receiver array. (© Historical Radar Archive)

between the twin-gantry CHLs and the new CHLs about to arrive.

From 1941 onwards combined transmitter and receiver buildings were built from brick. These replaced the earlier twin-gantry equipment on older stations and were constructed on all new stations. These combined T & R Blocks measured 50 feet by 18 feet, with a single 20 foot aerial gantry either at the end or at the side of the building. This combined common aerial working (a single aerial array for both transmitting and receiving) and power turning to greatly improve the operation of the equipment. Although many of these stations were built in 1942, they were nonetheless known as 1941 Type stations.

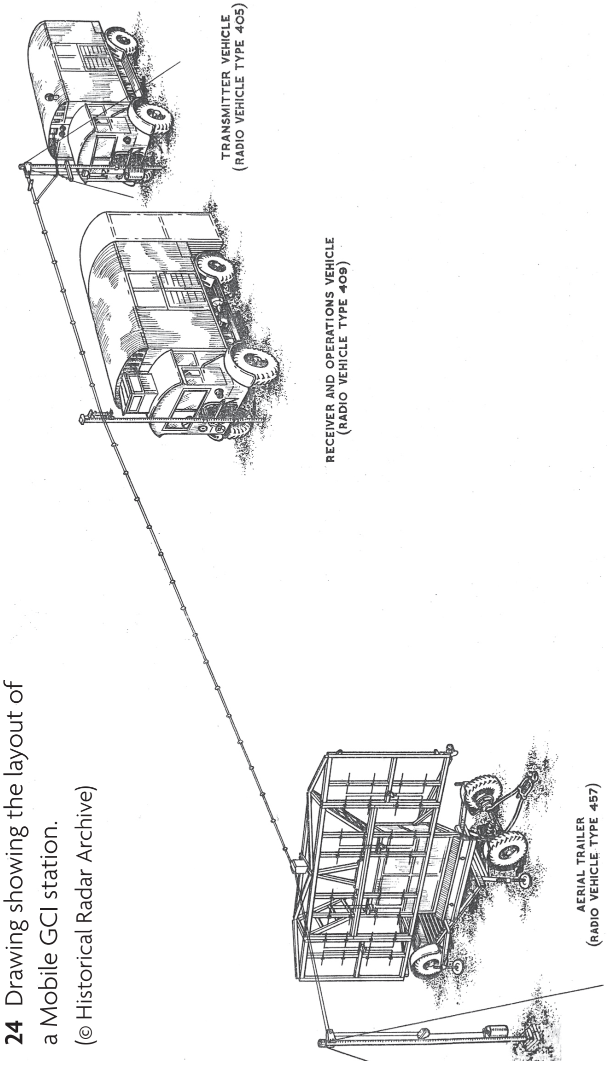
A few 1941 Type CHL stations on the Scottish islands did not have a brick-built combined T & R Block. Instead, a prefabricated wooden hut to identical dimensions was used, surrounded by a brick blast wall, as shown by the photograph of Clett in Illustration 51. These huts were of the type used by Intermediate GCI stations shown in Illustrations 25 and 26.

From December 1941 onwards, on some low-lying stations in England an additional

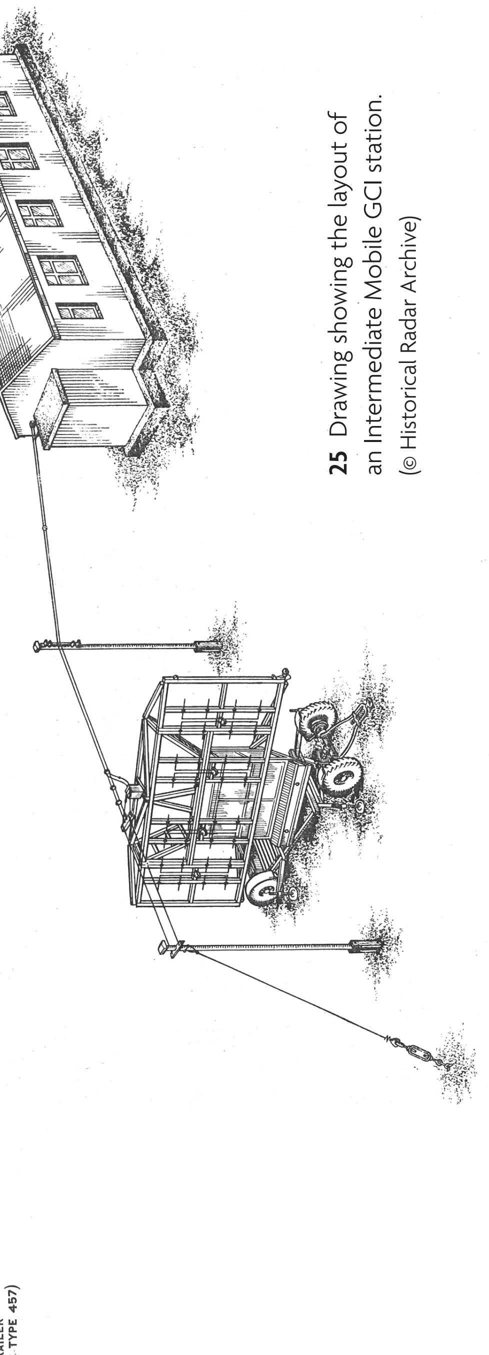


22 A typical 1941 Type CHL with brick-built combined T & R Block and rotating aerial array on a 20 foot gantry.
(© Historical Radar Archive)

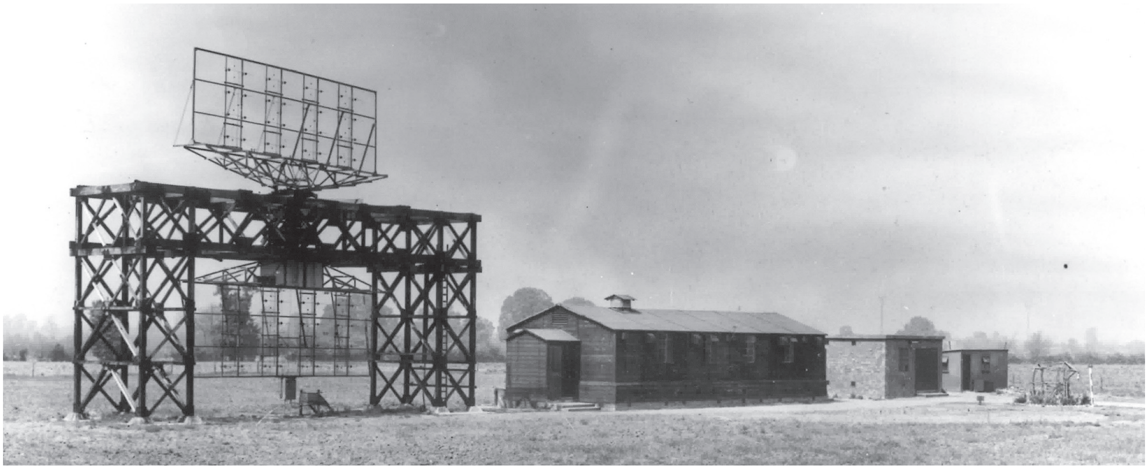
23 A CD/CHL station.
(© Historical Radar Archive)



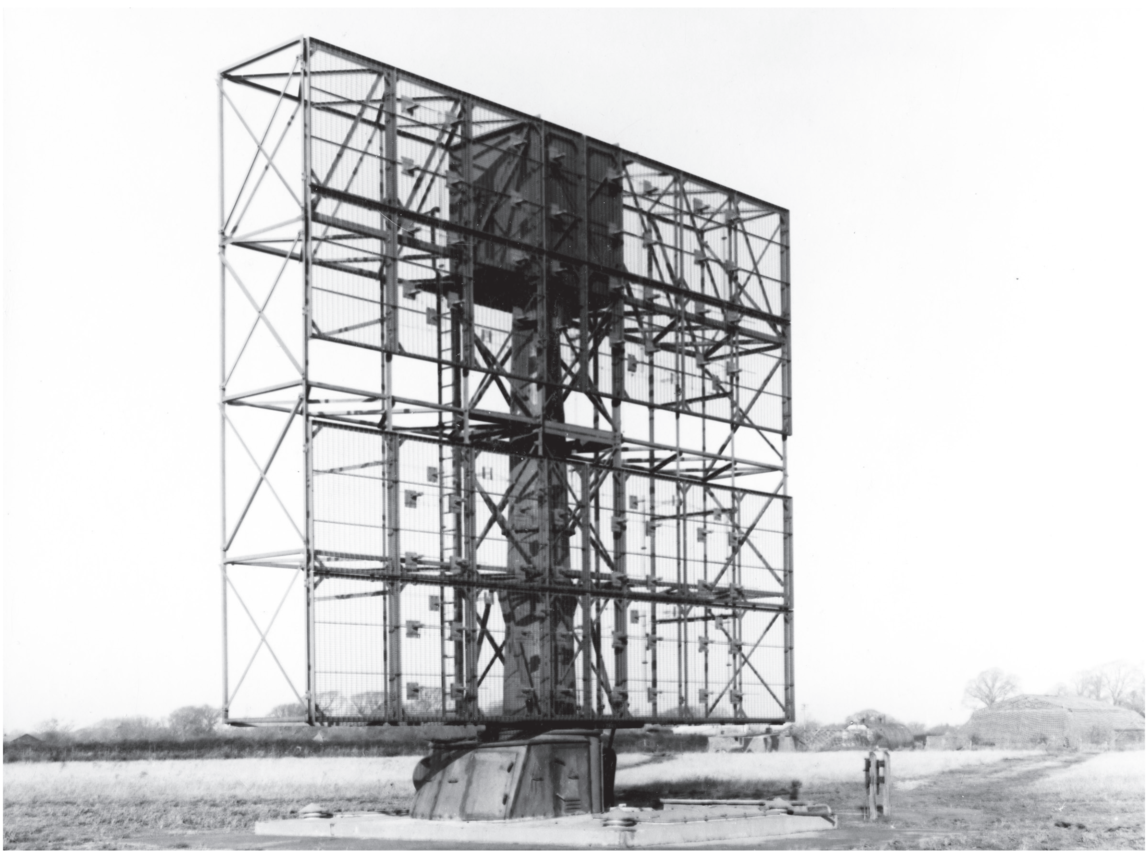
24 Drawing showing the layout of a Mobile GCI station.
(© Historical Radar Archive)



25 Drawing showing the layout of an Intermediate Mobile GCI station.
(© Historical Radar Archive)



26 An Intermediate Transportable GCI station.
(© Imperial War Museum London CH15195)



27 A Final GCI station, with the Happidrome Operations Room under camouflage netting in the background on the right and the Type 7 aerial array in the foreground.
(© Imperial War Museum London CH15188)

28 Type 15 GCI convoy technical vehicles.
(© Historical Radar Archive)

CHL equipment, known as Chain Home Low (Tower), was installed on a 185 foot tower, although none of the CHL stations in Scotland ever had such towers built.

Coast Defence/Chain Home Low

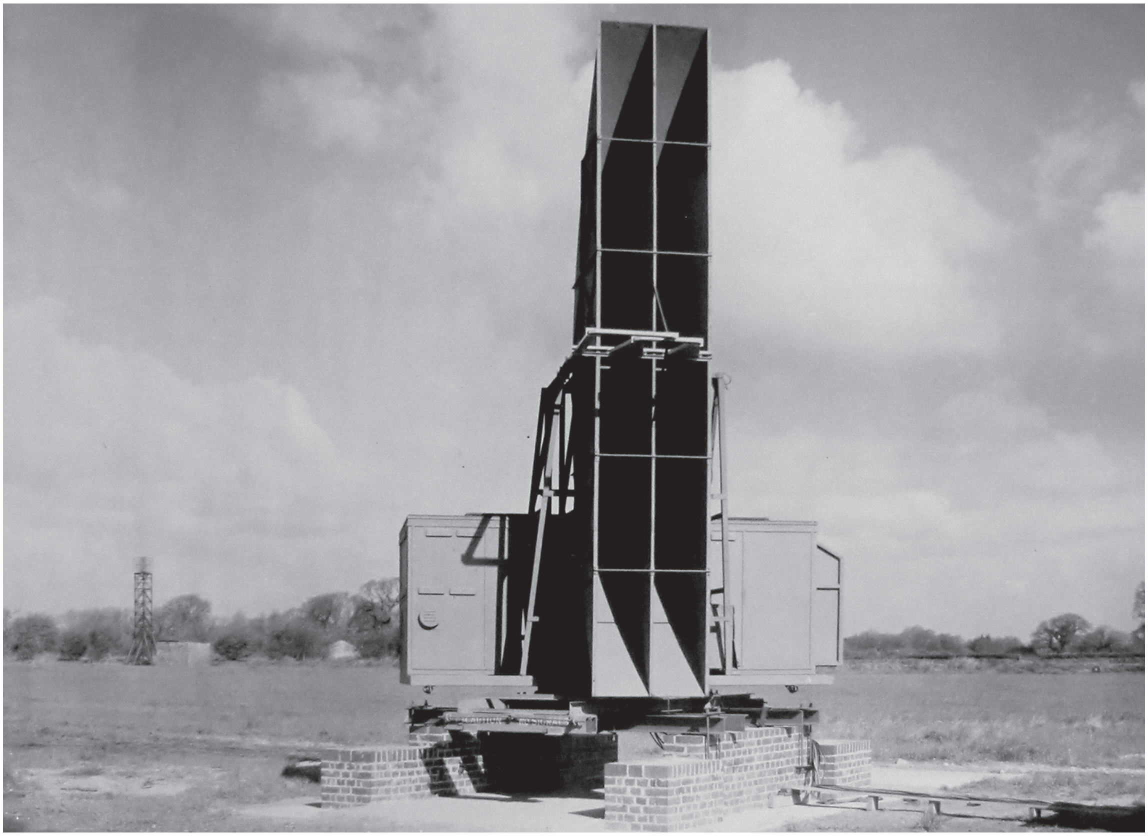
Although the RAF and Royal Navy 1½ metre stations for plotting shipping and low-flying aircraft, CHL and CDU respectively, were very much the same, the equivalent Army design, known as CD/CHL, was architecturally very different, even if the equipment was the same. The combined T & R Block was of concrete construction, but the aerial gantry was mounted on the roof of the building, rather than as a separate free-standing structure. To support the weight of the gantry and aerial array, four buttresses were built into the walls.

These stations were operated by Army personnel in the case of Gin Head, jointly by RAF and Royal Navy personnel at Crannoch Hill, and by staff from all three services (and hence were known as Triple Service stations) at The Law and Westburn.

29 A Type 13 Mk I radar.
(© Historical Radar Archive)

Ground Control of Interception

GCI stations were built to control night fighters directly from the radar stations themselves, thereby providing the accurate close control necessary for successful interceptions at night. These stations came in four stages of development: Mobile, Intermediate Mobile, Intermediate Transportable and Final. Mobile GCI was composed, as the name suggests, of fully mobile equipment, with the transmitter and receiver in lorries and the aerial arrays on wooden cabins on four-wheeled trailers. These mobile convoys could be set up in 12 hours, so coverage could be provided quickly where

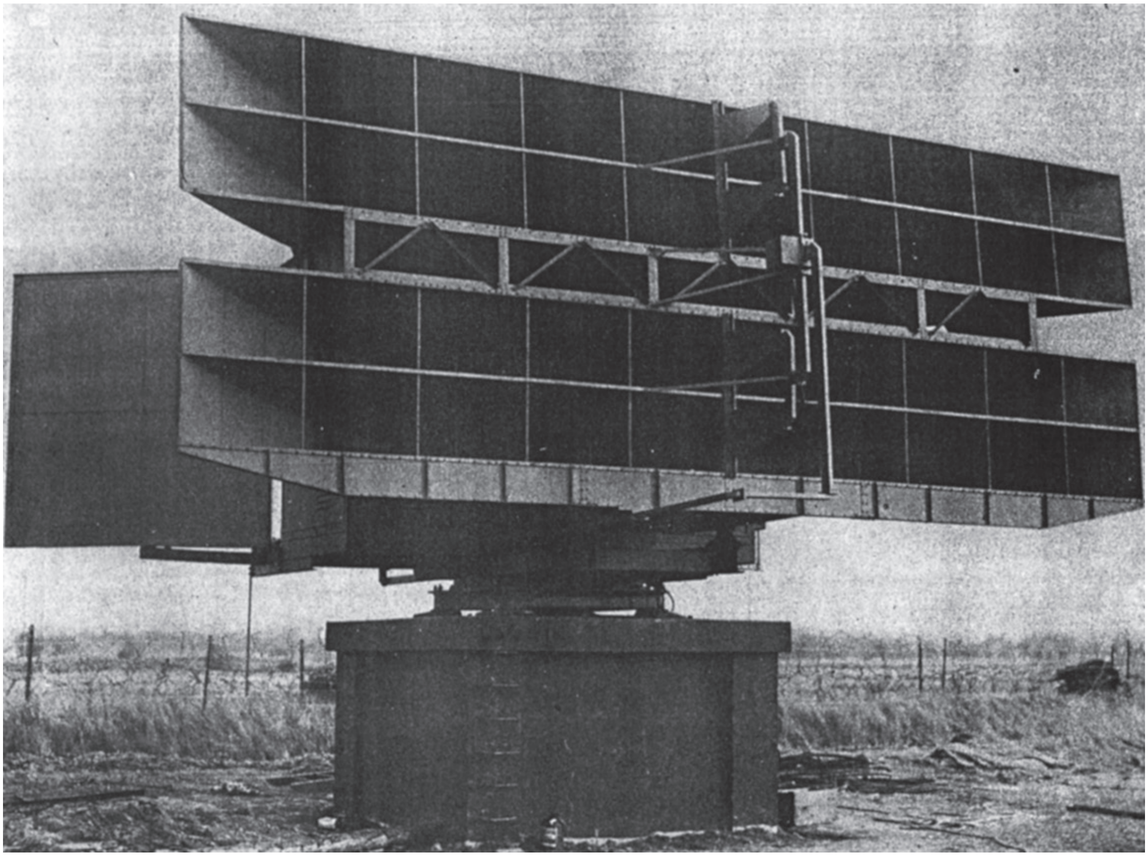


30 A Type 13 Mk II radar, demounted and operating at a Final GCI station.
(© Historical Radar Archive)

required. However, conditions in these mobile stations were not ideal, and Intermediate Mobile stations had a wooden hut for the Operations Room, although the aerial system on trailers continued in use. Another improvement came in the form of the Intermediate Transportable GCI, which also used a wooden hut as the Operations Room. However, the wheeled aerial arrays were replaced by a fixed n-shaped aerial gantry with an aerial array above, and one below, the aerials being at a height of 35 feet and 10 feet respectively. All three of these stages (Mobile, Intermediate Mobile and Intermediate Transportable) were designated as AMES Type 8.

The ultimate development was the Final GCI which was designated AMES Type 7. This had a brick Operations Block, known as the 'Happidrome' after a popular BBC radio programme starring Harry Korris, first broadcast in February 1941. The aerial system consisted of a huge power-turned aerial array measuring 54 feet by 25 feet and 5 feet wide, with the transmitters and receivers housed in an underground well beneath the array. Only one Final GCI station was built in Scotland, at Dirleton, although the Happidrome was under construction at Fullarton when the Final station there was cancelled, so this was never completed.

There was another type of mobile GCI, the Type 15, which was designed for overseas



31 A Type 14 Mk III radar at a Final GCI station.
(© Historical Radar Archive)

use, although some did operate in Scotland, primarily for training purposes. It evolved from the Type 8, but the aerial was mounted on an Austin lorry chassis and therefore was self-propelled rather than on a towed trailer.

In addition to these radars, which all operated on a 1½ metre wavelength, there were also some GCI radars which operated on the much shorter 10 cm wavelength, producing a narrower beam allowing for much more accurate plotting. These were the Type 13 Centimetric Height (CMH) and Type 14 PPI radars. When deployed together, these were known as the Type 21 radar. The aerial of the Type 13 moved, or 'nodded' up and down, providing very accurate height information on aircraft, whereas the Type 14 aerial continuously rotated, producing an accurate map-like display of aircraft in the area. Both Type 13 and Type 14 were mobile radars, but these could be demounted from their vehicles and installed at Final GCI stations. The Type 13 Mk I, whilst designed for height-finding, was later used almost exclusively to provide additional radar cover against very low-flying aircraft, as at Deerness.

Chain Home Beam

Chain Home Beam stations operated with GCI equipment (sometimes described as CHL equipment, but the transmitters and receivers were the same as GCI) and GCI aerial systems, but with a 1941 Type CHL combined T & R Block. Their appearance was therefore an odd mix of a CHL brick technical building with an Intermediate Transportable GCI aerial array. Although CHB stations used GCI equipment, they did not control fighters directly as GCI stations did, but passed plots into the reporting organisation and basically acted as CH early warning stations in locations where there was insufficient room to construct a full CH station.

Coast Defence (Chain Home Extra Low)

The various CD radars, which operated on a wavelength of 10 cm, were sometimes known collectively as Chain Home Extra Low. This referred to the fact that the very short wavelength produced a very narrow beam, which meant that very low-flying aircraft and even submarine periscopes could be detected. The CHEL description covered the sets designated as AMES Types 30–58, but those relevant to Scotland are Types 30, 31, 34, 37, 41, 50, 51, 52, 54, 55 and 57.

The Type 30, also known as Naval Type 273, only existed at the five Naval CDU stations (the initial two stations on Fair Isle having been replaced by one 1941 Type station): Dunnet Head, Fair Isle, Sumburgh (Grutness), Saxavord and South Ronaldsay. The Type 30 equipment was housed in the CHL combined T & R Block (except at Dunnet Head, where the old Transmitter Hut from the original twin-gantry station was used) and therefore had no specific building for it. There was, however, a Perspex lantern erected on the roof of each building to protect the Type 30/Type 273 paraboloids from the weather.

The Type 31, also designated CD No 1 Mk V, was housed in a wooden cabin, known as a Gibson Box, which measured 11 feet by 6 feet 11 inches and was 8 feet high. Mounted above the cabin was the hand-turned paraboloid aerial system, which was collapsible for travelling. The Type 41 was identical to the Type 31 but used a medium-power transmitter, as opposed to the low-power set in the Type 31.

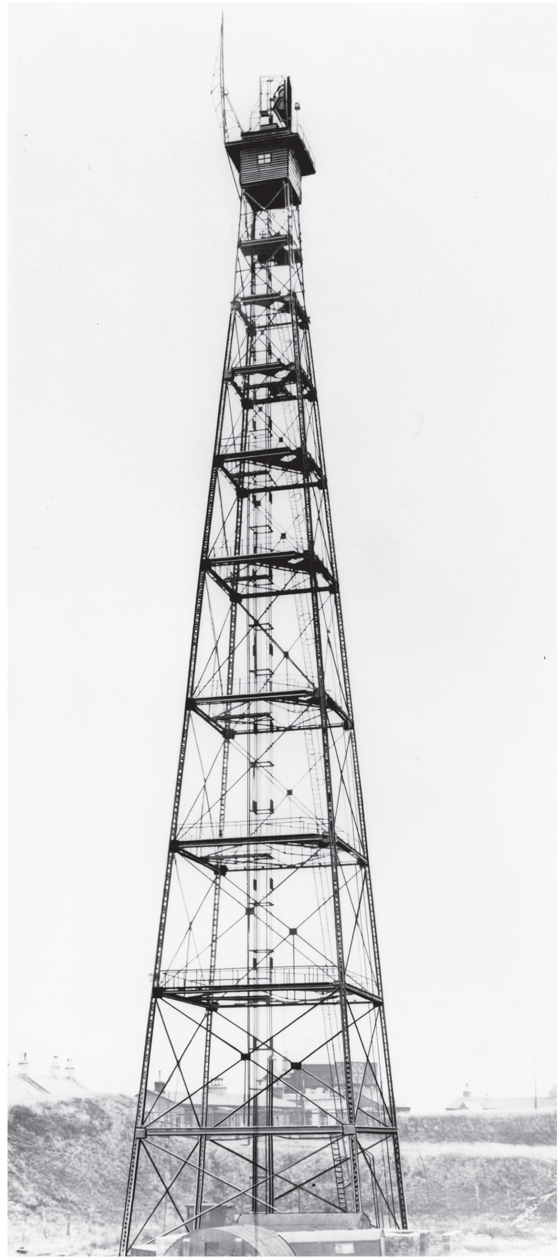
The Type 34 and Type 54 were essentially the same, the latter being a high-power version of the low-powered former. Rosehearty was the only station in Scotland equipped with these two radars (the Type 34 being upgraded to the Type 54), which consisted of a 200 foot steel tower with the paraboloid and cabin housing the equipment at the top, reached via a lift. There was another version with the equipment in a hut at the bottom of the tower, and no lift, but this did not exist in Scotland.

The Type 37 was a fully mobile equipment housed in a wooden cabin on a four-wheeled trailer, with two parabolic dishes attached to the side of the cabin.

The Type 50, also known as Naval Type 277, was built at Cockburnspath, Hesta Geo and

32 A Type 30 (Naval Type 273) Perspex lantern mounted on a ship, but identical to the lantern used at Naval CDU stations. (© Bob Jenner)

33 A Type 31 radar as usually deployed, in its transportable wooden cabin.
(© Historical Radar Archive)



34 A Type 54 radar.
(© Alan Aitken)

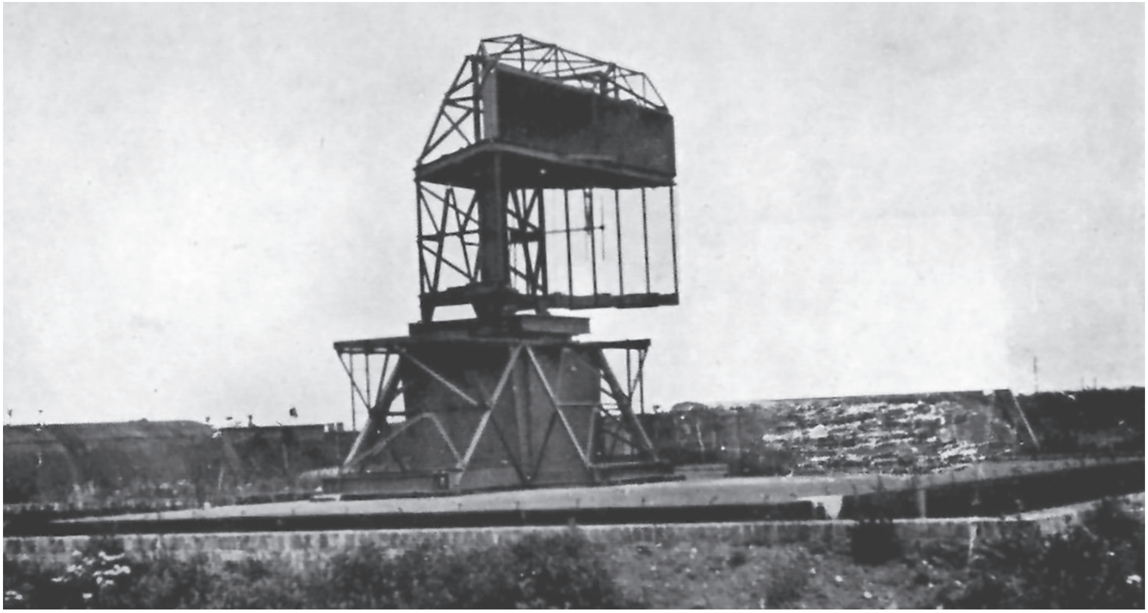
South Ronaldsay, and was a Naval radar used to detect surface vessels and very low-flying aircraft. At Cockburnspath and Hesta Geo the sets were used for interception training. The equipment was housed in a brick building with a 'cheese' type paraboloid mounted above (so called because this type of reflector resembled a wheel of cheese cut in half).

There were only three Type 51 stations in the UK, and Deerness was the only station in Scotland equipped with this radar (the others were Beachy Head and Truleigh Hill in Sussex). This equipment was housed in a building at Deerness which was straddled by a gantry, with the 10 foot diameter paraboloid above.

Much more common was the Type 52, which became the standard high-power 10 cm early warning set, replacing the low-power Type 31 at most sites. The Type 52 consisted of a Nissen hut containing the equipment, straddled by a 21 foot high steel gantry, topped by the 10 foot diameter paraboloid.

Only one Type 55 radar was constructed in Scotland. The set was installed on the 200 foot cantilever of one of the 350 foot steel transmitter towers at Douglas Wood CH station, and can be seen in Illustration 71.

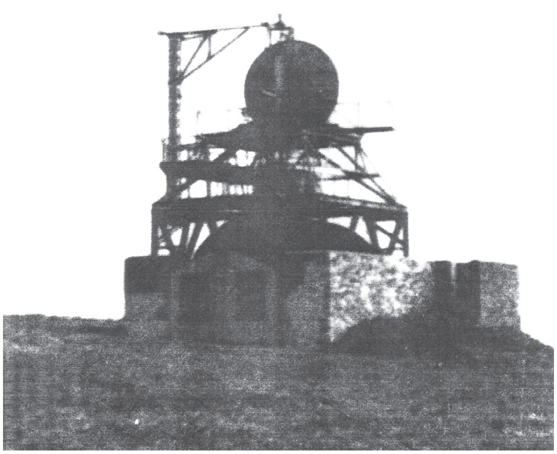
The last of the centimetric CD sets was the Type 57, which, like the Type 37, was housed



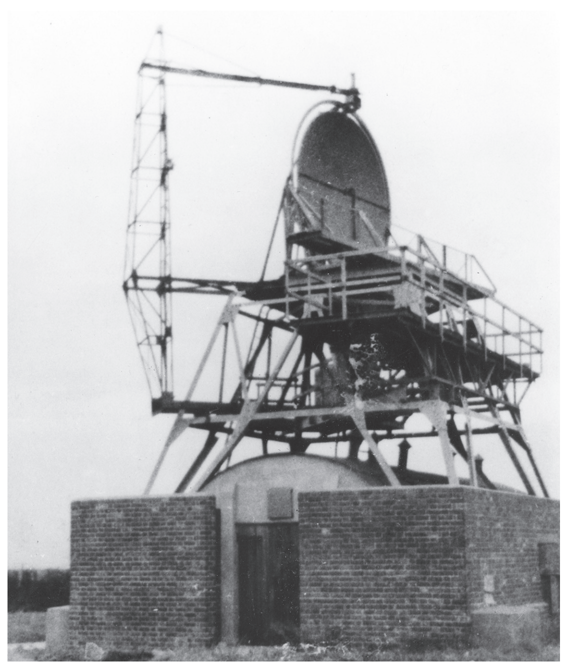
35 A Type 50 radar.
(© Historical Radar Archive)

in a wooden cabin mounted on a turntable on a four-wheeled trailer. However, the Type 57 employed a 'cheese' aerial system fixed to the top of the cabin of this mobile set.

It is clear that although these radars all come under the generic name of CD or CHEL, the radar sets used very different aerial systems and mountings and were extremely varied in appearance.



36 A Type 51 radar.
(© Historical Radar Archive)

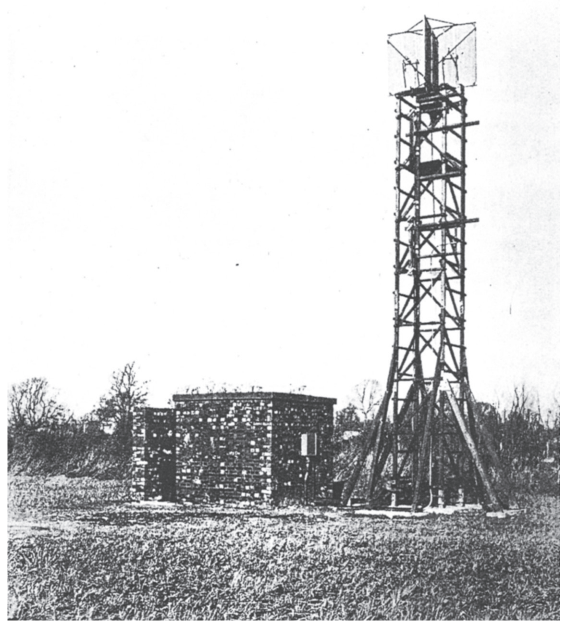


37 A Type 52 radar.
(© Historical Radar Archive)

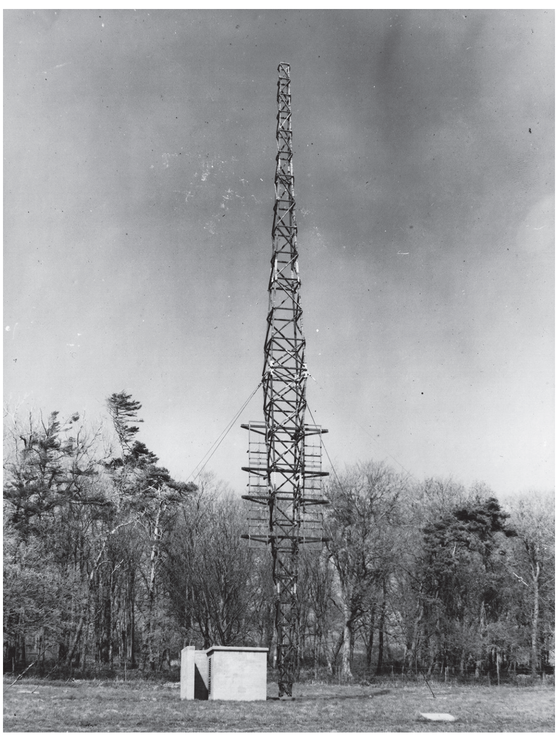
Identification Friend or Foe

Identification Friend or Foe was equipment which sent out a signal to aircraft which, if the aircraft was friendly, would trigger a transponder in the aircraft to return a particular signal, thereby identifying it as friendly. Aircraft that did not return the signal were classed as 'X' plots or unidentified, until confirmed as hostile. The lack of an IFF signal could not be assumed to automatically indicate a hostile aircraft because it took some considerable time for all aircraft to be fitted with equipment, and there was always the possibility of equipment failure in aircraft that did have IFF sets.

Three marks of IFF were used during the Second World War. Mk I operated on CH frequencies and Mk II on CH, Advance



39 An IFF Mk III tower with the cubicle to the left.
(© Historical Radar Archive)



38 An IFF Mk III 105 foot guyed mast, with the cubicle to the left.
(© Historical Radar Archive)

40 A pole-mounted aerial system for IFF Mk III at CHL stations.
(© Historical Radar Archive)

CH and Army Anti-Aircraft Gun-Laying radar frequencies (with a modified Mark IIG covering the CHL and GCI frequencies and a Mk IIN covering Naval radars and CHL stations). However, a need for a universal IFF set on its own frequency was identified, and this led to the development of IFF Mk III. The latter equipment was housed in a small brick cubicle, distinctive for the L-shaped wall protecting the cubicle entrance. Next to the cubicle was the IFF mast or tower, which came in two different forms: either a 105 foot guyed mast or a tower-mounted rotating array set on a distinctive Maltese-cross-shaped base. At CHL stations the IFF Mk III aerial was mounted on a wooden pole beside the 1941 Type combined T & R Block.

PART II

Histories of the radar stations, radio navigational aid stations and research establishments in Scotland 1938–46

Anstruther

Type	Radar station
Subtype	Coast Defence U-Boat/Chain Home Low (AMES Type 2)
Region	Fife
NGR	NO 5998 0586 (Barnsmuir)
NMRS	NO60NW 327
In use	November 1939 – August 1940

Type	Radar station
Subtype	Chain Home Low (AMES Type 2)
Region	Fife
NGR	NO 5468 0847 (Drumrack)
NMRS	NO50NW 31
In use	August 1940 – 3 September 1945

Anstruther has the distinction of being the first CHL type station built in the UK. Although not part of the Somerville Scheme, drawn up by Vice-Admiral Sir James Somerville to detect U-boats leaving the North Sea on the surface north of the Scottish mainland, the first such equipment was diverted from Shetland to the Forth. This was in reaction to the sinking of HMS *Royal Oak* in Scapa Flow on 14 October 1939 and the dispersal of the Home Fleet from there to other anchorages. Rosyth therefore required improved radar coverage, and the first equipment, which had been hand-made in the Cavendish Laboratory at Cambridge

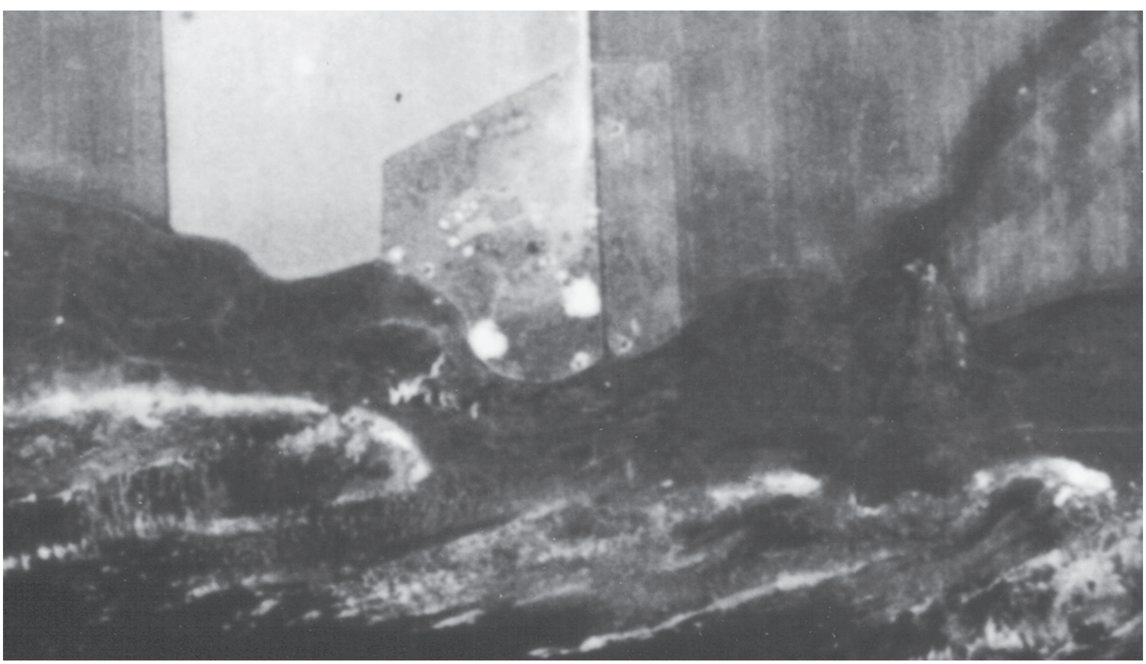
University, was dismantled and packed in trucks by 20 October 1939 (Clifford Evans, pers comm).

Although it was originally planned to set up the CDU station on the Isle of May, the weather prevented the equipment being transported to the island and it was decided instead to set it up on the Fife coast.

Maurice Wilkes was sent from the Air Defence Experimental Establishment at Christchurch to set up the station:

I received instructions to go there at once and pick a suitable site … it was some time before I found what I wanted. Eventually I settled on a site between Anstruther and Crail that had the required properties. It overlooked the cliffs, it was level and flat, and had good access from the main road … With great speed the site was requisitioned and arrangements made to do the necessary work on it … The materials for the huts and gantries were soon delivered to the site … There were two small huts, one for the transmitter and one for the receiver, with gantries over them to carry the aerials. These were about 20 yards or so apart along the cliff. Also parallel to the cliff, inland from the huts, was a hut providing accommodation for the crew, with a small office and a room with a bed in it partitioned off at the end. There may have been another large hut as well. The Army, who provided a guard, also had a hut, although their troops did not sleep on the site. Over to the left of the site as one faced the sea was a latrine and a hut built round the mobile Lister generator that provided electric power. (Wilkes, 1985: 49; Maurice Wilkes, pers comm)

Clifford Evans, a Sub-Lieutenant in the Royal Naval Volunteer Reserve who was the first Commanding Officer of Anstruther, remembers:



41 Vertical aerial photograph of the original twin-gantry CDU site at Anstruther, taken on 19 June 1941. The two white squares in the centre of the photograph are the locations of the Transmitter and Receiver Huts. (© Historic Environment Scotland)

The site was selected on the 5th November (a Sunday). It was requisitioned, access made, all the heavy building material transported and Cockcroft was able to watch the building going up on his visit on the 8th. Gantries and operating huts up, diesel generators installed and power supplies connected, the aerials could be assembled and connected in good weather, and otherwise work on installing and lining up the electronic gear could go on indoors. (Clifford Evans, pers comm)

Maurice Wilkes wrote:

Once the gantries were erected and the equipment installed in the huts, the job of lining up the aerials and getting the station into operation could begin … By 17 November, we were ready to carry out trials with co-operating aircraft. (Wilkes, 1985: 49–50)

Evans's account continues:

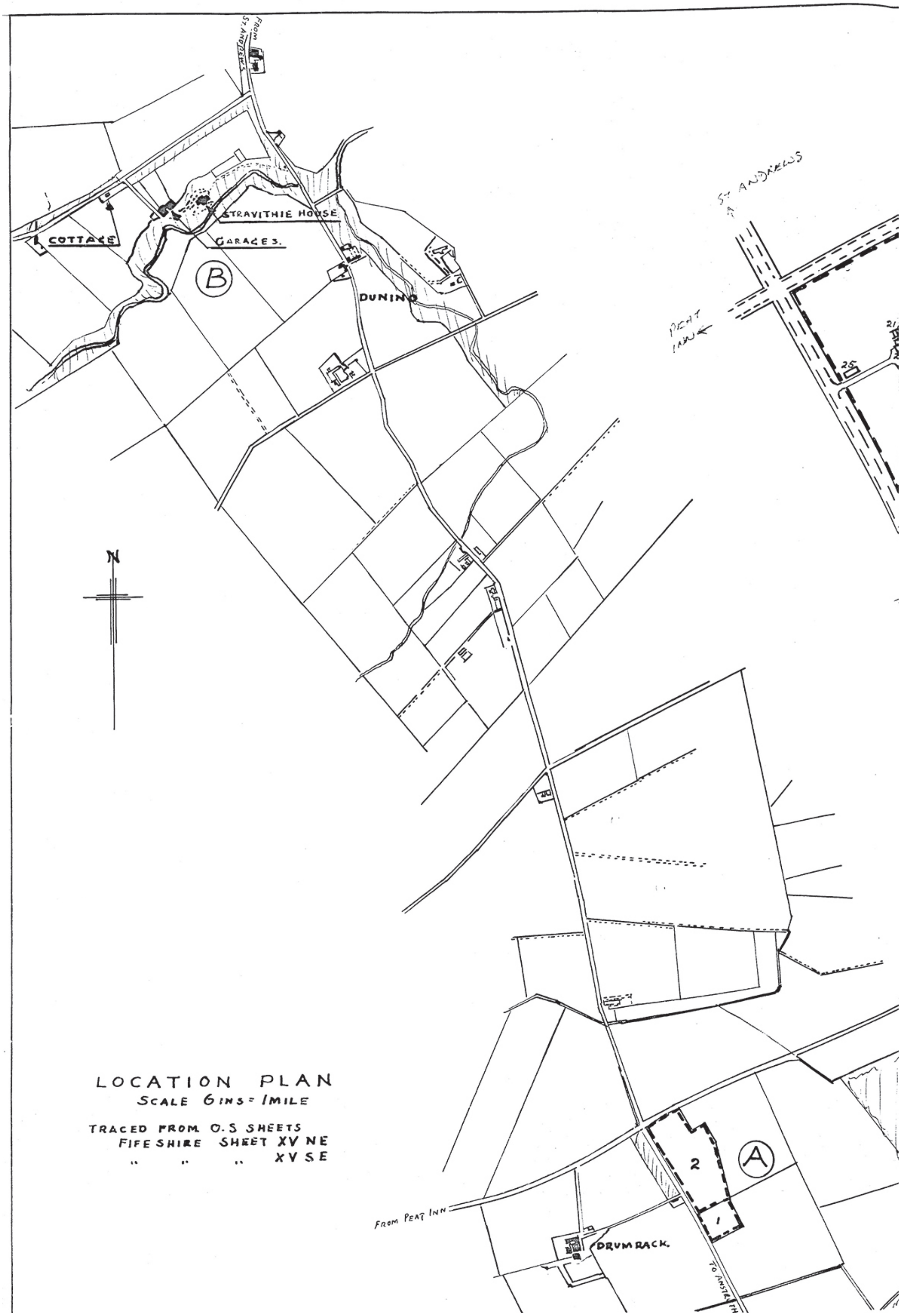
Within eleven days from a bare field, test flights could begin … Within very few more days the station was operational, reporting on aircraft movements to the Douglas Wood CH station … With the completion of the bunkhouse the crew moved in, and it was a great convenience having them all on the station as soon as 24-hour operation began, which was only a few days after the test flights of 17 November … When 24-hour operation began I slept in the cabin, so that I could be called out at once if an emergency arose, though it turned out in practice that these were confined to rising winds …

The equipment itself worked well and gave little trouble, so that as time passed and the crew gained in experience it became progressively less necessary to get up (at first several times) during the night to check its operation. Operation normally continued in a rising wind until the aerials became really difficult to hold, when they were turned into the wind and lashed, and the station shut down. Very occasionally the wind direction would change during a prolonged heavy gale, but with all the crew on site it was always easy to re-adjust the azimuth of the aerials without any risk of them taking charge, and the aerials themselves never sustained any damage up to our leaving.

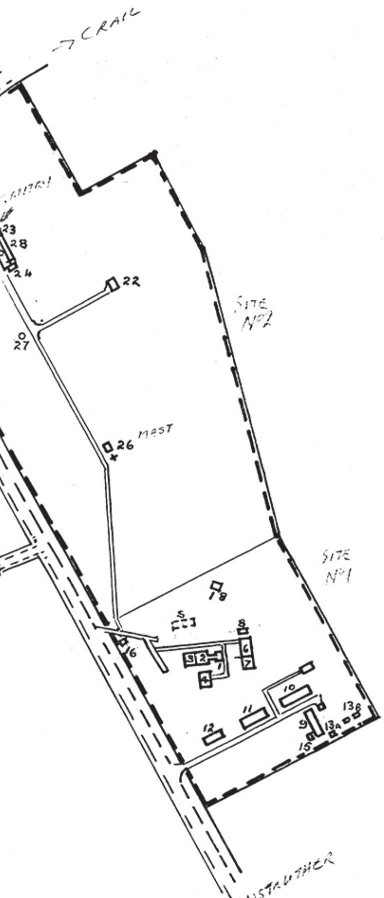
The bicycle chain operation had the great advantage of providing a weak link in the turning gear, so that on the rare occasions when a very strong rating held on until it broke, the aerial would turn into the wind automatically, ready for lashing, and while it was lashed nothing was easier than repairing the chain ready to resume operation when the wind died down …

The RAF had sited a radar on the low-lying ground of Fifeness, which necessitated the aerials being on a tower. It was never a very satisfactory arrangement and in a gale around the end of 1939 it blew down and was not worth repairing. But meantime the Admiralty's plans for a secure Fleet anchorage at Scapa Flow were maturing and the anomalous naval radar at Anstruther was no longer needed. In the middle of January 1940 we were therefore warned to begin packing up the naval establishment ready to hand over to F/Lt Bain and his crew who had been operating the Fifeness station … The order to do so was issued on 24 January … On 26 January my crew went on leave preparatory to transfer to Shetland, and I left to make a final report. (Clifford Evans, pers comm)

On 30 March 1940, very soon after Anstruther was taken over by the RAF, another site was surveyed for the station at Drumrack, this site being expected to improve the coverage for low-flying aircraft in the Firth of Tay very considerably (TNA, AVIA 7/257). The new CHL became operational in August 1940 (Air Ministry, 1950 (1): 124) as a single-gantry station with a Yagi transmitter aerial mounted on top of the receiver aerial array (TNA, AVIA 7/693). Enemy attention was soon received with



42 Anstruther (Drumrack) site plan. (© Historical Radar Archive)



TECHNICAL SITE PLAN

SCALE 1/2500

REFERENCE			
BLDG No	DESCRIPTION	CONSTRUCTION	DRG No
	SITE No 1		
1	RECEIVING ROOM	TIMBER 12'×12'	
2	TRANSMITTING ROOM	" 15'×18'	
3	GUARD ROOM	" 15'×18'	
4	STANDBY SET HOUSE	" 30'×30'	
5	COMPOUND		
6	OFFICE BLOCK R.A.F	" 30'×18'	
7	" " W.A.A.F.	T.B.C.	STA/8/42
8.	LATRINE	TIMBER	
9	ARMY GUARD-KITCHEN-DINING RM-ABLTS	" 50'×18'	
10	" " BARRACK BLOCK	" 50'×18'	
11	" " " · & STORE	" 50'×18'	
12	" " GUARD ROOM	NISSEN 36'×16'	
13A,B	" " LATRINES	TIMBER	
14	" " FUEL COMPOUND	T.B.C.	
15	" " RATION STORE	T.B.C. 10'×10'	
16	R.A.F. WATCH HUT	TIMBER 10'×10'	
17	ARMOURY & AMMO. STORE	4½" T.B.C.	44/41
18	STATIC FIRE POOL		
	SITE No 2.		
20	T&R BLOCK	BRICK	7978/41
21	GANTRY 20'0"	TIMBER	432/41
22	STAND BY SET HOUSE	T.B.C.	16444/40
23	LATRINES RAF	"	
24	" W.A.A.F	"	
25	RAF WATCH HUT/ARMY SLEEPING	"	STA/DBG/3
26.	COMBINED T&R CUBICLE & MAST	"	2799/42
27.	SEARCHLIGHT		

SECRET NO.

DRUMRACK
(ANSTRUTHER)
RECORD PLAN

LS. 58/22

SECTION OFFICE A.M.D.G.W. 3 QUEENS GARDENS St. ANDREWS. FIFE.		DRG No: STA/DBG/5

several bombs dropped at 7 pm on 25 October 1940, cutting off the power supply for a short time. Further attacks came at 9.30 pm on 30 March 1941 when three bombs were dropped 400 yards south-west of the station compound, but fortunately without causing any damage or casualties (TNA, AIR 26/100).

June 1941 saw a PPI display commissioned. A little over a year later, in July 1942, the 1941 Type CHL station, with power turning and a common aerial array for both transmitter and receiver, became operational (TNA, AIR 26/103).

On the night of 24/25 March 1943 Anstruther, along with Drone Hill and Cockburnspath, plotted a raid on northern England and southern Scotland by a small force of low-flying hostile bombers (TNA, AIR 26/103), several of which crashed in the hills of the Southern Uplands.

Installation of a Homing Beacon Searchlight began at Anstruther on 18 June 1943 and was completed on 17 September 1943. This equipment was to be used to direct lost aircraft to a safe landing at either RAF Leuchars or RAF Drem, and a practice was carried out on the night of 17 September in co-operation with Leuchars and Drem. The station was later informed by No 13 Group HQ that during this practice they had unwittingly homed an aircraft in distress. The searchlight was used again at 2.12 am on 17 November 1943 when an Armstrong Whitworth Whitley was successfully homed to Leuchars (TNA, AIR 26/103).

RAF Anstruther lost one of its functions when it ceased plotting on surface vessels on 23 June 1944, and thereafter only reported aircraft movements. All plotting ended when the station closed down on 3 September 1945 (TNA, AIR 26/92). Wilma Duguid was a WAAF Radar Mechanic there at the time:

The station was dismantled in October 1945. I was the only Mech left and had to attach labels with Stores Ref Nos to all items. Some small miscellaneous bits and pieces were unidentifiable and these were buried on the site. (Wilma Duguid, pers comm)

Arbroath

Type	Research establishment
Subtype	Air Ministry Research Establishment
Region	Angus
NGR	NO 668 418
NMRS	NO64SE 72
In use	March/April – May 1940

Between September 1939 and May 1940 the Air Ministry Research Establishment (AMRE), the radar research group which had been working at Bawdsey since 1936, was based in the Training College, Park Place, Dundee. During its stay in Dundee, a considerable effort was spent in adapting CHL to provide a useful GCI set. Two requirements for GCI had to be introduced: a PPI display (which was being developed in Dundee) and a height-finding capability.

In March or April 1940 a small site was

established by AMRE at East Seaton Farm outside Arbroath to conduct CHL height-finding experiments. K G Budden was one of the AMRE scientists at East Seaton:

Our object was to see if the height finding technique, already in use for CH, could be used at 200 Mhz for CHL. This would involve lower angles of elevation … JA Ratcliffe was head of the CHL group at AMRE and it was he who suggested that we should try it … We had two CHL aerials slung one above the other between two 70 ft high wooden towers. We could change the height by using ropes to raise or lower the aerial frames, but it was a rather difficult job. There were only three of us working there most of the time. The aerials pointed in a fixed direction out to sea. They could not be rotated and so we could only observe in one direction. We were provided with a test aircraft by RAF Leuchars. The pilot had to fly in towards us along a straight path in our line of sight and at a fixed, known height, usually 3,000 ft. Fortunately his navigation was excellent. We were soon able to establish that the elevation of the target aircraft could be measured with quite good accuracy …

Our small station was fenced with barbed wire and we had an army guard – mostly old men who had served in 1914–18. They were under a young officer who, I think, had been a keen boy scout. The men were most amusing to talk to when they were sober. The station was in use solely for our experiments. There was nothing else going on there …

In the summer of 1940 the Germans moved into Norway and the army took over our coastal area. They were worried about a possible raid or even invasion and they wanted us to go. Fortunately the main job was finished. There had been plans for using our site for other things but I think these were abandoned and the land was returned to the farmer owners. (K G Budden, pers comm)

As a result of this work, one of the prerequisites for GCI had been proven and, following the move of AMRE to Worth Matravers in Dorset, GCI equipment was developed and put into operational service in October 1940.

Barrapol

Type	Radar station
Subtype	Chain Home Beam (AMES Type 8C)
Region	Tiree (Argyll and Bute)
NGR	NL 9644 4279
NMRS	NL94SE 52
In use	June – October 1942, 19–20 December 1943, 1 March and 7–8, 10 April 1944

Barrapol was a CHB station and became operational in June 1942, although it was operating as a CHL station, and therefore not passing height information, until the following month. The station was very short-lived, and it ceased reporting and was placed on care and maintenance in October 1942 (TNA, AIR 26/103).

However, Barrapol was not dismantled and, during a gale lasting from 11.30 am on 18 December 1943 until 7.30 pm the following day, the main compound gates, Operations

Block door and two window frames were swept away by the wind. At Ben Hough CHL, the main transmitter feeder line was broken and operations were transferred to Barrapol until the damage at Ben Hough was repaired at 9 pm on 20 December. Barrapol was again on the air as a stand-by for Ben Hough, for 12 hours on 1 March 1944, for 29 hours from 7 to 8 April 1944 and for 10 hours on 10 April (TNA, AIR 26/92).

Ben Hough

Type	Radar station
Subtype	Chain Home Low (AMES Type 2)
Region	Tiree (Argyll and Bute)
NGR	NL 9485 4637
NMRS	NL94NW 8
In use	March 1942 – 7 March 1945

Jerry Taylor, who was a Canadian Radar Mechanic, recalls:

I was posted to Ben Hough in the first week of March 42. The station was a combined block with one antenna. I remember carrying a Cossor 3339 [oscilloscope] up to the station so we could not have been operational at that time. (Jerry Taylor, pers comm)

Air Ministry Experimental Station Number 82A Ben Hough became operational in March 1942 as a 1941 Type, common aerial working (single aerial array for both transmitting and receiving), power turned, Chain Home Low station. It was originally named Kilkenneth but in April 1942 was renamed Ben Hough to avoid confusion with the CH under construction at Kilkenneth (TNA, AIR 26/103).

On the afternoon of 8 December 1942 Ben Hough was asked by the filter room to keep a watch to the north for a missing aircraft. A short while later an aircraft was picked up 97 miles north-west of the station, which turned out to be the missing one, and it was plotted in to 11½ miles (TNA, AIR 26/103).

A radio-telephony (R/T) link with Stornoway SFR and Greian Head CHL was installed on 8 September 1943 and became operational at 1 pm. However, a gale swept Tiree on 18 and 19 December 1943, breaking the main transmitter feeder line. Consequently, operations were transferred to Barrapol and it was not until 9 pm on 20 December that repairs to Ben Hough were completed (TNA, AIR 26/92).

From 13 June 1944 Ben Hough was reduced to operating on a two-watch system, operating only between 12.01 am and 4 pm every day (TNA, AIR 26/92).

A party from No 70 (Signals) Wing went to Ben Hough in September 1944 to site a new aerial gantry. This was necessary because of the poor condition of the existing gantry and turning gear, which were considered unable to withstand the rigours of another winter. A new location for the gantry had advantages because the existing one gave very restricted coverage. The redundant gantry from The Law was to be reused for Ben Hough. However, it is not clear if this was in fact done before the station ceased operating on 7 March 1945 and the station was placed on care and maintenance (TNA, AIR 26/92).

Borve Castle

Type	Radar station
Subtype	Chain Home Beam (AMES Type 8A)
Region	Benbecula (Western Isles)
NGR	NF 7739 5056
NMRS	NF75SE 43
In use	August 1942 – 24 November 1945

Construction of AMES No 91, Borve Castle, began in April 1942. This was a CHB station, using GCI equipment but as a reporting station, rather than controlling aircraft directly from the station itself. The CHB installation was completed in June 1942 but could not be used because there were no communication facilities. Borve Castle became operational in August 1942, with plots being passed on a temporary line to the Stornoway SFR (TNA, AIR 26/103).

High winds during January 1943 caused the aerial to be lashed for long periods. At 1.50 pm on 11 January the filter room asked the station to concentrate on Learner 25. The aircraft was plotted for over an hour until communications were established and it was able to land safely (TNA, AIR 26/103).

On 3 May 1943 a track was plotted for 355 miles before finally fading at a range of 66½ miles. Another aircraft was plotted for 265 miles (TNA, AIR 26/103). The November 1943 issue of HQ No 13 Group Bulletin noted that 'commendation also goes to Borve Castle for their ability to maintain tracks and idents during heavy Transit programmes' (HRA, HQ No 13 Group Bulletin).

In November 1943 it was decided that Borve Castle was to be reduced to sufficient personnel to provide radar cover over part of the 24 hours only. The decision to reduce the coverage but keep Borve Castle operating part-time was made because although sufficient air warning cover was provided by other stations, Borve Castle would probably be necessary during certain periods to ensure accurate tracking of transatlantic aircraft (Air Ministry 1950 (1): 516). Thus, Borve Castle was retained for Flying Control purposes only. It continued to carry out this role until finally closed down at 9 am on 24 November 1945 (TNA, AIR 26/92).

Breckness

Type	Radar station
Subtype	CD No 1 Mk V (AMES Type 31)
Region	Orkney
NGR	HY 2366 0837
NMRS	HY20NW 39
In use	1942 – 25 May 1945

Breckness was originally an Army station operating CD No 1 Mk V, but was later taken over by the Navy (TNA, ADM 116/5790).

In April 1942 the Senior Technical Officer of No 70 (Signals) Wing visited Breckness at the request of the Admiral Commanding Orkney and Shetland. Following his visit, the officer recommended that Breckness be resited higher in order to improve its performance, but this suggestion does not appear to have been carried out (TNA, AIR 26/92).

The station was successfully operated until 25 May 1945, when it was then packed and returned complete. It was noted that 'it was very efficient, as proved by extensive trials, and was a great asset to the defences [of Scapa Flow]' (TNA, ADM 116/5790).

Brenish

Type	Radar station
Subtype	Chain Home (AMES Type 1)
Region	Lewis (Western Isles)
NGR	NA 9908 2420
NMRS	NA92SE 18
In use	February 1943 – 24 November 1945

By 5 May 1941 approval had been given for two CH stations on the Isle of Lewis as substitutes for the proposed main CH at Butt of Lewis. The two stations were to be sited at Broad Bay and Brenish (TNA, AIR 2/2667).

Air Ministry Experimental Station No 97, Brenish, was the last CH station to become operational in the UK, and was built as an Intermediate CH, with the aerials mounted on two 120 foot wooden towers. The construction of the station was completed in December 1942, but it was February 1943 before calibration was finished and the station became fully operational (TNA, AIR 26/92).

Geof Peach was posted to Brenish on 8 July 1942, and arrived there three days later:

The camp was composed of Nissen huts surrounded by barbed wire – guarded by Cameron Highlanders who had seen duty in Middle East or pre-Dunkirk … we were a stand-by station – no WAAFs – seldom activated. Never saw an enemy aircraft on the scope during my entire stay at Brenish … Remember overhauling the diesel engine that was our stand-by – very hard to start using a cranking handle … I remember unloading coal for use at the cook-house …

I remember it rained most days and we wore gum boots with stockings made from wool with lots of grease in it … Remember lying on one's bunk at 2 am in the morning and it was like daylight …

We used to snare rabbits – hold them by the hind legs and run hand down their back to break their necks. They ended up in a mess tin of marg on the stove in the Nissen hut … Remember the jam and puddings the coos [Cameron Highlanders] used to make for dessert – steamed pudding in tall cans …

I remember the ration truck run to Stornoway, a 1500 wt Ford – with engine accessibility between driver and front passenger. On the engine housing was a horizontally mounted green fire extinguisher with clip at top and saucer-shaped dish at bottom *end. I rode mid-position on top of engine housing with fire extinguisher removed. Road to Stornoway was full of holes and on one occasion I bounced up, came down with my coccyx (tail bone) landing on the bottom fire extinguisher support. Thought I had split the bottom of my spine. Still remember the day …*

I remember the Church of Scotland truck that used to visit our camp and give us chocolate bars … Remember parcels from home and the term 'Midnight Rustler' for guys who would dig into the parcel for cookies and candles after lights out … Pay day every two weeks £3 16s …

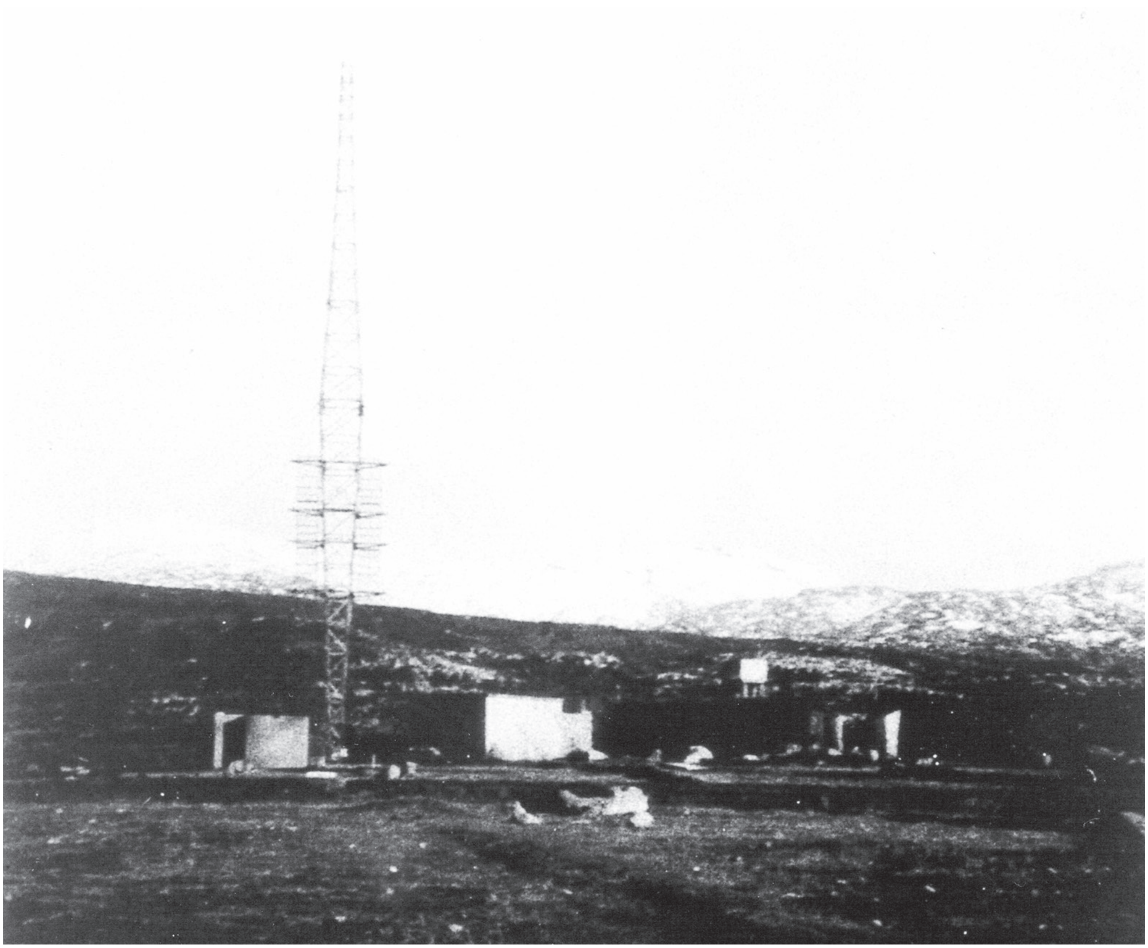
Remember the dances we had in the local

43 Oblique aerial photo of Brenish, showing the two 120 foot towers, taken on 18 September 1942.
(© Crown Copyright Royal Air Force Museum W1/7/8 Brenish)

44 Brenish, showing the 120 foot towers in the middle distance, taken in 1943.
(© Ken Peacock)

schoolhouse organised by the school teacher. One big room – reels. (Geof Peach, pers comm)

On 7 May 1943 a US Army Air Force YB-40 (a gun-ship version of the Boeing B-17 Flying Fortress bomber), serial number 42-5732, was on a delivery flight from the US to Alconbury, where it would have become part of the 327th Bomb Squadron, 92nd Bomb Group. Due to weather and navigation problems, the pilot got lost between Iceland and Stornoway. After flying for 13 hours, and with only a few minutes' flying time left, the aircraft broke clear of cloud and the pilot spotted a coastline. He flew along it until a flat piece of ground was seen and a successful wheels-up landing was made next to Loch Greivat at Brenish, without any injuries to the crew. The pilot thought he had landed in Norway, because of the hilly terrain. As the RAF personnel from Brenish approached the YB-40, the crew thought that they were Germans and turned the guns of the aircraft on them, ready for a shoot-out. Fortunately, identities were quickly established and word of the crash was relayed to the USAAF Air Transport Command



45 The IFF Mk III mast and building at Brenish on care and maintenance in 1946. (© Jim Russell)

Base at Stornoway aerodrome. At that time the YB-40 was top secret and recovery of the aircraft was a high priority. The Air Transport Command personnel built a ¼ mile length of track to get access to the aircraft and a 60 foot trailer was used to transport the aircraft back to Stornoway, where it was reassembled and test-flown and thence ferried back to the US (Rodney Long, pers comm).

Brenish provided assistance to the crew of another crashed aircraft on 26 January 1944. The station picked up a track at a range of 20 miles at 9.37 am which was given the identity A549. It began to show Broad IFF (meaning it was in trouble) at 9.44 am. Six minutes later a visual sighting was made on a Wellington flying at about 800 feet with its navigation lights on and a light flashing in its nose. A phone call was received from Timsgarry Post Office informing the station that an aircraft had crashed about 2 miles from there; a search party set off and found the Wellington crash-landed on Uig sands. The crew were unhurt and were taken back to the domestic site which Brenish shared with Islivig CHL (TNA, AIR 26/92).

On 29 August 1944 Brenish changed over to a two-watch system, covering the hours from 8 am to 11.59 pm daily. Operations at Brenish ceased completely at 12 pm on 24 November 1945 and the station was placed onto a caretaking basis (TNA, AIR 26/92).

Broad Bay

Type	Radar station
Subtype	Chain Home (AMES Type 1)
Region	Lewis (Western Isles)
NGR	NB 5291 3440
NMRS	NB53SW 23
In use	27 February 1942 – 24 November 1945

The construction of Air Ministry Experimental Station No 96, Broad Bay, was almost complete by the start of 1942. On 27/28 January 1942 receiver feeder lines (carrying the signal from the aerials to the receiver) were damaged by the collapse of a blast wall (HRA, Paul Carment diaries). Despite such setbacks the station became operational, as an Intermediate CH with aerials on two 240 foot wooden towers, on 27 February 1942 (TNA, AIR 26/92).

The maximum range achieved by Broad Bay during March 1942 was 146 miles, a creditable performance for a new station. The following month a maximum of 183 miles was achieved, and this was extended even further in May with a maximum of 204 miles (TNA, AIR 26/92).

At 2.35 am on 21 October 1943 Broad Bay was plotting B78T when the track was lost and the aircraft was believed to have crashed. Other aircraft carried out searches during the night and four search parties from Broad Bay scoured the peninsula coast on the afternoon of the 21st without result (TNA, AIR 26/92). This track was, in fact, Wellington Mk III DF595 of No 20 Operational Training

46 Broad Bay, with the two 240 foot towers in the centre of the image, taken on 18 September 1942. (© Crown Copyright Royal Air Force Museum W1/6/4 Broad Bay)

Unit, which was on a night cross-country training flight when it crashed in the Minch. Two of the crew were rescued, but sadly four men were killed (Chorley, 2002: 257). On 20 January 1944 Stornoway SFR asked for close co-operation from Broad Bay in tracking C531, a friendly aircraft which was lost. A good track was obtained on the aircraft and it landed safely at Stornoway (TNA, AIR 26/92).

Broad Bay ceased operations at 12 pm on 24 November 1945 and the station was placed on care and maintenance (TNA, AIR 26/92).

Burifa Hill

Type	Radio Navigational Aid station
Subtype	Gee Master & Monitor (AMES Type 7000)
Region	Caithness (Highland)
NGR	ND 2036 7564
NMRS	ND27NW 8
In use	14 November 1942 – 31 March 1946

Construction of the Northern Type 7000 Chain began during June 1942. The chain comprised four stations: Burifa Hill (Master and Monitor), Scousburgh (Slave), Windyhead Hill (Slave) and Sango (Slave) (TNA, AIR 29/147). The Master Station was designated Air Ministry Experimental Station No 7311, with the Monitor being AMES No 7331.

The Northern Type 7000 Chain became operational at 2 pm on 14 November 1942, 24 hours ahead of schedule. On 1 March 1943 operational trials of the Northern Chain began and that month a number of operations were carried out using Northern Chain signals, including a heavy bomber raid on St Nazaire on the night of 22/23 March. April 1943 proved an interesting month, with the night of 20/21 April particularly busy. That night navigational assistance was provided for a heavy bomber raid on Stettin, as well as a diversionary raid on Berlin by de Havilland Mosquitoes and minelaying operations off Brittany by Vickers Wellingtons. A week later, on the night of 27/28 April, the chain was on the air for Grade A operations between 9 pm and 7.10 am for the largest minelaying operation carried out by that stage of the war. A total of 160 aircraft were involved in minelaying off Brittany, Biscay and the Frisian Islands. Further minelaying was carried out the following night (TNA, AIR 29/147).

Perhaps the most interesting operation for which the Northern Type 7000 Chain was used was the large attack on the rocket research facility at Peenemünde on the night of 17/18 August 1943. The chain was Grade A operational between 8 pm on the 17th until 4.30 am on the 18th, and a total of 596 aircraft took part in this raid (TNA, AIR 29/147).

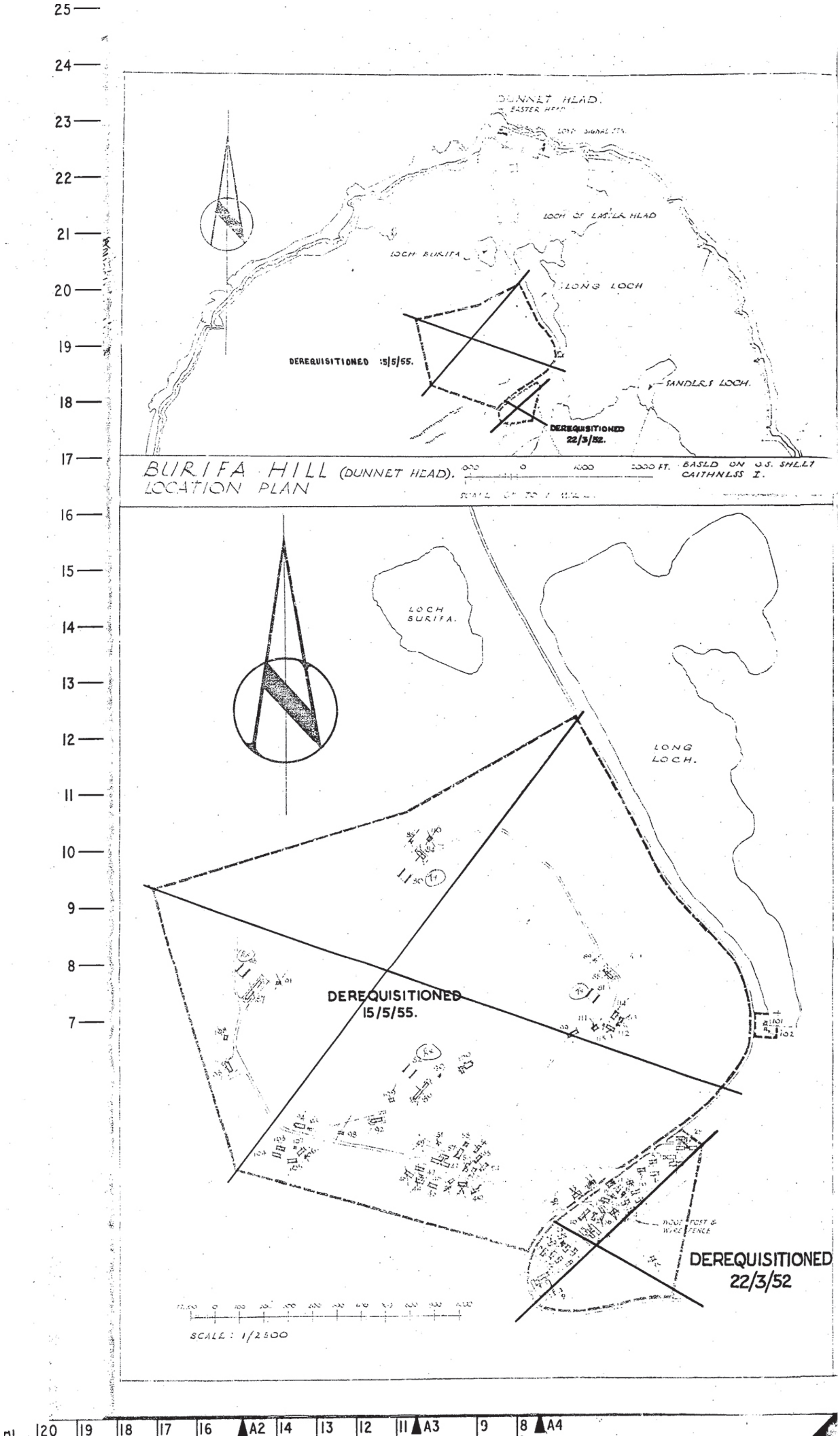
Various other raids used Gee coverage from the Northern Chain, including attacks on Berlin, Hanover, Le Mans, Frankfurt and Duisburg, as well as USAAF 8th Air Force attacks on Trondheim, Bremen, Kiel and Hamburg. The coverage was also used for Coastal Command strike aircraft attacking shipping off the Norwegian coast (TNA, AIR 29/147).

Peter Harrild was a Controller at the Monitor Station at Burifa Hill between September 1943 and April 1944:

In the Gee navigation system, pulses radiated by the Master Station are received by the aircraft and also by each of the slave stations. Each slave radiates a pulse which is locked to the Master pulse but delayed by a fixed time. These pulses are also received by the aircraft, which has equipment to assist the navigator to measure the difference in time between the reception of the master pulse and that from a slave, and therefore find the difference in distance between the distance of the plane from the master, and its distance from the B-slave. Lines of equal distance will be a lattice of hyperbolae, with another set of hyperbolae from lines of equal distance for the C-slave. Knowing which hyperbola the plane is on for each of the two lattice sets gives the position of the plane as one of the two points of intersection …

From the above brief description it can be seen that the time delays introduced at the slave stations must be kept correct with great accuracy and that the pulses must be kept at full strength. The job of the monitor station was to monitor the pulses sent out and ensure that they did not vary …

In the Ops Room at Burifa (a Nissen Hut on 'A' Site) there was a row of five receivers, each with a cathode ray tube on which a selected part of the total pulse system could be displayed. One (on MTB – Main Time Base) was used to monitor that all the transmitted pulses were present and in their correct position (timewise) relative to the master pulse. Three (on STB – Strobe Time



47 Burifa Hill site plan.
(© Historical Radar Archive)

SCHEDULE OF BUILDINGS

ALL TOWERS AND BUILDINGS DEMOLISHED AND SITE CLEARED

R.A.F. & W.A.A.F. SITE

	PICKET POST & STORE	N	[illegible]
	ADMINISTRATION BLOCK 'A'	N	[illegible]
	LATRINE BLOCK 'A'	[illegible]	4277/[illegible]
	R.A.F. & W.A.A.F. OFFICERS MESS & W.A.A.F. OFFICERS QTS.	N	4285/42
	R.A.F. OFFICERS QTRS. & [illegible]	N	4278/42
	R.A.F. OFFICERS QRS.	N	4278/42
	R.A.F. OFFICERS QRS	N	4278/42
	R.A.F. & W.A.A.F. DINING RM. & SERGEANTS MESS. 'A'	N	4261/42 LOOKING GLASSLD
	R.A.F. & W.A.A.F. INSTITUTE [illegible] STORE & QRS. FOR N.A.A.F.I. STAFF (R.A.F. 22/97 & W.A.A.F. [illegible] 'A'	N	4282/42
10	RATION STORE 'A'	N	4278/42
11	R.A.F. SGTS. QRS. & BARRACK BLK.	N	4278/42
12	R.A.F. BARRACK BLOCK	N	4278/42
13	Do Do Do	N	4278/42
14	Do Do Do	N	4278/42
15	Do Do Do	N	4278/42
16	R.A.F. OFFICERS & SGTS BATHS SHOWERS ABLUTS LATS & DRYING RM BLOCK 'B'	N	4279/42
17	R.A.F. O/RS SHOWERS, ABLUTS. LATRINES & DRYING RM. 'C'	N	4279/42
18	R.A.F. BOILER RM.	TA	4279/42
19	W.A.A.F. SGTS QRS. & BK BLOCK	N	4278/42
20	Do Do Do Do Do	N	4278/42
21	Do Do Do Do Do	N	4278/42
22	Do Do Do Do Do	N	4278/42
23	Do Do Do Do Do	N	4278/42
24	W.A.A.F. BARRACK BLOCK	N	4278/42
25	W.A.A.F. SGTS & O/RS SHOWERS BATHS & DRYING RM. 'D'	N	4279/42
26	W.A.A.F. SGTS & O/RS [illegible] LATRINES & LAUNDRY 'E'	N	4279/[illegible]
27	W.A.A.F. BOILER HOUSE. 'D'&'E'	T.B.	4279/42
28	R.A.F. & W.A.A.F. SICK QRS. (MEDICAL INSPT. & BOILER Ho LOOKING GLASSLD).	N	4284/42 506/108/42
29	FUEL COMPOUND. 45'X45'	CHAIN LINK	9108/41
30	M.T. SHED (3 BAYS).	TB	4277/42
31	PETROL STORE.	TB	4277/42
32	CYCLE SHED. 33'X9'	TC-C.I.	
33	WORKS SERVICES STORE.	N	
34	WORKS SERVICES BUILDINGS.	TB	1975/41
35	INCINERATOR 4'6"X4'6"	P.B.	
36	EQUIPMENT STORE.	N	4277/42
37	SEPTIC TANKS.	P.B	WA15/524/42

112	[illegible]		
108	DINING RM. & KITCHEN [illegible]	N	[illegible]
109	[illegible] OFFICES	N	[illegible]
110	[illegible]	N	[illegible]
111	WATER TOWER [illegible]		
	PLANT BLDG	N	
	TECHNICAL [illegible]	N	
	PLANT BLDG	N	
111	GUARD ROOM	N	
	DINING RM KITCHEN	N	2801/42
	BARRACK BLOCK	N	2801/42
114	BARRACK BLOCK	N	2801/42
115	LATRINE BLOCK	TB	4277/42

ARMY GUARD SITE

40	PICKET POST & STORE.	N	4277/42
41	ORDERLY ROOM.	N	4277/42
42	DINING RM. & RECREATION RM. FOR 32 & SGTS MESS FOR 7	N	4280/42
43	SERGEANTS QRS. & STORE	N	4278/42
44	BARRACK BLOCK	N	4278/42
45	BARRACK BLOCK	N	4278/42
46			
47	SGTS. & O/RS SHOWERS, ABLUTS & DRYING RM. & SGTS LATS 'A'	N	4279/42
48	BOILER RM. & O/RS LATS.	TB	4279/42
49	FUEL COMPOUND. 45'X45'	CHAIN LINK	9108/41
50			
51	INCINERATOR 4'6"X4'6"	P.B.	
52	O/RS BARRACK HUTS.	TA	2997/42
53	Do Do Do	TA	2997/42
54	Do Do Do	TA	2997/42
55	Do Do Do	TA	2997/42
56	Do Do Do	TA	2997/42
57	SGTS. & O/RS ABLUTS SHOWERS DRYING RMS & LATS	TA	[illegible]
58	SGTS. QUARTERS. (1/2 HUT)	TA	2997/42
59	OFFICERS QUARTERS. (1/2 HUT)	TA	2997/42

TECHNICAL SITE.

80	240' TRANSMITTING TOWER	1	TIMBER	3889A/40
81	240' TRANSMITTING TOWER	2	Do	3889A/40
82	240' RECEIVING TOWER	3	Do	3889A/40
83	240 RECEIVING TOWER.	4	Do	3889A/40
84	TRANSMITTING HUT.	5.	NT	4098/42
85	TRANSMITTING HUT.	6	NT	4098/42
86	RECEIVING HUT	7.	NT	3882/42
87	RECEIVING HUT	8.	NT	3882/42
88	LATRINE BLOCK 'B'		TS	4277/42
89	LATRINE BLOCK 'B'		TS	4277/42
90	LATRINE BLOCK 'A'		TS	4277/42
91	LATRINE BLOCK 'A'		TS	4277/42
92	POWER HOUSE.		N	4110/42
93	STAND BY SET HOUSE.		N	4110/42
94	PICKET POST FIRST AID & [illegible]		N	4277/42
95	CYCLE STORE & LATRINE		TS	4277/42
96				
97				
98	ARMOURY & AMMO. STORE		TA	[illegible]
99	WORKSHOP		TA	2997/42
100	RESERVOIR & FILTER PLANT		TA	WA15/520/42
101	PUMP HOUSE FOR WATER SUPPLY		TA	WA15/602/42

ABBREVIATIONS

TB = TEMPORARY BRICK
PB = PERMANENT Do
TC-C.I. = TIMBER & CORRUGATED IRON
N = NISSEN HUTTING
NT = Do Do TRAVERSED
TA = 'TURNERS' CURVED ASBESTOS HUTTING

AMENDMENTS

NOTE

I. SHAW
73 [illegible] Drive
[illegible]
LANARKSHIRE

PREPARED FROM WORKS AREA DRG. No. [illegible]/45 [illegible]

BURIFA HILL A.M.E.S.
(DUNNET HEAD).

RECORD SITE PLAN

REPRODUCTION OF A.M. DRG. No. 1775/45.

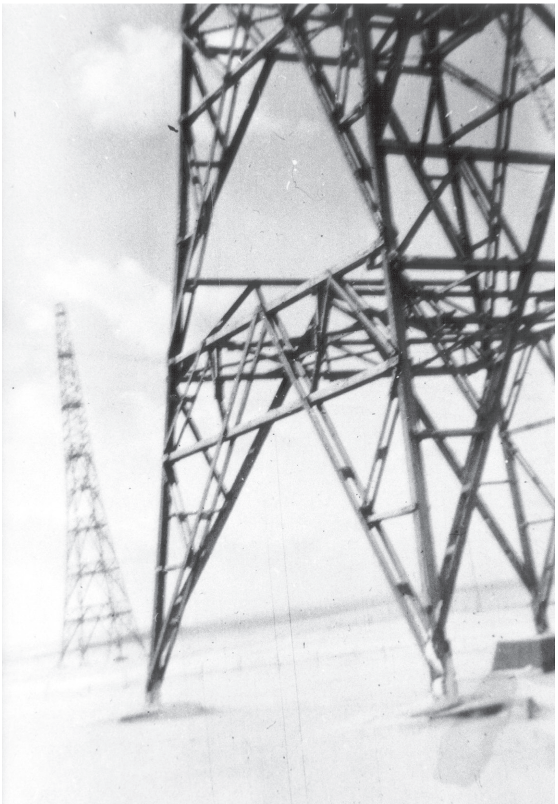
SCALE [illegible]

NO. 15 WORKS AREA

D.G. OF W.

WA15/110/48

AIR MINISTRY



48 Two of the 240 foot transmitter and receiver towers at Burifa Hill.
(© C P Hillesley)

Base – an expanded time base, showing a small part of MTB …) were used to monitor the 'B', 'C' and 'D' slaves and ensure their phasing was correct. One spare. Each of the four receivers in use was manned by a WAAF operator. The three operators monitoring the slave pulses wore a telephone headset and were permanently connected by telephone line to the headset worn by the operator on the receiver at the slave station which they were monitoring. When no action was required the two would bind (chat) to each other at great length and often became very friendly, though they seldom, if ever, met. This helped to relieve the boredom of the job …

Also in the Ops. Room was a large sign, hanging from the ceiling, in which one of the letters 'A', 'B', 'C' or 'D' could be illuminated (each in a different colour) to indicate which grade of service the chain was providing, with Grade 'A' indicating fully operational and Grade 'D' completely off the air. The grade of service required was ordered by a Controller at Barkway (the Monitor Station for the Eastern Chain and the headquarters of the whole Gee system), and was dependent on the operational situation within the chain's coverage. It was sometimes switched to Grade 'A' in an attempt to help a lone plane, late back from an operation and possibly damaged.

Opposite the row of five receivers in the Ops Room was a long desk, at which the Controller and the i/c of the watch sat, facing the backs of the operators, with a small PBX (Private Branch Exchange) telephone switchboard on the desk, which could be operated by the i/c. Included in the lines from this switchboard were private lines to each of the slave stations. The line to Scousburgh was not at all reliable and there was therefore a back-up radio telephone link. In order to call the operator at Scousburgh over the radio link one had to activate a VOR (voice operated relay) at their end by whistling into the microphone at the Burifa end. This didn't always work and one could sometimes whistle till the cows came home with no result! And of course there were times when the Controller just couldn't whistle, causing much amusement to the operators!

The job of the Controller was to ensure that the orders from Barkway as to grade of service required were carried out correctly by the chain and, when on Grade 'A', that all the pulses were at full strength and accurately phased, checking (and maybe giving advice) that the appropriate remedial action was taken as quickly as possible at the slave station if one of them went off the

49 Scene from a pantomime staged at Burifa Hill during 1942/3.
(© Joe Wilkie)

air or the phasing varied. He also had to keep a record of all that happened during his watch and, when he went off watch, brief the new controller. The job could be very boring when all was going smoothly, but in times of trouble it could involve quick thinking and a lot of responsibility. (HRA, Peter Harrild, 'RAF Burifa Hill')

The Northern Type 7000 Chain closed down at 11 pm on 31 March 1946 and the Type 7000 equipment at Burifa Hill was placed on care and maintenance (TNA, AIR 26/93).

Burifa Hill was also the location of a Type 700 Monitor Station, Air Ministry Experimental Station No 702, which took over the function of the Monitor of the North East Atlantic Loran Chain from Scousburgh. The receivers were installed in the main Receiver Block of the Type 7000 station on 2 June 1945; the aerial was suspended from 240 foot tower number 3. AMES No 702 became operational at 6 pm on 21 June 1945 (TNA, AIR 29/167). The North East Atlantic Loran Chain remained operational until handed over to the Ministry of Civil Aviation in June 1946 (Air Ministry, 1956: 208).

Carsaig

Type	Radar station
Subtype	Chain Home Low (AMES Type 2)
Region	Mull (Argyll and Bute)
NGR	NM 542 217
NMRS	NM52SW 6.02
In use	December 1941 – October 1942

Preliminary work began in July 1941 on the installation of Air Ministry Experimental Station No 80A, Carsaig. The 1941 Type CHL with power turning went on the air in December 1941, designed to cover the approaches to RAF Oban. Reporting was to No 82 Group by W/T link via RAF Port Mor, until the new filter room became operational on Tiree (TNA, AIR 26/103).

Jean Montgomerie, a WAAF Technical Officer from No 72 (Signals) Wing, recalls her first visit to Carsaig on 8 June 1942:

At that period American Signals Officers had been sent to the UK to learn about the various forms of radar stations and how they operated … We had a quota of four sent to us in June 1942 and on this particular day my S/Ldr and I were due to go to Carsaig and we took along one of the group. His name was Lt Frank Hollandsworth. We arrived on the steamer from Oban and I remember we were taken to the pier at Craignure by motorboat. There, transport was waiting to take us to Carsaig. None of us had been on the island before and that first journey was a revelation, for the road was little more than a cart track and grass growing between the wheel ruts. It was a rough and bumpy ride but very enjoyable.

We had tea on the station (tinned herrings in tomato sauce!), settled our American into his new quarters and introduced him to the station Commanding Officer. We then did a station inspection before being taken back to Salen and the Glenforsa Hotel …

My next visit was on 27th August 1942, this time on my own. The station had reported that it was off the air and I was taking out a transformer to enable it to function again. I was met at Craignure by a driver with a jeep. He was an Englishman and told me that he was very happy on the station, although when he first arrived he thought that he had been posted to the ends of the earth. Now he loved it and as we drove over the bumpy road to the site the early evening sunshine lit up the hayfield and surrounding pasture. The driver stopped the vehicle so that I could admire the scenery. His words were 'How green is my valley' – spoken with such heartfelt pleasure – as if he couldn't quite believe it. And it truly was a scene full of golden light and the promise of better things to come.

This time I was accommodated on the station and met Mrs Gordon who owned the property and who was extremely kind to the RAF crews who were stationed in this remote place. The transformer had been installed; the station was once more on the air and I carried out my inspection and had supper. Then I did another check before turning in for the night sometime after midnight. (Jean Montgomerie, pers comm)

In October 1942 Carsaig ceased operations and the equipment was dismantled (TNA, AIR 26/103).

Charterhall

Type	Radar station
Subtype	Ground Control of Interception (AMES Type 15)
Region	Berwickshire (Scottish Borders)
NGR	NT 7447 4562
NMRS	NT74NW 48.07
In use	13–18 April 1944, May 1945 – date unknown

On 6 April 1944 AMES 15128, a mobile AMES Type 15 GCI unit, arrived at RAF Charterhall (TNA, AIR 26/41). Charterhall was an aerodrome occupied by No 54 Operational Training Unit, a night fighter training unit (TNA, AIR 29/682), and 15128 GCI was one of the mobile radar units which would be sent to the Continent following the landings

50 15128 GCI convoy in north-west Europe, 1945.
(© Frank McCann)

in Normandy to provide ground control for fighters protecting the liberating armies.

Owing to damaged equipment, 15128 GCI was unable to go on the air on 9 April, although direct communication with Blakelaw Sector Operations Room was made on 11 April. The GCI commenced operations on 13 April using the R/T frequencies and call signs of Northstead GCI station in Northumberland (TNA, AIR 26/41).

Frank McCann recalls the time he spent at Charterhall with 15128 GCI:

Our visit to Charterhall, although relatively short, was long enough for us to erect our aerials and set up and calibrate our equipment. I remember this particularly because I had to report to the CO (Sqn Ldr Stanley 'Ropes' Cable) when he was controlling a practice interception … A few days later, [we] stowed our gear, packed our tents and joined our colleagues for the big trek south – and preparations for the invasion. (Frank McCann, pers comm)

Instructions were received by 15128 GCI on 18 April to move to Woolsington, near Newcastle (TNA, AIR 26/41).

In April 1945 another Type 15 mobile GCI convoy arrived at Charterhall and was installed during April and May 1945. The unit was used for training pilots in interception techniques (TNA, AIR 26/92).

Clett

Type	Radar station
Subtype	Chain Home Low (AMES Type 2)
Region	Shetland
NGR	HU 5504 6148
NMRS	HU56SE 31
In use	29 March 1942 – 4 August 1945

Rushed into service in response to demands for greater radar coverage in the Shetland Islands area, Clett became operational at 4.20 pm on 29 March 1942. The station was built as a 1941 Type CHL with a single transmitting and receiving aerial array and power turning. Telephone lines had not yet been completed, so field telephones were laid by station personnel, covering the 2 miles from the site to the submarine cable nearby. The first aircraft plotted by Clett was Coastal Don at a range of 40 miles (TNA, AIR 26/100).

Len McMillan was a Canadian Radar Mechanic and he remembers the radar station entering service:

Commissioning Clett (CHL, power driven antenna) involved tuning the receiver and the transmitter to get the best response from known targets, eg hills on the mainland of Shetland. This helped with our ranging calibration. However, one of our main problems was with our power generators. These generators were called Nunns. They had a poor governing system and often shut us down during our run-ups, until we could get them adjusted. However, along came a four cylinder diesel (Lister) which we had to manhandle onto a concrete bed. We were now in a position to be operational. (Len McMillan, pers comm)

Clett was still far from complete by the end of April 1942, with temporary power supplies having been arranged, pending the installation of the permanent diesel generator in the Main Power House, as described by Mr McMillan above (TNA, AIR 26/100). By October 1943 things had improved considerably and that month Clett achieved a new station record with a range of 206 miles (HRA, HQ No 13 Group Bulletin).

J Shackleton was the Senior NCO at Clett and he recalls that life was:

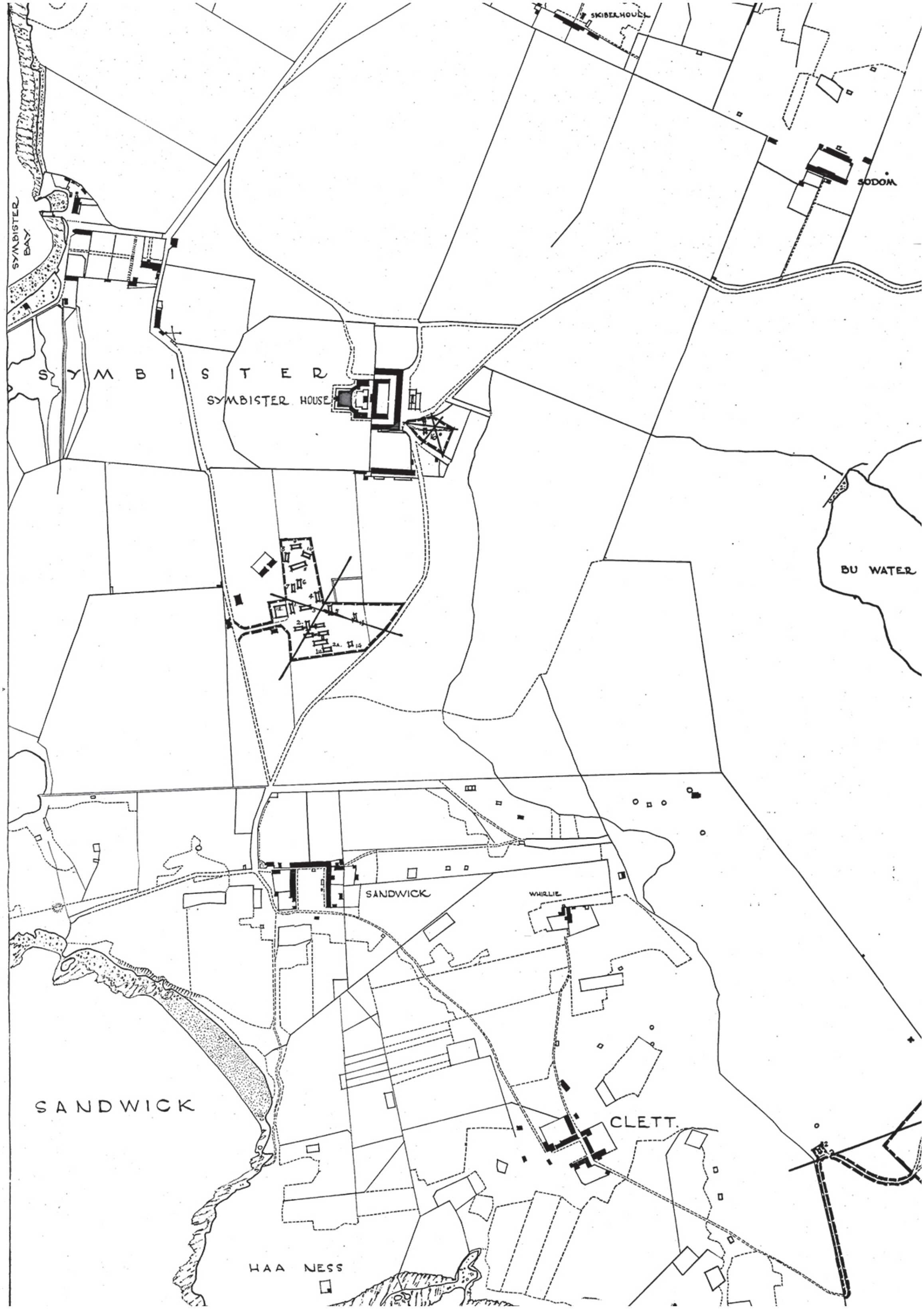
pretty quiet as far as aerial activity concerned. Mainly German coastal traffic. An all male crew working three-watch system, and apart from a small canteen, virtually no leisure facilities at all. The main occupation of off-duty personnel: the scraping, stretching and curing of sheepskins for sale later, always providing they could carry them when going on leave, etc.

Sheep, of course, outnumbered everyone else on the island and were the only occupants not worried by the weather and the extremely high winds, which made walking up and down to the Tech Site from the living quarters … at the bottom of the hill, quite a hazardous operation. (J Shackleton, pers comm)

On 4 August 1945 Clett ceased operating and was placed on care and maintenance (TNA, AIR 26/92).

51 Clett 1941 Type CHL, with a wooden hut variant on the standard combined T & R Block.
(© Whalsay Heritage Centre)

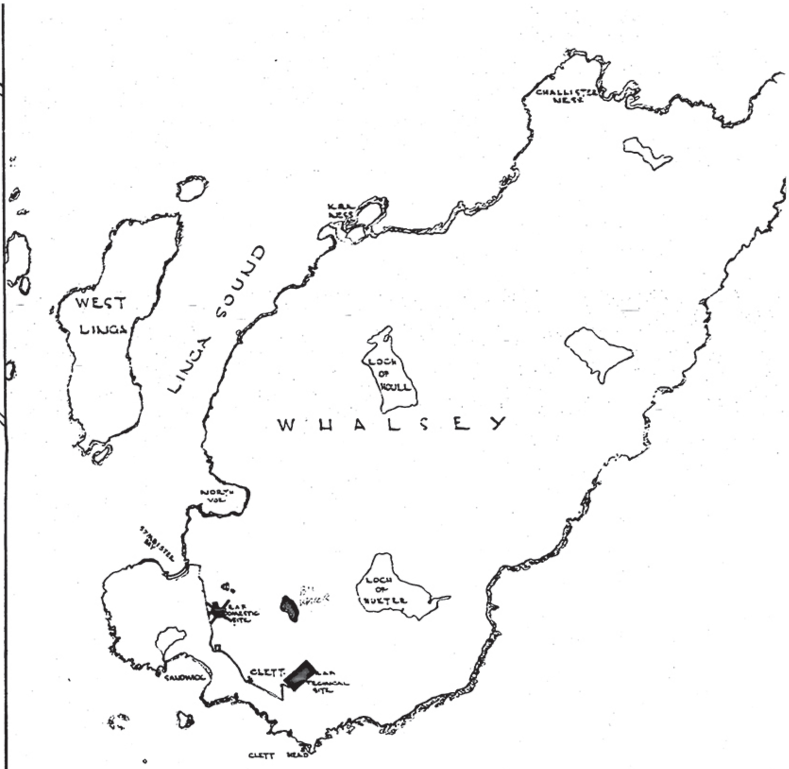
52 Clett Domestic Site, with Symbister House overlooking the site at the top right.
(© Thomas Reid)



53 Clett site plan. (© Historical Radar Archive)

LKI/9/45

SCALE : 1/2500.



SCALE : 1/25,000.

LOCATION PLAN OF CLETT, WHALSEY.

REFERENCE

No	DESCRIPTION	CONSTN	DRG. No	No	DESCRIPTION.	CONSTN	DRG. No.
~~1~~	~~PICKET POST & STORE~~	~~N~~	~~5904/41~~	~~20~~	~~[illegible] HUT~~	~~T~~	~~[illegible]~~
2	COMBINED DINING RM, RECREATION RM., OFFICERS MESS		5904/41 &	~~21~~	~~20' GANTRY~~		~~[illegible]/41~~
	SERGEANTS MESS & QUARTERS & N.A.A.F.I. (2A)	"	600?/7142	22	STANDBY SET HOUSE	P.C.	16444/40
3	RATION STORE	"	5904/41	23	POWER HOUSE	"	10893/41
4	OFFICERS QUARTERS FOR 2 No.	"	5904/41	24	TECHNICAL LATRINE	T.C.I	
5	SICK QUARTERS.	"	5904/41	25	ARMOURY	T.C	WA15/920/41
6	ABLUTION BLOCK & OFFICERS LATRINE.	"	5904/41	26	600 GAL. WATER TANK		
7	BOILER HOUSE, SGTS & O.R.s LATRINES	T.C.	5904/41	27	NISSEN HUT FOR [illegible] SET.	N.	5903/41
8	BARRACK BLOCKS	N	5904/41	28	COMBINED [illegible], SGTS MESS		5903/41
9	BARRACK BLOCK	"	5904/41		OFFICERS [illegible]	N	
10	BARRACK BLOCK	"	5904/41	29	LATRINES	T.C.I	WA15/287/41
11	BARRACK BLOCK. 60'-0"	T.B.	18'-0" SPAN	30	PICKET POST & FIRST AID POST.	N.	4277/42
12	FUEL COMPOUND. (BRICK WALLS)	T.B	6991/41	31	FUEL COMPOUND. (BRICK WALLS)	T.B	
13	AIR RAID SHELTER		WA15/531/42	~~32~~	~~PICKET POST. (BRICK)~~	~~T.B.~~	
~~14~~	~~PETROL COMPOUND. (BRICK WALLS)~~	~~T.B~~					
~~15~~	~~M.T. ACCOMMODATION [illegible]~~						
~~16~~	~~RESERVOIR FILTER & WINDMILL PUMP~~		~~WA15/7?0/41~~				

DEREQUISITIONED

DEREQUISITIONED
30/6/54

CONSTRUCTIONAL ABBREVIATIONS

PERMANENT CONCRETE - INDICATED THUS	P.C.
TEMPORARY " "	T.C.
TEMPORARY BRICK " "	T.B
TIMBER " "	T
CORRUGATED IRON " "	C.I.
NISSEN HUTTING " "	N

CLETT

A.M.E.S. TYPE II

20' Gantry

RECORD SITE PLAN.

for SECTION OFFICER

No 1 SECTION OFFICE,
A.M.W.D. LERWICK.
W.C.M. MARCH. 1945.

THIS DRAWING MUST NOT BE SEEN BY UNAUTHORISED PERSONS. IT MUST BE KEPT UNDER LOCK & KEY WHEN NOT IN USE & ITS SAFE CUSTODY IS THE RESPONSIBILITY OF THE PERSON TO WHOM IT IS ISSUED.

SECRET
No

D. of W.

WA15/160/45

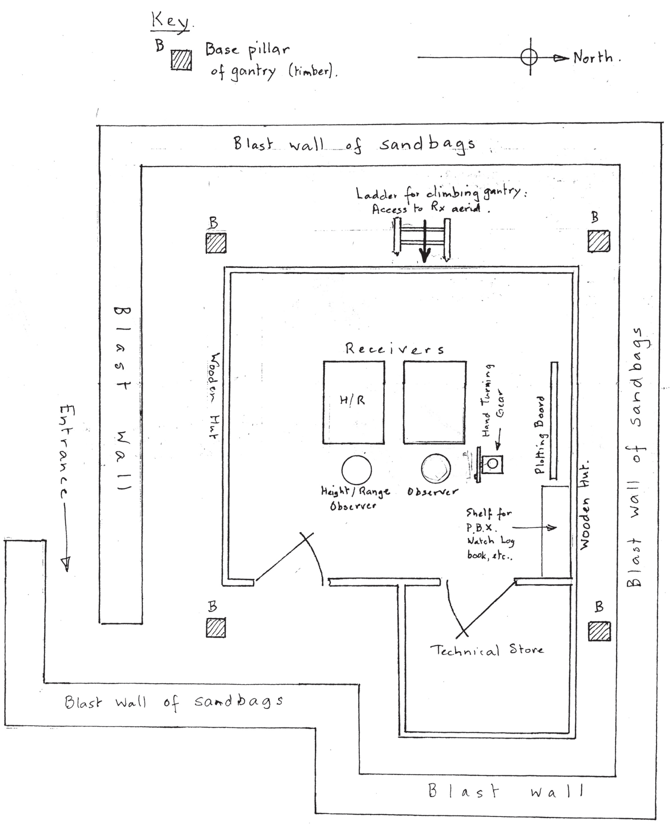
AIR MINISTRY

Cockburnspath

Type	Radar station
Subtype	Chain Home Low (AMES Type 2), AMES Types 8, 12, 13, 15, 50
Region	Berwickshire (Scottish Borders)
NGR	NT 7874 7126
NMRS	NT77SE 71
In use	26 January 1940 – 15 March 1946

Designated Air Ministry Experimental Station No 42A, Cockburnspath was a station set up as part of the first 'crash' CHL programme. As such, the station went on the air on 26 January 1940 (Air Ministry, 1950 (1): 84). Even before this, the RAF had had a presence there, with an R/T station which provided a link between Turnhouse Sector Station and its squadrons. This was certainly at Cockburnspath in December 1939 but appears to have been removed before construction of the CHL station began (TNA, AIR 14/273).

In a report dated 25 November 1940, the following details about the performance of the station were noted: the normal operational sector was 310°–0°–90°, although 284°–0°–165° was possible. The range on an aircraft at a height of 500 feet was 27 miles, the maximum range achieved being 107 miles. Hopkins turning gear had been installed on 10



54 Sketch plan of the Receiver Hut at Cockburnspath.
(© John Sharp)

September, which was a major improvement on the bicycle chain. There was, however, a 1° backlash on the ruler. Plot sheets for the three weeks from 2 to 22 November 1940 were examined and the percentage of tracks plotted were as follows (TNA, AVIA 7/494):

Coastal	35.6
Unidentified	25.8
Naval	19.6
Hostile	6.9
Fleet Air Arm	5.2
Fighter	4.0
Army Co-operation	1.7
X	1.2

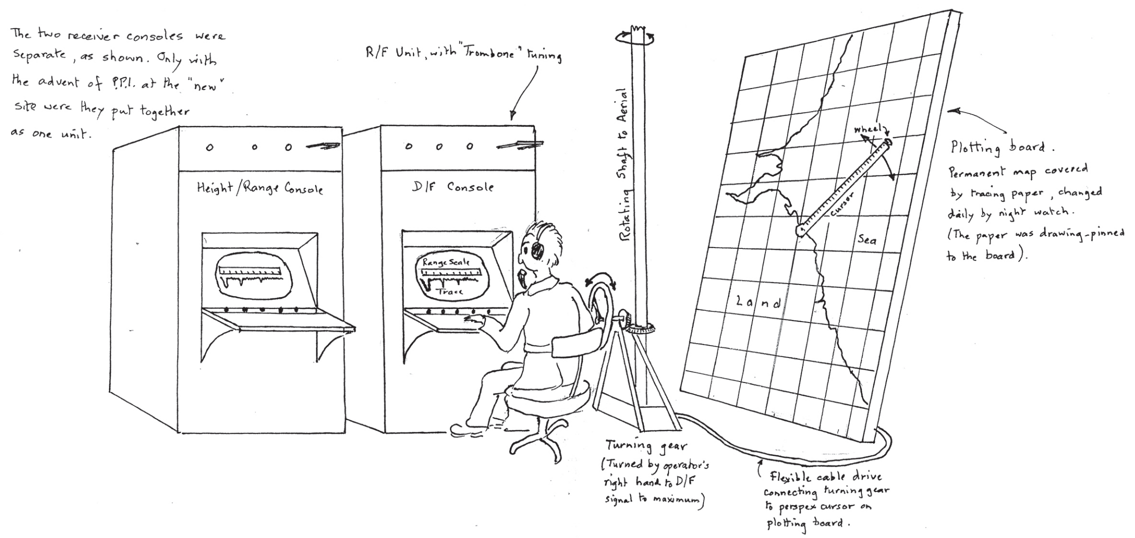
On 5 May 1941 a fire was started by incendiary bombs at nearby Tower Farm. Four bombs were dropped in the vicinity of the CHL station but no damage was suffered (TNA, AIR 26/103).

John Sharp was posted as a Radio Operator to Cockburnspath in November 1941:

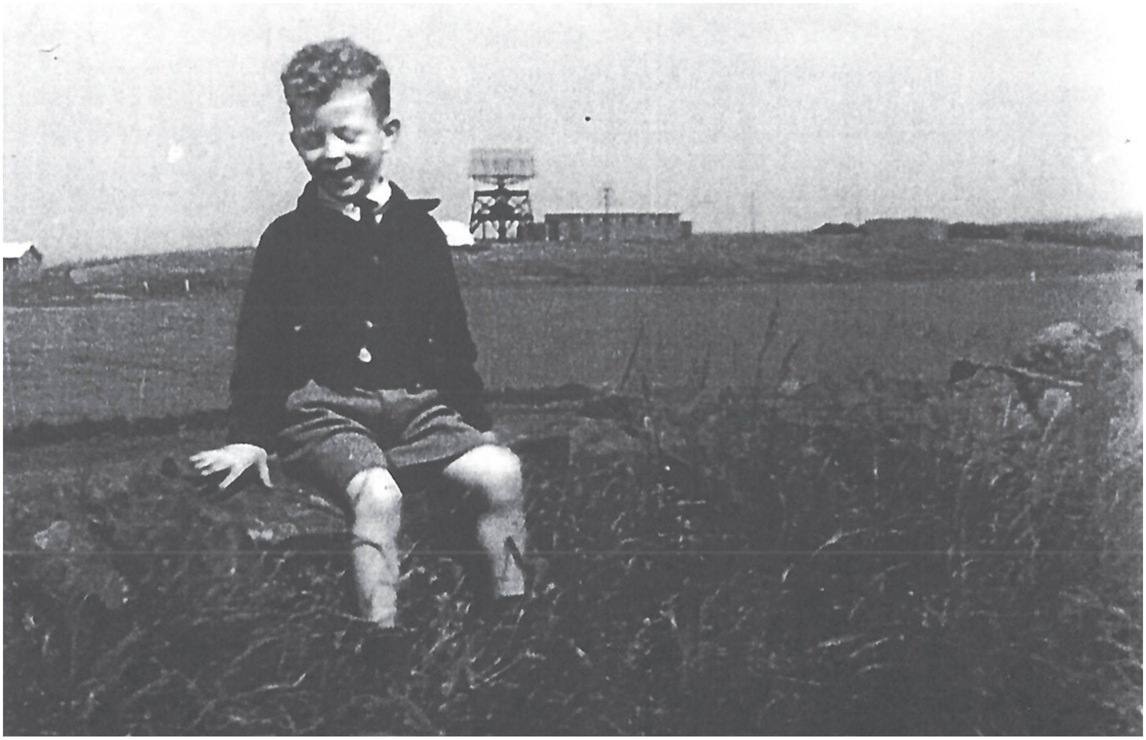
The station, commanded by Sgt Harry Freeman, a Regular Wireless Op by trade, had separate transmitter and receiver huts with independent aerial arrays on wooden gantries. The arrays were hand-turned, with a galvanometer device for 'following', i.e. for keeping the two aerials synchronised in direction … The hand-cranking wheel was connected by a flexible cable to a rotating perspex ruler, marked off in ranges, which moved over the large plotting board, allowing the plots to be marked on tracing paper over the map of the sweep area. The plots were transmitted by land-line to 13 Group Filter Room in Newcastle, monitored by the parent CH station at Drone Hill. (John Sharp, pers comm)

In July 1941 the site was chosen for the 1941 Type CHL station, roughly 200 yards farther back from the cliffs (TNA, AIR 26/103). George Lowrie, who was 16 at the time and was employed as a bricklayer's labourer, was at the site:

While the brickwork was being built – a period of about 6 weeks to 2 months … My father and I,



55 Sketch of the internal layout of the Receiver Hut at Cockburnspath.
(© John Sharp)



56 Cockburnspath 1941 Type CHL.
(© David Arnott)

along with about 10 other workmen, used to load a lorry at Drone Hill with bricks, sand, cement, water, etc., in the morning for use on the site. The same lorry would return at night to take us back to Drone Hill. (George Lowrie, pers comm)

The technical equipment for the new CHL began to arrive on site during April 1942, and it became operational, with continuous rotation, in June that year (TNA, AIR 26/103).

In July 1942, No 784 Squadron, Fleet Air Arm, arrived at RAF Drem for the purpose of training Fleet Air Arm pilots in night interception techniques. Soon after their arrival they selected the station at Cockburnspath for interception and Fighter Direction Officer training (TNA, AIR 28/220). A hut was erected for Naval use, but in June 1943 the Naval CHL receiver was moved from there into the Receiver Hut on the original CHL site (TNA, AIR 26/103). B C Lyons was on a course at No 784 Squadron from May to August 1944:

It was a comparatively small outfit and equipped with Fairey Fulmar II aircraft fitted with Mark IV AI [Airborne Interception] … The courses were small – about six trainee crews – and quite intensive. Day and night interceptions were carried out between aircraft, under the direction of a ground controller. Control was exercised from Dirleton GCI for general interceptions at height and from Cockburnspath … for low interceptions … always over the sea. Low interceptions were always rather difficult because of the 'sea-clutter' on the aircraft's AI set. (B C Lyons, pers comm)

Also in July 1942 Cockburnspath was used for radio countermeasures trials carried out by the Telecommunications Research Establishment with Moonshine (Brew, 1996: 43), a device used to create spurious returns on the German *Freya* radar (Streetly, 1978: 160). These trials involved the conversion of the CHL to a Type 12 radar which was:

A CHL working on a frequency of 125Mc/s … The Type 12 equipment uses the CHL type transmitter and receiver modified to work on the lower frequency, but requires a different type of array … The array is fitted on a mobile aerial trailer of the type used for mobile GCI stations … Thus, to convert a CHL to Type 12, the tuning circuits in the transmitter and receiver are modified and the aerial feeder lines diverted to a mobile array. (TNA, AVIA 7/1877)

The Type 12 operated on the same frequency as the German *Freya* radar and was installed at Cockburnspath in July 1942, with performance tests carried out in September (TNA, AVIA 7/1877). It was used in the trials during 21–25 July (TNA, AIR 27/1981) to represent a German *Freya* to evaluate the performance of Moonshine against it. The Type 12 was later converted back to normal CHL operation and the mobile aerial trailer returned to the Telecommunications Research Establishment, before being refurbished and sent to Tantallon for the radio countermeasures trials there in March and April 1944 (TNA, AVIA 7/2455). These trials were a final test before the first operational use of Moonshine on 6 August 1942 (Air Ministry, 1950 (2): 192).

Around June 1943, John McKee was posted to Cockburnspath as an Aircraftman 2nd Class RDF Operator:

I can always remember the day I reported to the station – few, if any, personnel about, and as it was late evening, and having little food on the journey I went straight to the dining-room (cookhouse). On the door was a notice to the effect that I should help myself to the food available. I don't believe I ever saw the CO …

It was an isolated station, but nonetheless picturesque, and on free days one went either to Berwick or Dunbar, hitching a lift. Weekend leave was spent in Edinburgh. The only social events I can remember were the weekly Sunday visits to Lamberton Moor (controlled by the Army) for a shooting match on their 25 yd range, and followed by tea!

Locally, the ladies of the village organised a teashop in one of the terraced cottages in the main street. Their cakes were thought highly of, as they were cooked on the premises. (John McKee, pers comm)

Work commenced on 20 March 1945 on the installation of Naval Type 277F radar in the old CHL T Hut for the Royal Navy personnel (TNA, AIR 26/95). This work was completed in April 1945, with the exception of a rectifier for the turning gear. A Skiatron cathode ray tube was installed in the Naval Operations Room at the same time (TNA, AIR 26/92).

A Type 8 mobile GCI trailer was installed during May 1945 but was replaced later in the month by a Type 15 aerial trailer. In November, with a Type 13 centimetric height-finder radar being on site, it was hoped that authority would be received for installation of this equipment to begin (TNA, AIR 26/92), and a hard-standing was erected in March 1946. However, on 15 March, along with all the other Scottish radar stations still operating, Cockburnspath was instructed to cease reporting at 4.30 pm on that date (TNA, AIR 26/93).

Cocklaw

Type	Radar station
Subtype	Chain Home Low (AMES Type 2)
Region	Aberdeenshire
NGR	NK 0895 4420
NMRS	NK04SE 39
In use	16 March 1941 – 15 March 1946

On 15 February 1941 the Air Ministry Works Directorate reported that all huts had been erected on the site of the new station at Cocklaw. The plotting table and landline were installed on 4 March and, following delays due to the non-arrival of some technical equipment, Cocklaw CHL radar station became operational at 11 pm on 16 March (TNA, AIR 26/100).

During June 1941 VT98 transmitting valves were installed, which improved the station performance. Cocklaw was complimented by the Scientific Observer at Kirkwall Filter Room for its accurate plotting at a range of 102 miles on Hostile 288 on 23 June. Further compliments were received for accurate plotting at long ranges during July, with tracks being frequently plotted that month at ranges over 100 miles, including one at 145 miles. The conversion to common aerial working, with a single aerial array for both transmitting and receiving, took place during August, and Cocklaw was the prototype for this conversion. October brought a new record range for the station of 173½ miles. That month also saw an important new function for Cocklaw as a CHL used in the GCI role, giving vectors to intercepting fighters directly. This was seen by the station as a way to hit back at the enemy, as well as simply detecting them (TNA, AIR 26/100).

F F M McClean recalls:

I was posted to Cocklaw from Anstruther in 1941 as Flight Sergeant in charge of station, as there were no technical officers then available – although later we had two or three Canadian Technical Officers posted to us for experience before, I understand, being posted overseas. We also had several Canadian Radar Mechanics over a period of time.

Being in charge of Cocklaw of course meant I also had to undertake admin duties as well as technical. I had a good Orderly Room Sergeant who undertook all the typing of the necessary reports that were called for from our HQ 71 Wing at Bucksburn, Aberdeen. Fortnightly I used to draw the money for Pay Parade from a bank in nearby Peterhead – I had special dispensation for this as I was not an officer. I was always accompanied on these occasions by an armed RAF policeman (of whom we had four) for guard duties and security.

All personnel, both RAF and later WAAF, were billeted in Peterhead and continued to [be] so until I left in 1944 but I believe were [later] billeted at the RAF Peterhead airfield …

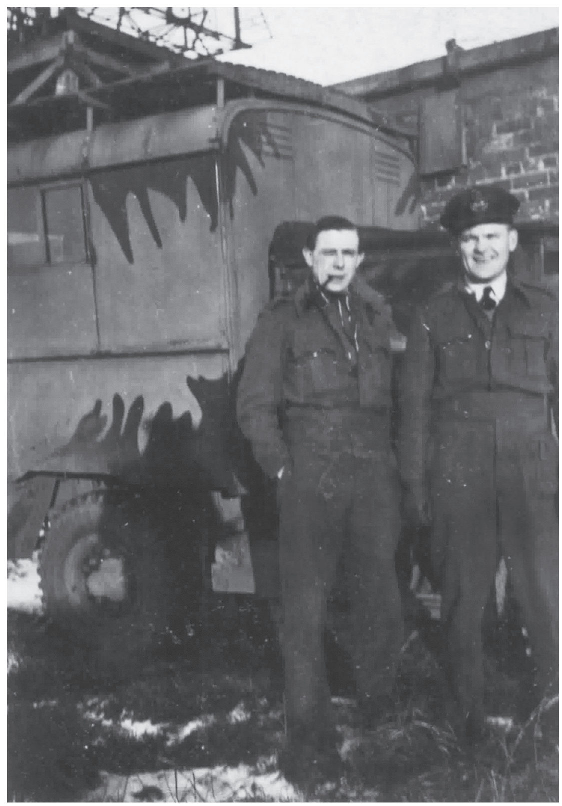
The main enemy aircraft tracked were 'Weather Willie', a specially adapted Heinkel 111 for weather observation over the North Sea. It used to take off from Denmark and land at Stavanger in Norway. The height and distances from Britain varied not allowing us to set up a pattern for interception, although we managed to down one whilst I was at Cocklaw. They were *also observing details of convoys, which were numerous and stretched for miles – some taking a whole day to pass our post of observation.*

Several air raids were made on Peterhead – warnings were frequent and some damage was caused but few casualties. We had no raids on Cocklaw itself but had several on nearby Peterhead airfield. The equipment we used was fairly reliable – the main trouble was with the PPI display – namely mains transformers burning out. This was finally rectified. (F F M McClean, pers comm)

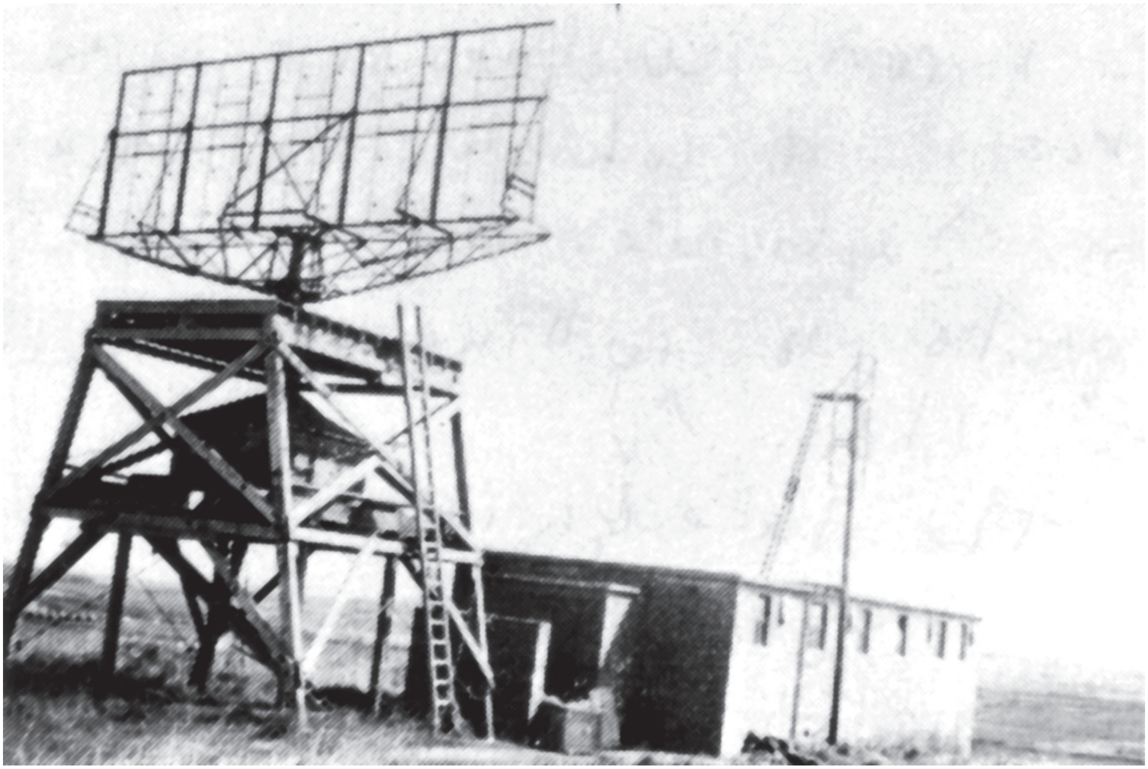
A lack of nearby enemy activity gave little opportunity for Cocklaw-controlled interceptions. Practice interceptions were, instead, carried out and during April 1942 an average of two per day were performed. This work proved its value when, towards the end of May that year, Hostile 212 was intercepted well out to sea, setting the port engine on fire. Although the aircraft was not seen to crash, it was considered unlikely it would return safely to base (TNA, AIR 26/100).

At 11.28 pm on 19 June 1942 the new power-turned, common aerial working 1941 Type CHL station became operational. The larger building removed the over-crowding which had been present in the old Receiver Hut, and also provided a rest room for off-duty members of the on-duty watch. It was noted that the acoustics in the new combined Transmitter and Receiver Block were poor. An echo was present which made it almost impossible to clearly listen to the radio traffic from fighters. Sound-absorbent material was fitted to deal with this problem. Despite these difficulties, the station performed well and two 'Weather Willie' aircraft were successfully intercepted during November 1942. The second of these interceptions took place at a range of 125 miles and required the combined efforts of fighter pilot, Sector Controllers and the Controller of Cocklaw to achieve success (TNA, AIR 26/100).

During the night blitz on Aberdeen, on 21 April 1943 Cocklaw plotted 30 hostile aircraft. Interceptions were attempted but were unsuccessful because the Spitfires did not have IFF. Later that night some Beaufighters were sent up from RAF Turnhouse and the Controller at Cocklaw tried to take them over. However, he failed to make radio contact owing to a misunderstanding about the R/T channel in use. The indications of both hostiles



57 Flight Lieutenant B G Morgan (Senior Controller) and Flight Lieutenant Evans in front of the combined T & R Block (note the aerial array in the top-left corner of the photograph) at Cocklaw, September 1944.
(© B G Morgan)



58 Cocklaw 1941 Type CHL, photographed in March 1946.
(© Joe Pratt)

and friendlies were clear, and if control of the night fighter had been achieved, successful interceptions might well have been completed (TNA, AIR 26/100).

An interesting insight into the work of a Controller at Cocklaw comes from B G Morgan:

In July 1942 I was posted to Peterhead as a Sector Controller. At that time we sometimes handed over the control of an interception to a controller – F/L Knight – at Cocklaw, but the facilities and liaison were poor and the results disappointing.

In the autumn of 1943 I was detached to Cocklaw to set up a standard CHL interception unit … We had no special height finding equipment at Cocklaw. We worked in the same room as the chain operators, but we had our own PPI, a range tube, navigation table and, for heights, we were plugged in to Sector Ops. – taking the filter room heights from the sector table – and to the CH station at, I think, Hillhead. The heights were notoriously inaccurate (the equipment and the system, not the operators) …

From time to time we had flights of Beaufighters at Peterhead – I remember 604 and 68 Squadrons in particular – and every afternoon I had to be available for the NFTs [Night Flying Tests] and at night I had plenty of practice doing the PIs [practice interceptions]. We had our first success on the night of 16/17 January 1944 when a Ju 88 was destroyed … The filter height throughout was A9 [Angels 9, ie 9,000 feet]. I made a successful interception on the PPI at that *height some 50 miles NE of Peterhead, the two blips merging nicely on to the same course, but the AI operator was unable to hold the contact. With some difficulty I managed to separate the two tracks and resumed the interception. Clearly the height was inaccurate and – instinctively, I suppose – I ordered A5 (four thousand feet lower) and it was at about that height that the 88 was shot down … H.500 was the plot number of the Ju 88 …*

Because I was preoccupied with the control of fighters, I left all the technicalities to my WO, the superb Mr McClean. (B G Morgan, pers comm)

The end of the war in Europe on 8 May 1945 saw an end to hostile air activity, and consequently, with effect from 5 pm on 27 June, the function of Cocklaw CHL as a forward control point ceased (TNA, AIR 28/862). However, the early warning role was retained until the station closed down at 4.30 pm on 15 March 1946 (TNA, AIR 26/93).

Crannoch Hill

Type	Radar station
Subtype	CD/CHL (AMES Type 2), AMES Type 31
Region	Banffshire (Aberdeenshire)
NGR	NJ 5301 6703
NMRS	NJ56NW 35
In use	22 May 1942 – 1 June 1945

Crannoch Hill CD/CHL station became operational on 22 May 1942, passing plots to Invergordon NPR and from there to Inverness Filter Room. However, delays in the installation of telephone lines meant that the station was not fully operational until 8 June 1942 (TNA, AIR 26/100).

The performance of the station was good, with ranges of 107 and 115 miles being obtained on aircraft and 40 miles on surface vessels during June 1942. July saw the station converted to continuous rotation and PPI, and the plotting speed improved as a result. The maximum ranges for the month were 145 miles on aircraft and 40 to 50 miles on shipping. On 27 August, Crannoch Hill plotted Hostile 292 at a range of 165 miles, its longest for the month. Hostile activity had increased, with hostiles being plotted almost every day during the second half of that month (TNA, AIR 26/100).

On 16 March 1943 a CD No 1 Mk V (AMES Type 31) centimetric radar became operational. WRNS, assisted by WAAF, took over the operation of this equipment. Accuracy of plotting was excellent and ranges of 64,000 to 66,000 yards were obtained on convoys during the rest of March 1943. Performance improved as the operators became more experienced, and May 1943 saw ranges of 73,000 to 75,000 yards on convoys (TNA, AIR 26/100).

The air raid on Aberdeen on 21 April 1943 provided a busy period for Crannoch Hill. However, the station only detected the low-flying hostiles a few miles from the coast and the tracks were taken over by the Royal Observer Corps almost immediately afterwards (TNA, AIR 26/100).

George Ross was a Radar Operator stationed at Crannoch Hill in 1943:

The first surprise here was to find there was no camp. We were billeted in hotels and boarding houses in the town [Cullen] – an arrangement which sounds ideal until you find that hotel keepers have been ordered to take in airmen. Relationships were somewhat strained until they found out that we were really civilians in uniform, quite civilised and the majority well educated. A further surprise was to find that we worked with WAAF operators and a pleasant interlude it was. The CHL had additional 10 cm equipment and a searchlight. The station had excellent all round coverage with plenty activity … There was only one occasion when, as i/c watch, I was instructed from the Filter Room to get the searchlight operational. The beam was to be kept vertical for a short time and then dipped to point towards the aerodrome at Banff. The aeroplane was heard approaching from the sea and it did follow the beam to its landing site. I think it was a Whitley bomber returning from a mission to Norway. (George Ross, pers comm)

The Type 31 closed down on 1 January 1944 and was removed from the station on the 26th. The CD/CHL equipment remained on the air and plotted Hostile 500 on 17 January, a Junkers Ju 88 which was eventually shot down by a fighter controlled by Cocklaw CHL. On 1 June 1945 the CD/CHL ceased operating and was placed on care and maintenance five days later (TNA, AIR 26/92).

Cromarty

Type	Radar station
Subtype	Chain Home Low (AMES Type 2)
Region	Ross and Cromarty (Highland)
NGR	NH 8064 6692
NMRS	NH86NW 13
In use	August 1940 – 6 August 1943

Cromarty CHL station became operational during August 1940 (Air Ministry, 1950 (1): 124), sited to provide cover over the Moray Firth but in practice also able to plot aircraft over the Aberdeenshire coast, as well as over the Minch and the area west of the Orkney Islands (TNA, AIR 26/92).

The station was performing well, plotting a Coastal Command aircraft 121½ miles north-east on 6 April 1941. On 18 April, Cromarty plotted Hostile 268 at a range of 108 miles to the north-east (HRA, RDF Bulletin).

During December 1941 conversion to a common transmitting and receiving aerial array was carried out. Although the array remained hand-turned, this new system used a single aerial array for transmitting and receiving, to avoid the problems and delays involved in having the transmitter array following the receiving array. Hopkins turning gear was also installed that month. The station maintained good performances and in April 1942 achieved ranges of 146 miles on aircraft and 20 miles on surface vessels (TNA, AIR 26/92).

On 6 August 1943 Cromarty CHL closed down, its area being adequately covered by more up-to-date stations. The station ceased plotting at 12 pm and the turning gear was immediately dismantled for use at an Oboe blind-bombing system ground station in England (TNA, AIR 26/92).

Crustan

Type	Radar station
Subtype	Chain Home Low (AMES Type 2), AMES Type 13
Region	Orkney
NGR	HY 2743 2906
NMRS	HY22NE 36
In use	8 March 1941 – 15 March 1946

Air Ministry Experimental Station No 72A, Crustan was a twin-gantry, hand-turned CHL station which became operational on 8 March 1941. The station performed well, achieving a maximum range for October 1941 of 130½ miles on Hostile 286. The following month a single transmitter aerial was mounted on top of the receiver aerial array, thereby avoiding the problems of having the transmitter array having to follow the receiver array. Further improvements were carried out during December 1941 when Hopkins turning gear was fitted, a definite improvement over the bicycle chain drive (TNA, AIR 26/92).

February 1942 saw improvement in the performance of the station, with the maximum range for the month reaching 135½ miles. This was extended in March to 148½ miles on aircraft and 57 miles on surface vessels, and again in April to 180 miles, but only 50 miles on shipping. More good performances were achieved during May, with a maximum of 186 miles during the month (TNA, AIR 26/92).

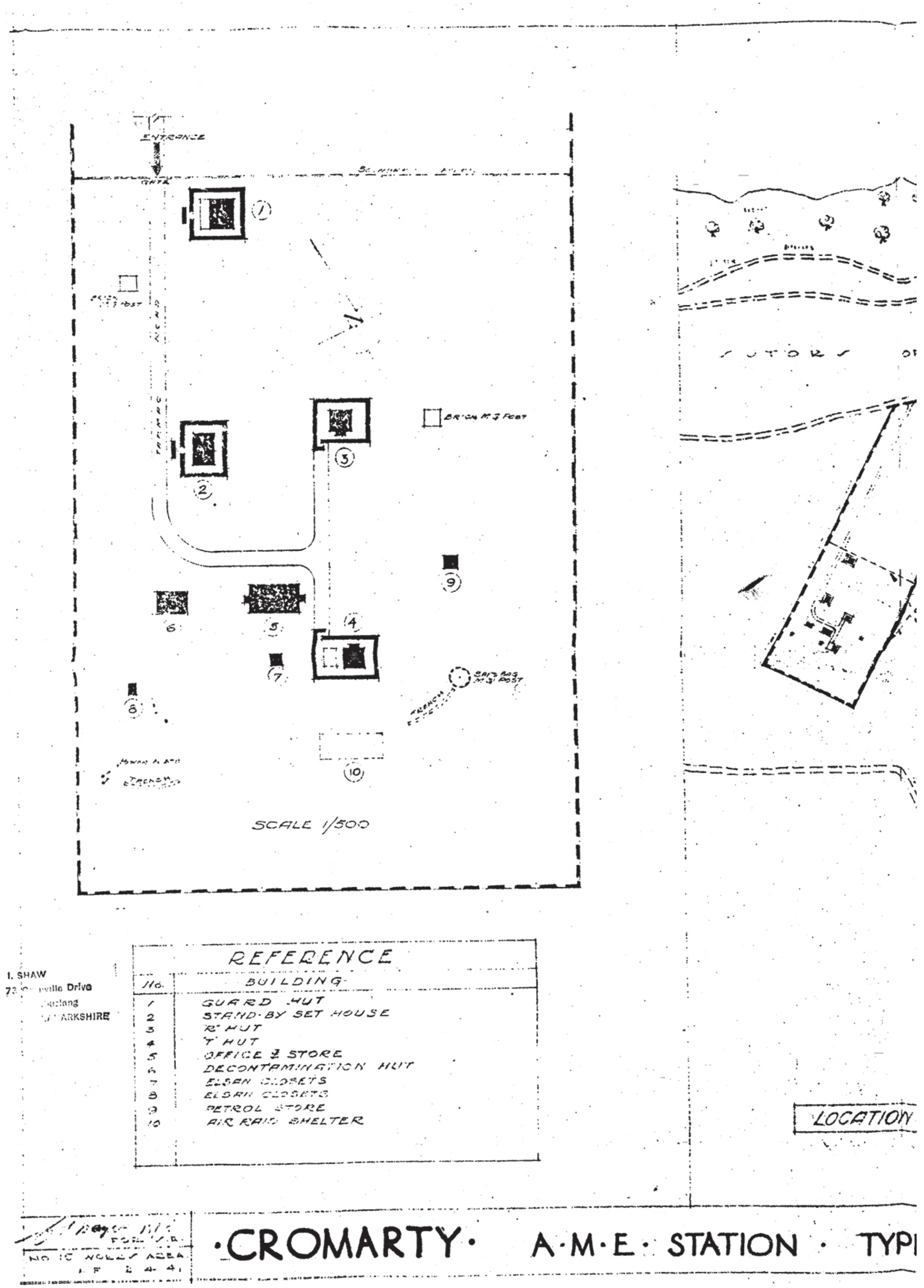
On 19 July 1942 the 1941 Type CHL station, with common aerial working (a single array for both transmitting and receiving), power turning and continuous rotation, became operational. The new equipment performed well right from the start. Naval personnel arrived in October 1942 to man the second PPI tube, passing shipping plots to Lyness NPR (TNA, AIR 26/92).

More new equipment became operational on 21 December 1943 in the form of a 90 cm searchlight Mk 7 which was to be used to direct lost aircraft to the nearest suitable airfield. Practice illuminations on Skeabrae (192°) and Hatston (148°) were carried out successfully (TNA, AIR 26/92).

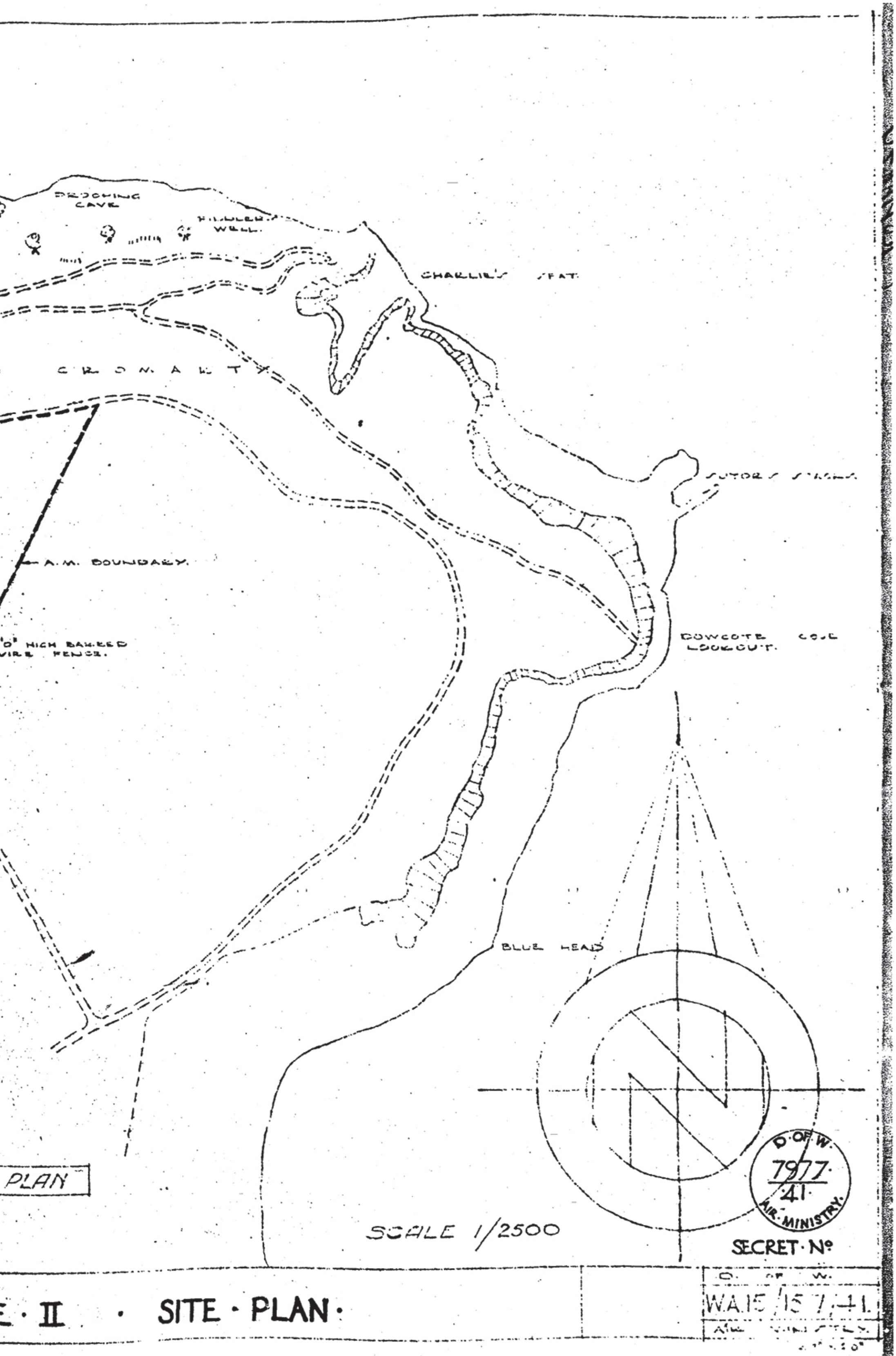
George Ross was stationed at Crustan in 1944:

This was a self-contained unit and covered all activity in the area. There were frequent rumours of enemy U-boat … and aircraft activity around Scapa Flow – rumours which on many occasions proved to be correct …

Football here was not the occasional game against a local select on Saturday evening but participation in a full league programme with matches against teams from all parts of the 'Mainland' … I think the football league consisted of about a dozen teams. Owing to station strength – possibly 50 – our team was not



59 Cromarty site plan. (© Historical Radar Archive)


FIDDLER'S WELL
CHARLIE'S SEAT
CROMARTY
A.M. BOUNDARY
SUTOR'S STACKS
DOWCOTE COVE
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60 Crustan from the air, taken on 4 May 1943.
(© Orkney Library & Archive L4544/4)

61 Crustan Football Team, known as the Crusts, photographed in 1944.
(© George Ross)

of the highest standard, so we were in the lower part of the league. If I recall correctly, there were teams from Deerness (CHL) and Netherbutton (CH) but the main teams were RNAS Twatt and RAF Skeabrae. (George Ross, pers comm)

On 20 September 1944 an AMES Type 13 centimetric height finder became operational at Crustan, covering an arc from 300° to 360°. Although this equipment was normally used to give height information only, in this instance it was a temporary measure to plot low-flying aircraft until the Type 50 radar became operational at Hesta Geo, due to the fact that low-flying hostiles were able to approach the Orkney Islands undetected. With Hesta Geo's Type 50 becoming operational on 18 January 1945, the Type 13 closed down at 10.30 am on 19 January (TNA, AIR 26/92). The CHL ceased operating at 4.30 pm on 15 March 1946 and was placed on care and maintenance (TNA, AIR 26/93).

Deerness

Type	Radar station
Subtype	Chain Home Low (AMES Type 2), AMES Types 13 Mk I, 14 Mk I, 51
Region	Orkney
NGR	HY 5690 0736
NMRS	HY50NE 51
In use	August 1940 – 15 March 1946

In July 1940 it was decided to close down the CHL station at Gaitnip, which had been performing poorly. It was suggested later that month to re-site the station at Deerness, although the Assistant Chief of the Air Staff (Radio) had reservations:

I am reluctant to agree to the setting up of the station at Deerness until the performance data is available from the Naval stations now in course of erection at Wardhill (South Ronaldsay) and Dunnet Head, since it is not clear from a cursory examination of the chart that Deerness would materially improve the CHL coverage which will then be available. (TNA, AIR 2/5476)

The Director of Communications Development at the Air Ministry, A G Lee, replied on 27 July 1940: 'My recommendation on technical grounds is that the existing proposals stand and that Gaitnip be transferred as early as possible to Deerness' (TNA, AIR 2/5476).

Steven Bichan, five years old at the time, remembers the initial stages of the construction at Deerness:

We heard that a camp was being built at the Wart, news of which, of course, had to be investigated, and so on a Sunday forenoon we again set out on reconnaissance. This must have been about the first week of August. You may ask, how do I know the date after fifty-two years? The answer is simple: we walked along the ditch between Springfield and Upper Notland where the blueberries which grew there in profusion were rife, and I well remember my extreme reluctance to go any further.

However, regardless of my wishes, we carried on to the Wart. All that had been erected at that *date was a small wooden hut. Two or three men were pottering around, earning their double pay for Sunday work. My main impression was of admiration of the boxes of shiny new wire nails, far more attractive than the dull galvanised nails I was accustomed to … As I can remember no further visits, the site must have been put out of bounds to the public very quickly. It was certainly surrounded by barbed wire entanglements soon after.* (Bichan, 1992: 22–3)

As Steven Bichan recalls, Deerness CHL station became operational during August 1940 (Air Ministry, 1950 (1): 124), and was soon in action. At 7.30 pm on 18 October the station was bombed by a Heinkel, but fortunately without damage or any casualties. Deerness achieved a good performance in plotting Hostile 297 on 6 April 1941 at a range of 121½ miles east-south-east of the station (HRA, RDF Bulletin).

The station tracked Hostile 216 on 11 July 1941. The aircraft, a Junkers Ju 88, was originally picked up by Netherbutton 90 miles to the north-west, but Deerness was one of the stations plotting the hostile, which was followed by fighters for about 80 miles until it was shot down into the sea. The Scientific Observer at Kirkwall Filter Room noted that 'Deerness plotting on this raid was noteworthy, the track finally fading to this station at 104 miles NE.' This performance was improved upon when the station achieved a new record range of 147½ miles on Hostile 222 on 31 July 1941, and was bettered again the following month when a hostile was followed to a range of 166 miles (TNA, AIR 26/92).

Conversion to a common transmitting and receiving aerial array was carried out during December 1941. However, construction of the 1941 Type common aerial working, power-turned CHL was already under way and the building of the new combined Transmitter and Receiver Block was completed during February 1942, and the new equipment went on the air on 8 August. This saw an immediate improvement in performance, with a maximum range that month of 204 miles. The following month was almost as good, with a maximum range of 201 miles and several other plots of

62 Image deleted from this edition.

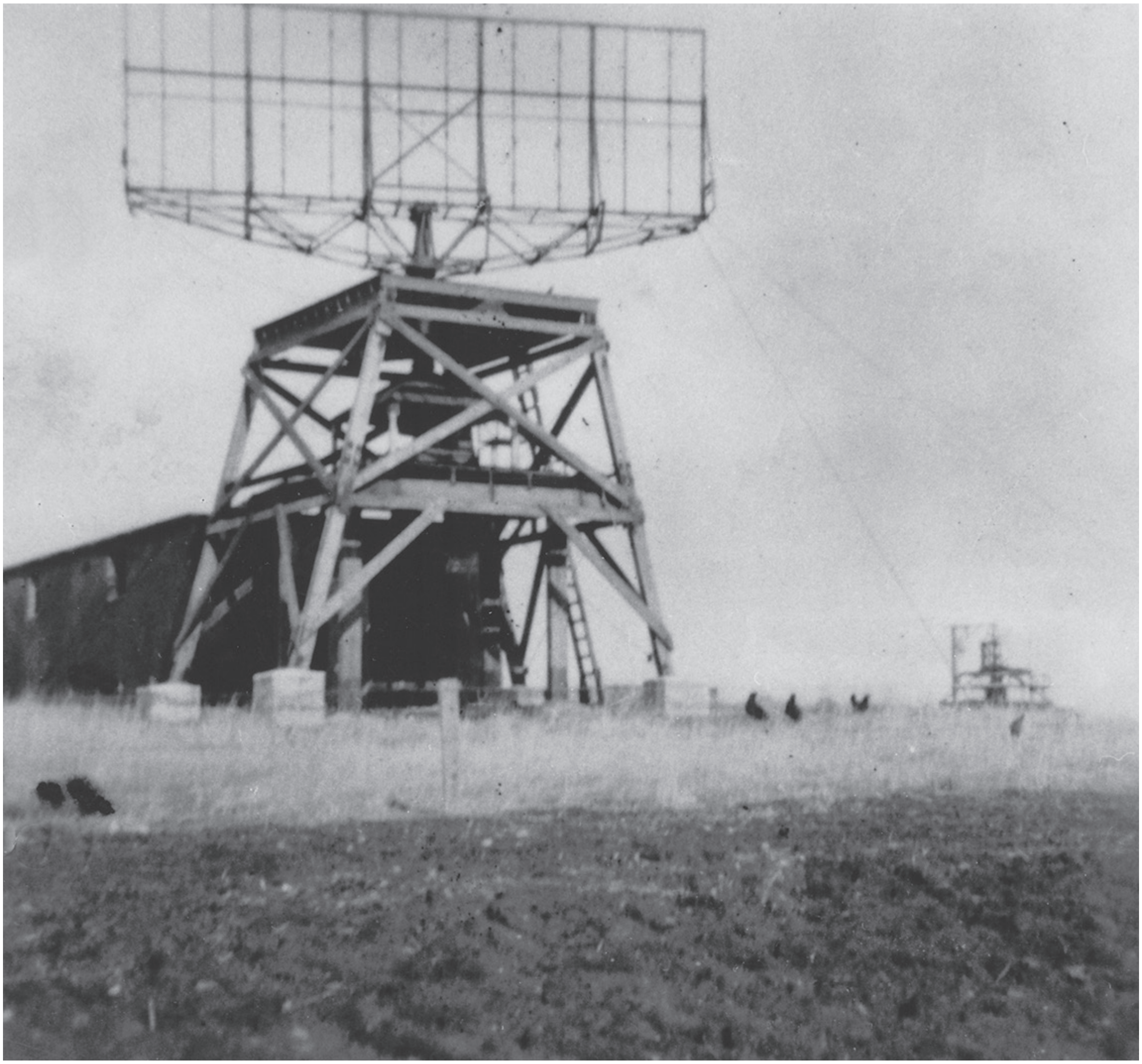
63 Deerness 1941 Type CHL.
(© Orkney Library & Archive L7/3)

over 180 miles' range. Deerness also achieved the longest range in September 1942 within 70 Wing on shipping of 58 miles, on a convoy flying barrage balloons (TNA, AIR 26/92).

From October 1942 the second PPI tube was manned by Naval personnel passing information on surface vessels to Lyness NPR. That was not, however, the only development that month, because an AMES Type 13 centimetric height-finder set arrived and installation began, with the equipment becoming operational during November. The purpose of setting up this radar at Deerness was to try and improve coverage against very low-flying aircraft in the Orkney area. The equipment proved itself on 24 March 1943 when the Type 13 was the first radar to detect an approaching Junkers Ju 88 at a range of 20 miles, flying at a height of less than 1,000 feet. Eighteen minutes after Deerness picked it up, the Ju 88 was shot down into the sea by a Spitfire from Sumburgh aerodrome. A quarterly overhaul on the Type 13 was postponed so that the equipment could remain on the air all of the night of 13/14 August 1943 to provide cover for the visit of His Majesty King George VI to the Home Fleet in Scapa Flow (TNA, AIR 26/92).

Even with the centimetric equipment, the CHL was still performing well, and at 6 am on 18 August 1943 Deerness CHL picked up Hostile 577 at a range of 14 miles, flying at a height of 250 feet. Nonetheless, the Type 13 continued to produce results, providing early warning on 25 August of Hostile 643, a Junkers Ju 88 flying at less than 500 feet off Fair Isle. The Ju 88 was shot down by anti-aircraft fire from Fair Isle (TNA, AIR 26/92).

On 15 September 1943 another centimetric radar arrived, an AMES Type 14 Mk I, and installation of this equipment began immediately, with the set going on the air at 1 pm on 25 October. The Type 13 closed down at 6 pm and thereafter acted as stand-by for the Type 14, until being removed during September 1944. An interesting track was plotted by the Type 14 from 12.05 pm on 24 October 1943, before the radar officially became operational. Three ships of 15,000 tons each were picked up at 30 miles' range at 94° and plotted until 1.20 pm at 26 miles and a bearing of 132°. At that point they split, one part heading for Scapa Flow, finally fading at 3 pm. These ships were redesignated Type 51, although it remained the same equipment. That month, on the 16th, the equipment achieved a record range on surface vessels of 74 miles (TNA, AIR 26/92).



64 Deerness 1941 Type CHL, with the Type 51 radar on the right minus its paraboloid aerial. (© Orkney Library & Archive L2/1)

from Gothenburg, Sweden, and were carrying repatriated British prisoners of war (TNA, AIR 26/92).

By January 1944 the Type 14 had been

RAF Deerness ceased operating at 4.30 pm on 15 March 1946 and was placed on care and maintenance (TNA, AIR 26/92).

Dirleton

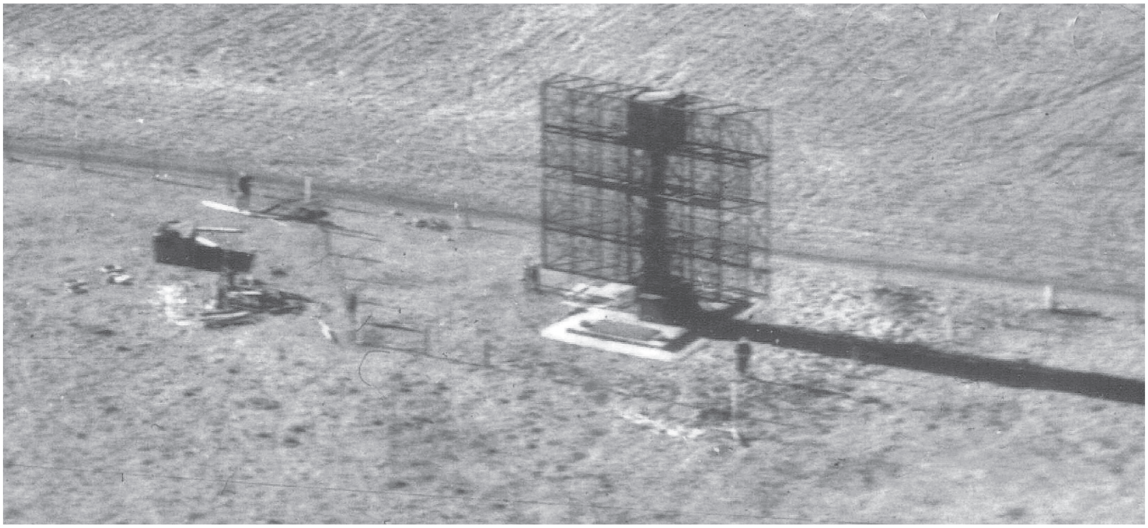
Type	Radar station
Subtype	Ground Control of Interception (AMES Types 7, 8, 13 Mk II, 14 Mk III, 21)
Region	East Lothian
NGR	NT 5168 8484
NMRS	NT58SW 72
In use	25 April – 8 May 1941, October 1941 – 25 March 1946

The installation of a mobile GCI at Dirleton commenced on 11 April 1941, with the station becoming operational on 25 April. This mobile station was to be short-lived, however, because it was dismantled on 8 May 1941 and transferred to Trewan Sands on Anglesey (TNA, AIR 26/103).

It would not be until September 1941 that another mobile GCI unit, AMES No 836, was despatched to Dirleton (TNA, AVIA 7/1314), with the station starting operations in October 1941. The GCI was converted to common aerial working (ie using a single aerial array for both transmitting and receiving) on 24 December 1941 (TNA, AIR 26/103).

Work on the construction of the Intermediate Mobile GCI commenced in March 1942, using the same aerial trailer as the mobile GCI but with operations carried out from a wooden hut, rather than a vehicle. Height calibration was completed on 28 April and the Intermediate GCI went on the air in August. A form of power turning for the aerial was installed in July 1943. Continuous rotation was achieved by providing a drive from an electric motor onto the hand-turning gear (TNA, AIR 26/103).

65 Dirleton GCI, photographed on 21 February 1950, with the Happidrome centre left, the Type 14 in the centre foreground (with the recently removed 'cheese' type aerial sitting on the ground in front), the IFF in the right foreground, the Type 13 behind it and the Type 7 in the top-right corner. (© Historic Environment Scotland)



66 Dirleton GCI Type 7 radar, photographed on 21 February 1950.
(© Historic Environment Scotland)

The installation of the Final GCI was completed and the equipment commissioned on 1 October 1943. The Final GCI used a Type 7 radar which was fully power turned, and operations were conducted from a large brick-built Operations Block, nicknamed the Happidrome. The Intermediate Mobile was dismantled on 2 January 1944. Installation of the Skiatron display began on 21 July 1944 (TNA, AIR 26/103).

Although GCI stations were primarily for controlling night fighters in the night air defence of their locality, RAF Dirleton played an important role in the training of local night fighter units, as well as training the controllers themselves. No 54 Operational Training Unit based at RAF Charterhall (and its satellite station, RAF Winfield) and No 784 Squadron, Fleet Air Arm, based at RAF Drem, were two of the main units which carried out practice interceptions whilst being controlled from Dirleton.

It is believed that no enemy aircraft were ever shot down by fighters under Dirleton control. However, numerous scrambles did take place on hostile and unidentified aircraft. Such interceptions, as well as playing an important part in the air defences, were also useful training for units such as No 54 Operational Training Unit. On 20 June 1944, for example, a Bristol Beaufighter from Winfield (call sign Millpond 116) intercepted hostile plot H93U, only to discover that it was an RAF Handley Page Halifax bomber (TNA, AIR 29/167).

On 13 September 1944 there was a 'Window' exercise in the Perth area involving No 289 Squadron. Interception on Window-dropping aircraft was carried out by Tiger Yellow Section of No 309 Squadron under Dirleton control. The squadron was again used to intercept unidentified plot X550, on 15 September. The plot was later changed to a hostile designation, H550, and although the Hawker Hurricane IICs of No 309 Squadron got within 1½ miles of the target, the plot faded and it was assumed to be a North American P-51 Mustang fighter returning from Norway to Royal Naval Air Station (RNAS) Crail (TNA, AIR 29/167).

The Type 14 trailer for the Type 21 centimetric GCI arrived at Dirleton during January 1945 (TNA, AIR 26/92). On 1 June installation of the Type 21 was completed (TNA, AIR 28/199). The Type 21 comprised two different equipments: a Type 13 Mk II and a Type 14 Mk III. The Type 13 was a height-finding unit, capable of giving a height reading in any desired direction; the Type 14 was a PPI unit, rotating about six times per minute.

All WAAF Radar Operators, a total of 27, except for those due for release, were posted from Dirleton on 3 December 1945. On 25 March 1946 information was received from No 13 Group that RAF Dirleton was to close down operationally at 5 pm that day (TNA, AIR 28/199). Ancillary equipment on the station was dismantled from 15 to 20 May 1946, in accordance with No 90 Group instructions. The main radar equipment in the Operations Block was left in situ (TNA, AIR 26/93).

Doonies Hill

Type	Radar station
Subtype	Chain Home Low (AMES Type 2), AMES Type 14, 31
Region	Aberdeenshire
NGR	NJ 9665 0388
NMRS	NJ90SE 23
In use	February 1940 – 7 November 1945

Air Ministry Experimental Station No 46A, Doonies Hill was part of the second 'crash' programme of hurried CHL station installation. The programme started in January 1940 and Doonies Hill became operational during February (Air Ministry, 1950 (1): 85).

William Inglis was a Technical Civilian employed by the Air Ministry and was sent to Doonies Hill in February 1940. He encountered problems on the way due to the secrecy of radar:

Off to Aberdeen. Got some very queer looks when I asked for 'Doonies Hill'. Was picked up by two SPs and driven and dumped at Dyce. Next day found me at Schoolhill beside other puzzled civvys and left on my own. Nobody seemed to know much about Doonies Hill. Then two civvys from Pye, Cambridge, looked me up and took me to Doonies and about 10 in the evening said, 'Toodle oo. We're off in the morning. It's all yours.' The installation was a 1940 CHL Hopkins hand-turning gear (Austin 10 gearbox and motor car steering wheel). You could hardly swing a cat in the Rx and Tx huts, bags of valves and knobs, very frightening!

A voice on the phone (… Leighton Buzzard) – a calm voice – said, 'Just hold on. Don't panic.' Some ACHs [Aircrafthands] would appear next day with a corporal i/c. They would form 'watches'. The corporal would attend to all admin. Next day another civvy appeared … He was as puzzled as I. We started to make a circuit diagram of the works (what a hope). Anyway, we got 'on the air' and watched the blips – everything hostile; no IFF.

That night it was panic stations, rain (it was a gale outside) came pouring down the feeder cables into the gear, fuses blowing, trips tripping. Tried to plug the water with soap – all we got *was soap suds, but we managed and got back on the air. The rest of my experience was to keep the station on the air! That was my prime function, come hell or high water!* (William Inglis, pers comm)

Security at the station was improved with the erection of a permanent, hinged road barrier outside the main entrance gates in October 1940. That month also saw several visits by Commander Cumanoury of Aberdeen Naval Base with a view to co-operation in the reporting of minelaying aircraft (TNA, AIR 26/100).

During May 1941 two WAAF Radar Operators from Schoolhill CH station visited Doonies Hill and they both took a turn at operating the CHL. However, they discovered that the radio energy was not being directed at right angles to the aerial array and as a result new feeders were fitted that month. There was a resulting improvement in station performance, with permanent echoes being recorded on certain days at a range of 85 miles and ranges on aircraft going right to the limit of the screen of 100 miles (TNA, AIR 26/100).

Early in the afternoon of 14 July 1941 a Junkers Ju 88 dived low over Doonies Hill. The station defences opened fire on the aircraft and several hits were observed. Reports were later received that the aircraft had crashed near St Cyrus and the machine-gunners at Doonies Hill were awarded an 'assist' in the destruction of the bomber (TNA, AIR 26/100).

Work began in November 1941 on the new common aerial system, which was installed the following month. However, on the night of 25 January 1942 the aerial gantry was swept away by a 65 mph gale, but a replacement was quickly provided from St Cyrus. Progress on the new 1941 Type CHL continued, and the new transmitter and receiver arrived during February 1942. In the meantime, the range of the station was extended with a new record of 215 miles. Although the performance of the station was good, problems were experienced with the installation of the new CHL, with various components arriving and then being taken away for other stations. As a result, it was not until 12 pm on 22 November 1942 that the power-turned common aerial CHL became operational. Although teething troubles were experienced with the new equipment, it quickly gave good performances, with ranges in December including 156 miles on 65° and ranges up to 36 miles on surface vessels (TNA, AIR 26/100).

On the morning of 16 January 1943 a CD No 1 Mk V (AMES Type 31) centimetric radar, complete with trailer generator, arrived at Doonies Hill. A week later personnel arrived from No 71 (Signals) Wing to commission the equipment, and this work was quickly completed. However, Doonies Hill waited for personnel to arrive to operate the new equipment, only to be told that it was the responsibility of the existing staff. The 10 cm radar finally went on the air at 12.01 am on 1 February. It immediately proved its value: during the night of 21 February it was responsible for the first radar-controlled surface vessel interception in the Aberdeen area. The following month the equipment achieved a range of 48 miles on a single vessel not flying a barrage balloon (TNA, AIR 26/100).

April 1943 was a busy month for Doonies Hill. During the attack on Aberdeen on the 21st, 10 different hostile aircraft were plotted and most of these tracks were initiated by Doonies Hill CHL, seen on the range tube but just outside the PPI tube. The rest of the month saw a lot of activity, with numerous ranges between 140 and 150 miles being obtained on high-flying aircraft. The Type 31 set was also busy, with two steamers picked up at 87,000 yards and plotted right in to Aberdeen harbour (TNA, AIR 26/100).

A Type 14 centimetric radar which had been installed at Doonies Hill in order to provide additional low-flying cover in the Aberdeen area was closed down and removed on 2 December 1943. Further reduction in cover came with the closing down of the Type 31 on 1 September 1944, leaving only the CHL still on the air. At 12.30 pm on 7 November 1945 the CHL ceased operating, and Doonies Hill was placed on care and maintenance the following day (TNA, AIR 26/92).

Douglas Wood

Type	Radar station
Subtype	Chain Home (AMES Type 1), Chain Home Low (AMES Type 2), AMES Type 55
Region	Angus
NGR	NO 4877 4146
NMRS	NO44SE 46
In use	10 March 1939 – 15 March 1946

Before construction of Douglas Wood CH radar station could begin, the Air Ministry had to acquire the site. The local newspaper reported on 5 October 1938:

Dundee Corporation Water Committee yesterday agreed to sell to the Air Ministry seven acres of ground at Gallow Hill, Douglas Wood, on the Crombie estate. Lord Provost Phin, who presided, said it was a small piece of ground wanted, evidently, for the erection of aerial masts. The Town Clerk had replied to the Ministry that the committee would be prepared to dispose of the ground provided there was no camping or buildings to be erected. Ministry had accepted the price, a lump sum of £60. ('Air Ministry Buys Land at Crombie', *The Courier*, 5 October 1938)

Throughout the period of its construction the station was known as Gallow Hill, but in January 1939 the name was changed to Douglas Wood, to avoid confusion with another, more prominent Gallow Hill only a few miles away (TNA, AVIA 7/302).

E W Seward, a civilian scientist with the Bawdsey Research Station, produced a report on the performance of Douglas Wood, dated 14 March 1939:

General
The station was inspected between the dates 8.3.39 and 10.3.39 and, subsequent to the moderately satisfactory performance obtained on the latter date, the station was handed over officially to the RAF technical crew.

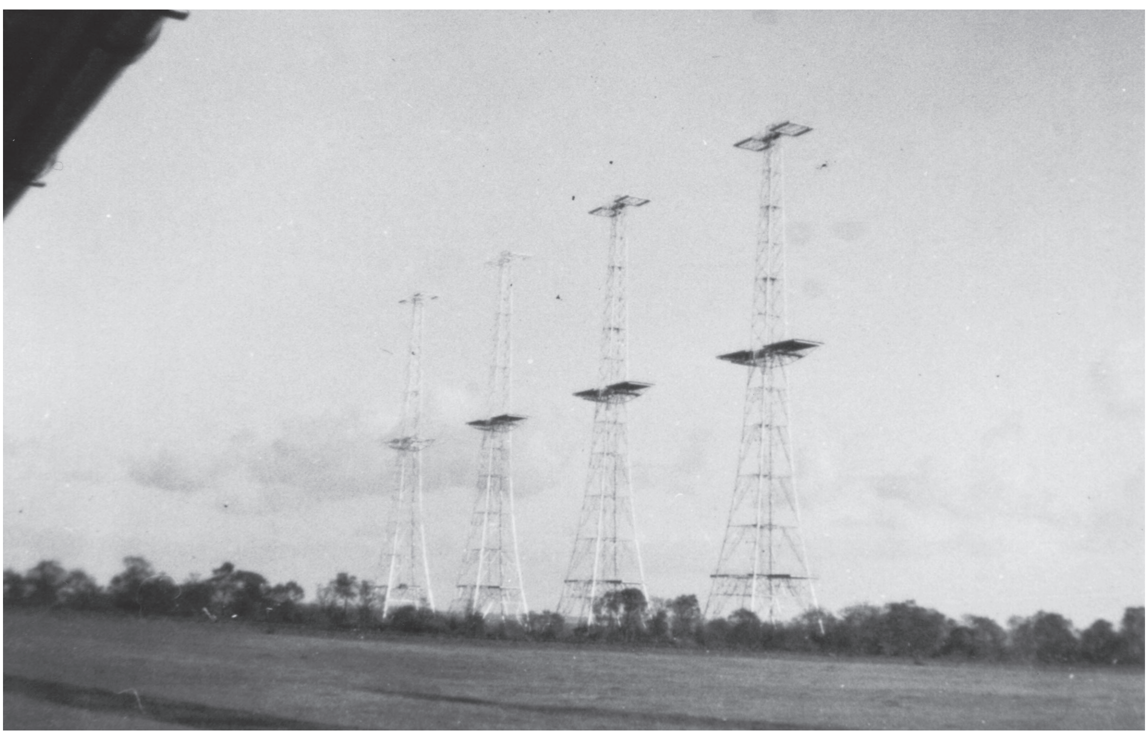
Performance
The performance of this station is below the general standard obtained so far on Intermediate sites. Relevant technical details are given under the appropriate heading below …

Clutter, from fixed obstructions both inland and out to sea, is extremely troublesome, and aircraft at ranges less than 34 miles from the station are likely to prove extremely difficult to follow unless they are producing very strong reradiation. (TNA, AVIA 7/302)

Len Dobson was a Radar Operator. He recalls:

On 24.4.39 I received a posting to Air Ministry Experimental Station Douglas Wood with billeted accommodation in Carnoustie … The CO was Corporal ER Jeffries who had come from the next station south, Drone Hill. The only airmen's names I can remember are MacKenzie, Little and Smith and we were immediately placed on a 24-hour watch. As I had already been on 24-hour duties at HQ Signals Montrose I was used to a shift system …

At Douglas Wood there were four wooden masts with dipole aerials approximately 100" long being ¼ wavelength of around 10 metres. Aerials at 80 and 240 feet with sensing reflectors were fed into a temporary wooden hut with some sandbags round it and connected to a type of receiver I had never seen before, an RF5, and eventually providing a visual indication on a cathode ray tube of distance, bearing and height of aircraft flying up to approximately 100 miles from the station … Some 50 yards away was another wooden hut near another 240' mast and this contained an MB1 transmitter connected up to a temporary transmitting array on the mast. This transmitter was gradually brought on air and as far as I can recall was some 400 kilowatts on full power, which was considerably more that I had been accustomed to at Montrose. As we were all wireless operators, none of us had been trained on maintenance but we just had to get on with it as it was absolutely essential that the equipment be kept in operation and so give early warning to our aircraft … It was not until the



67 Douglas Wood in 1939 with the Final CH transmitter towers almost complete (note the far tower lacks wood on the middle platform).
(© Len Dobson)

summer that a wireless operator mechanic was posted in … In that part of the east coast there were very few aircraft flying and it was quite an occasion when we reported a flight of three aircraft.

The transmitter masts, some 360' high and made of solid steel, were in a separate compound some 500 yards away. In April 1939 1½ masts had been completed and they gradually increased to 4 during the summer. I remember going across to the Tx site and trying to lift some of the steel lengths which were to be used in the mast assembly, but I couldn't move them. At times, mostly on a clear day, I would climb a Tx or Rx mast and I am sure I could see as far as East Lothian. The defence of this highly important radio station consisted of two elderly Air Ministry wardens occupying the two houses in the R compound, augmented by other retired regular servicemen who came in on a 24-hours shift system. It was only on 1st September that [a] company of soldiers arrived to guard this top priority radio station. (Len Dobson, pers comm)

68 Alex Hunter on the 200 foot platform of one of the transmitter towers at Douglas Wood. (© Alex Hunter)

In what appears to be a rather belated step by the Air Ministry, *The Courier* dated 6 June 1939 noted:

Dundee Water Committee were informed yesterday that the Air Ministry wish to depart from the condition whereby no habitations were to be erected on ground sold to them by the Corporation at Douglas Wood, Crombie estate. This condition was introduced to safeguard the purity of the water draining into Crombie reservoir.

To house personnel, the Air Ministry are putting up quarters on land not purchased from the Corporation. One or two houses, however, are required on what was Water Department land, and the engineer intimated they might be erected, providing they are off the catchment area. The committee approved. ('Air Ministry Wants to Build', *The Courier*, 6 June 1939)

Len Dobson recalls one particular track plotted by Douglas Wood in the late summer of 1939:

On Thursday 3rd August I had just come on duty when I was sure I could see a response at over 120 miles, the bearing appeared to be almost on our line of shoot, our best transmission direction, which was 114°. The plot was passed to Headquarters Fighter Command who asked us to keep plotting. The response which was at first in the plotting square QZ was soon in QU and coming slowly towards us and appeared to be moving at about 60 mph. What was it? HQFC would not tell us but asked us to keep passing positions and when asked how many aircraft I had to say between 50 and 100. I had never seen such a large response.

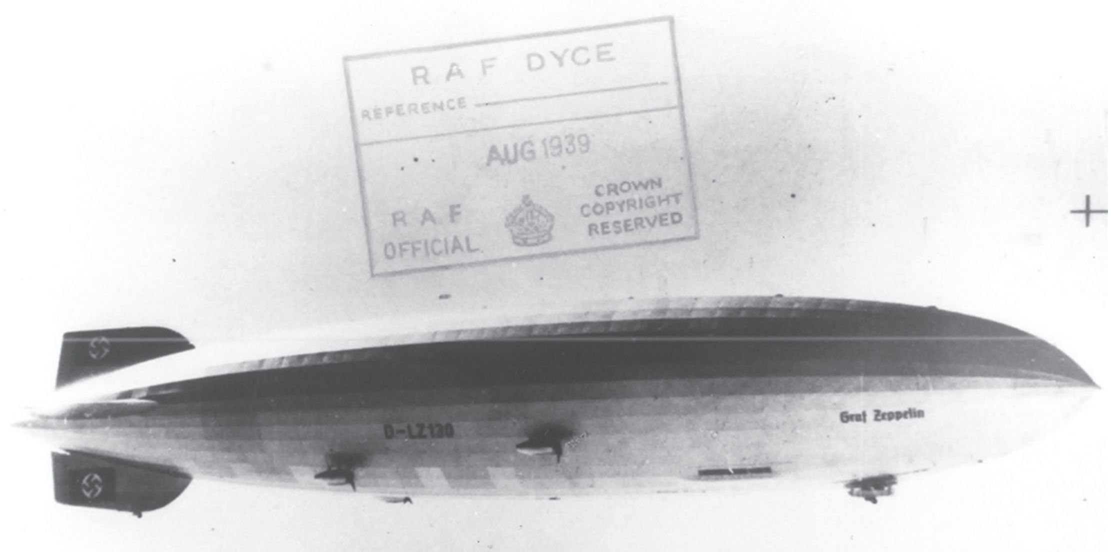
With the position in Europe as it was in 1939 was this an invasion of the UK and why was it coming directly in the direction of Douglas Wood and why was it moving so slowly? Was it an invasion fleet with protective balloons above *it? By 14.30 hours it was quite near the Bell Rock Lighthouse and must have been seen by the lighthouse keepers but of course we had no contact to find out. Then the response appeared to change course and started to go in a direct line towards the next RDF station at Schoolhill. It was now in square QP which was our best square for good responses. About 15.00 hours it changed course again and proceeded in a northeasterly direction parallel with the Aberdeenshire coast and gradually the response faded … I was on duty until 21.30 on the 3rd August and at about 21.00 this large response appeared again about 100 miles to the north east and coming down almost due south. Plots were again passed regularly to HQFC and it was only the next day that they confirmed it had been the Graf Zeppelin and they were sure it had been trying to find out the purpose of the large masts which had appeared all down the east coast.* (Len Dobson, pers comm)

By early 1940, although Britain was now at war, many people were still acting as though the peacetime economy was continuing. As an example, on 27 January 1940 the Dundee Town Clerk wrote the following letter to Sir Norman Macpherson, Secretary in Scotland to the Air Ministry, concerning the Crombie Shootings:

The tenant of the above Shootings rented from my Council has successfully claimed a reduction in the rental thereof on the ground of the deterioration in the value of the Shootings due to the Air Ministry's activities and presence at Douglas Wood, etcetera.

It was pointed out on the tenant's behalf that the area of ground occupied by the Air Ministry formed the most valuable nesting area for grouse and game on the Estate and that their activities seriously disturbed the birds and prevented nesting, not only on this area but also a considerable portion of the Estate adjoining estimated at approximately one-quarter of the whole Estate.

After going very carefully into the whole matter my Council agreed on a reduction of



69 Graf Zeppelin LZ 130, photographed by an aircraft from RAF Dyce on 3 August 1939.
(© Len Dobson)

70 Image of Len Dobson from the special identity document he was issued with to gain entry to the technical buildings at Douglas Wood.
(© Len Dobson)

£20 in the rental of £105 on account of this deterioration.

My Council are holding the Air Ministry responsible for this loss and I shall be pleased to hear from you that they are agreeable to accept responsibility therefor in terms of the Deed of Servitude of part of Douglas Wood etc by my Council in their favour. (Dundee District Archive and Record Centre, TC/SF/A19)

Between September 1939 and May 1940, whilst AMRE was based in Dundee, Douglas Wood was used as a trials station for experimental work. One such experiment was the installation of CHL arrays on the 200 foot cantilever on a 350 foot steel tower at Douglas Wood, at the same time designing a steel gantry for fixing to the platform and supporting both aerial arrays, one above and one below the cantilever. Charles Lochrie, a department manager with Caledon Shipbuilding and Engineering Co Ltd, recalls:

Around October 1939 two 'boffins' came to see me and asked if we could help in production of an aerial. I went along to the college next day and was escorted by an armed guard to see someone who explained what they wanted. Although everything was rather vague, I had an inkling of what was happening …

We finally put together an aerial framework, but had to find an engineering firm in the area to produce a power-operated driving gear. The work was done by the Monifieth firm of Low & Duff, who gave us 100% co-operation. This gear required very accurate machining and assembly. When the job was complete, the equipment was installed on the 200-foot level at Douglas Wood and put through its paces. It passed all tests, and so we were given contracts for various stations throughout the country. (Charles Lochrie, pers comm)

At the end of May 1940 AMRE had experimented with this motor-driven CHL aerial array at Douglas Wood, which was capable of sweeping through 180° in 65 seconds. In May a turntable and mast had been erected which carried both the transmitter and receiver aerial arrays on one gantry. Previously, all aerial rotation on CHL stations had been done by hand, the minimum rate of sweep allowed being eight minutes for a coverage of about 180° (Air Ministry, 1950 (1): 110).

Douglas Wood was built as a standard Final CH station, with four 350 foot steel towers carrying the transmitter aerials and four 240 foot wooden towers for the receiving aerials. On 25 April 1941 it was decided that two of the transmitter towers were to be dismantled and removed for reuse on a Type 7000 Radio Navigational Aid station (TNA, AIR 2/4489). These were replaced on 25 June 1941 with two 325 foot guyed masts, as used on West Coast CH stations, positioned 300 feet apart and in line with the original 350 foot towers (TNA, AIR 2/3272). This left the Transmitter Site at

71 One of the 350 foot transmitter towers at Douglas Wood, with the two 325 foot guyed transmitter masts which replaced the two removed towers. Note the Type 55 radar on the 200 foot platform of the tower.
(© Alex Hunter)

Douglas Wood with an unusual mix of East Coast CH transmitter towers and West Coast CH transmitter masts.

In September 1941 several important changes took place at Douglas Wood. The MB2 transmitter was commissioned which promised an improvement in performance. The station was re-camouflaged, with large squads working on the 350 foot and 240 foot towers, not without damage to the aerials, which was repaired in October. Also that month, Douglas Wood CH station began plotting to Newcastle Filter Room, rather than to Stanmore. However, plotting arrangements became rather complicated from October, when Douglas Wood was instructed to pass all plots north of a particular line to Inverness Filter Room (TNA, AIR 26/100).

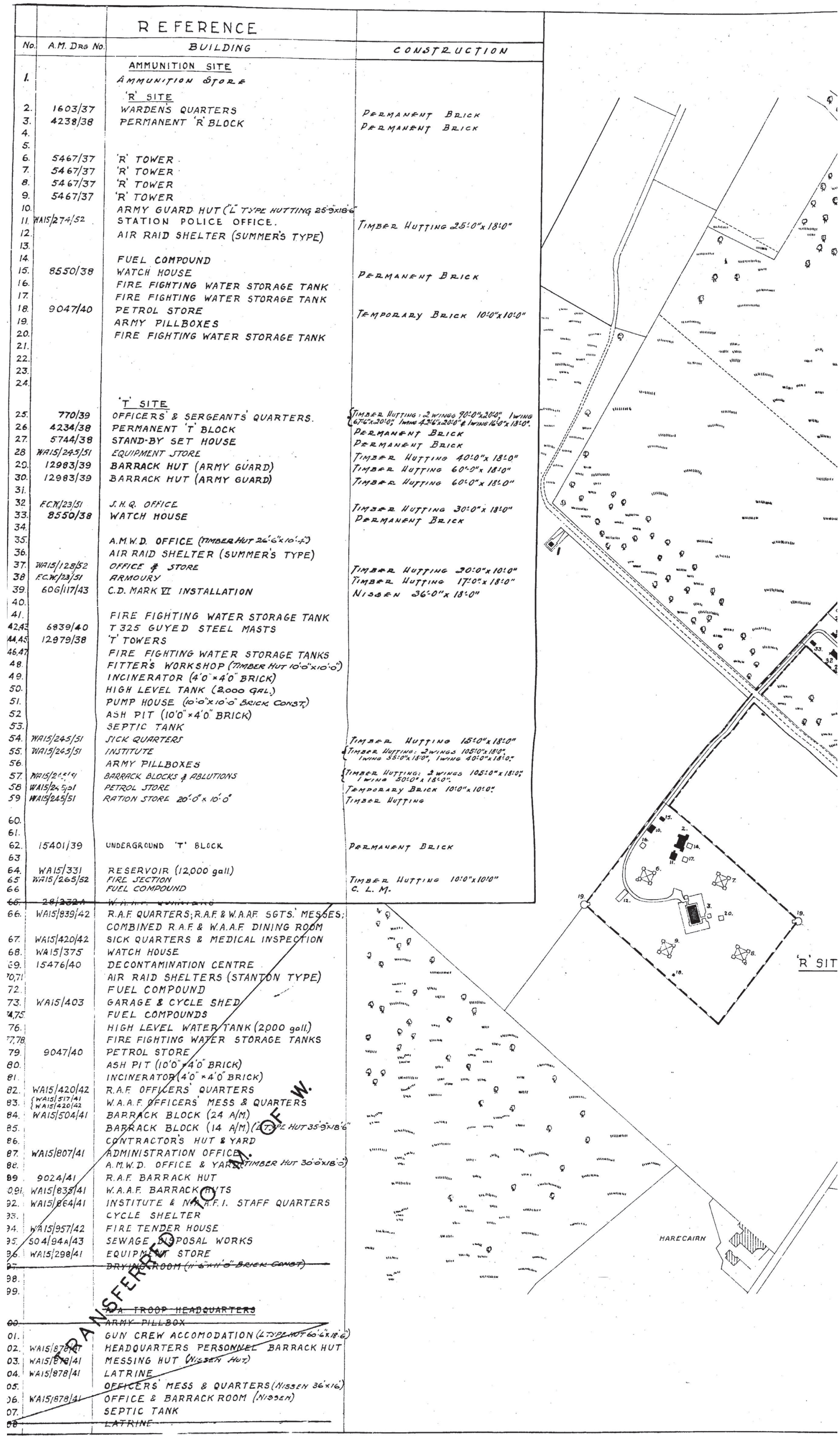
During 1942 Douglas Wood plotted a lot of hostile activity. On the night of 3 June hostiles in the area of Newcastle were detected at long range. On 8 July a small blitz on Newcastle was detected at ranges of 174 to 118 miles at a height of approximately 16,000 feet. There was a mass of 20 aircraft and Newcastle Filter Room asked Douglas Wood for macroscopic plotting (plotting the mass as a whole, rather than the individual aircraft), but the echoes separated and individual plotting continued. The station was informed later that three aircraft had been shot down. On 26 July approximately 15 aircraft were detected at ranges of 160 to 170 miles at a height of 18,000 feet and were presumed to be minelaying. The closest range on these aircraft was 114 miles, and information was later given to the station that this time two aircraft had been shot down (TNA, AIR 26/100).

November 1942 saw the commissioning of the Buried Reserve and calibration was completed during December. It was used for operations twice in December and it was planned to use the underground equipment for a short time every week. January 1943 saw the old receiver, an RF5, removed and the RF7 installed in the Buried Reserve used in its place. On 3 December 1943 the calculator (which converted radar ranges and bearings into a map plot) became operational in use with the RF7 (TNA, AIR 26/100, AIR 26/103).

Hostile activity was continuing on a fairly regular basis and February 1943 saw some interesting tracks. On the 16th at 4.21 pm H228 was detected at a range of 100 miles at 105° travelling south-east from Aberdeen, and was plotted out to 150 miles. The aircraft was calculated to be travelling at a speed of approximately 480 miles per hour (TNA, AIR 26/100).

During April 1943 a new high-power transmitting curtain array for the Final CH was erected by Marconi. The installation was completed on 18 May and wired up to Transmitter 'B' only. The new array was designed to handle the increased current for higher-power transmitters but it was only in November that the parts for the high-power modification to the CH transmitters arrived on site. Work could not begin, however, until staff from Metropolitan-Vickers arrived at the station (TNA, AIR 26/100).

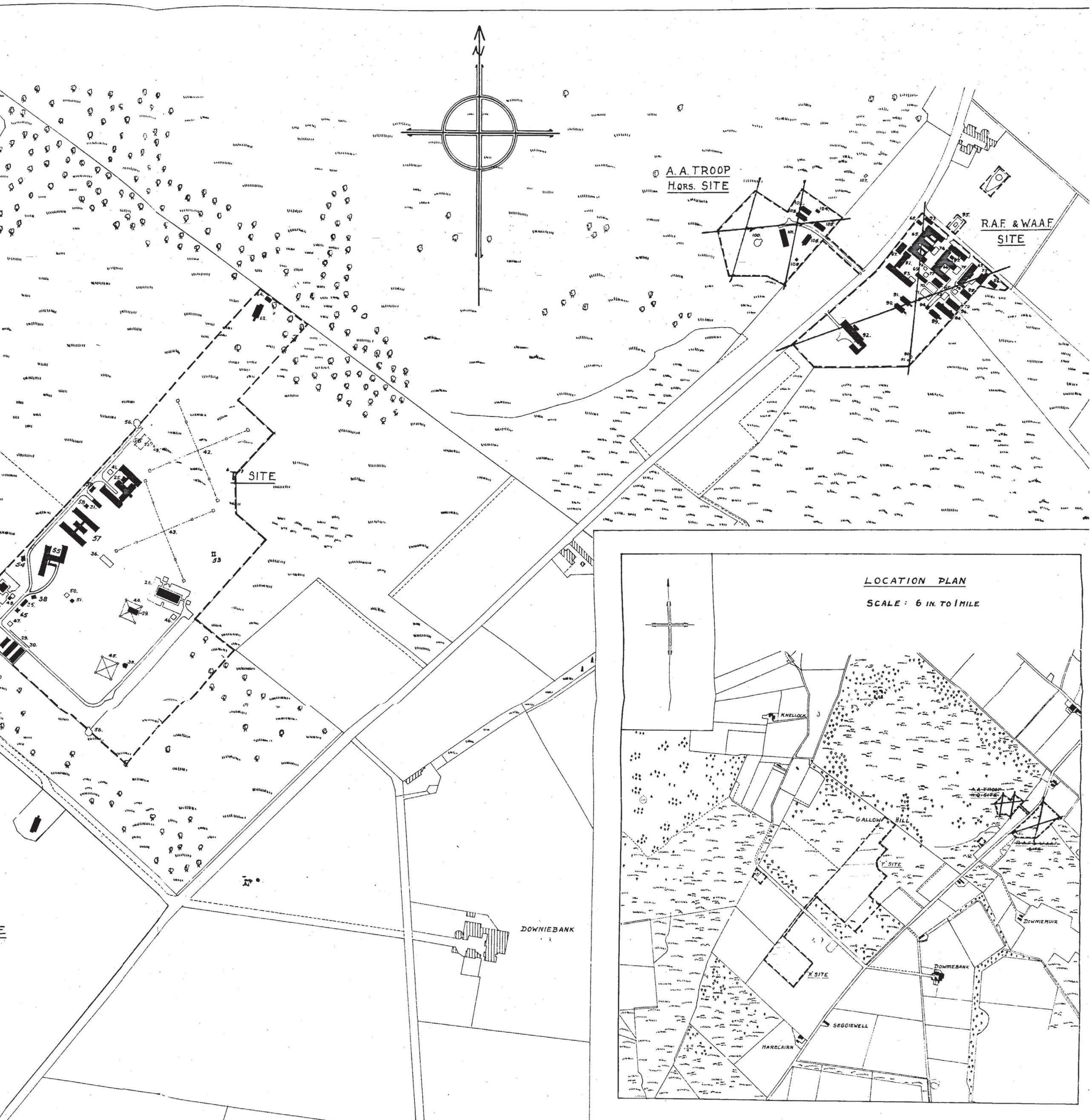
Improved equipment continued to be installed at Douglas Wood. The RF6 in the Receiver Block was calibrated at the end of December, and in January 1944 the CH T3026 transmitters with the RF6 receiver became operational, replacing the MB2 and RF7. In February the latter were removed from the Buried Reserve and sent to No 4 Maintenance Unit at Ruislip, and the feeder lines and aerials were dismantled from the Buried Reserve transmitter and receiver sites. The CH transmitters themselves were still being worked on: the high-power modifications were



No.	A.M. Drg No.	Building	Construction
		AMMUNITION SITE	
1.		AMMUNITION STORE	
		'R' SITE	
2.	1603/37	WARDEN'S QUARTERS	PERMANENT BRICK
3.	4238/38	PERMANENT 'R' BLOCK	PERMANENT BRICK
4.			
5.			
6.	5467/37	'R' TOWER	
7.	5467/37	'R' TOWER	
8.	5467/37	'R' TOWER	
9.	5467/37	'R' TOWER	
10.		ARMY GUARD HUT ("L" TYPE HUTTING 25'9"x18'6")	
11.	WA15/274/52	STATION POLICE OFFICE.	TIMBER HUTTING 25'0"x 18'0"
12.		AIR RAID SHELTER (SUMMER'S TYPE)	
13.			
14.		FUEL COMPOUND	
15.	8550/38	WATCH HOUSE	PERMANENT BRICK
16.		FIRE FIGHTING WATER STORAGE TANK	
17.		FIRE FIGHTING WATER STORAGE TANK	
18.	9047/40	PETROL STORE	TEMPORARY BRICK 10'0"x10'0"
19.		ARMY PILLBOXES	
20.		FIRE FIGHTING WATER STORAGE TANK	
21.			
22.			
23.			
24.			
		'T' SITE	
25.	770/39	OFFICERS' & SERGEANTS' QUARTERS.	TIMBER HUTTING: 2 WINGS 90'0"x20'0", 1 WING 67'6"x20'0", 1 WING 42'6"x20'0" & 1 WING 16'0"x 18'0".
26.	4234/38	PERMANENT 'T' BLOCK	PERMANENT BRICK
27.	5744/38	STAND-BY SET HOUSE	PERMANENT BRICK
28	WA15/245/51	EQUIPMENT STORE	TIMBER HUTTING 40'0"x 18'0"
29.	12983/39	BARRACK HUT (ARMY GUARD)	TIMBER HUTTING 60'0"x 18'0"
30.	12983/39	BARRACK HUT (ARMY GUARD)	TIMBER HUTTING 60'0"x 18'0"
31.			
32	F.C.W./23/51	S.H.Q. OFFICE	TIMBER HUTTING 30'0"x 18'0"
33.	8550/38	WATCH HOUSE	PERMANENT BRICK
34.			
35.		A.M.W.D. OFFICE (TIMBER HUT 26'6"x10'4")	
36.		AIR RAID SHELTER (SUMMER'S TYPE)	
37.	WA15/128/52	OFFICE & STORE	TIMBER HUTTING 20'0"x 10'0"
38	F.C.W./23/51	ARMOURY	TIMBER HUTTING 17'0"x 18'0"
39.	60G/117/43	C.D. MARK VI INSTALLATION	NISSEN 36'0"x 18'0"
40.			
41.		FIRE FIGHTING WATER STORAGE TANK	
42,43	6839/40	T 325 GUYED STEEL MASTS	
44,45	12979/38	'T' TOWERS	
46,47		FIRE FIGHTING WATER STORAGE TANKS	
48.		FITTER'S WORKSHOP (TIMBER HUT 10'0"x10'0")	
49.		INCINERATOR (4'0" x 4'0" BRICK)	
50.		HIGH LEVEL TANK (2,000 GAL.)	
51.		PUMP HOUSE (10'0"x10'0" BRICK CONST.)	
52		ASH PIT (10'0" x 4'0" BRICK)	
53.		SEPTIC TANK	
54.	WA15/245/51	SICK QUARTERS	TIMBER HUTTING 15'0"x 18'0"
55.	WA15/245/51	INSTITUTE	TIMBER HUTTING: 2 WINGS 105'0"x 18'0", 1 WING 55'0"x 18'0", 1 WING 40'0"x 18'0".
56.		ARMY PILLBOXES	
57.	WA15/245/51	BARRACK BLOCKS & ABLUTIONS	TIMBER HUTTING: 2 WINGS 105'0"x 18'0", 1 WING 50'0"x 18'0".
58	WA15/245/51	PETROL STORE	TEMPORARY BRICK 10'0"x 10'0".
59	WA15/245/51	RATION STORE 20'0" x 10'0"	TIMBER HUTTING
60.			
61.			
62.	15401/39	UNDERGROUND 'T' BLOCK	PERMANENT BRICK
63			
64.	WA15/331	RESERVOIR (12,000 gall.)	
65	WA15/265/52	FIRE SECTION	TIMBER HUTTING 10'0"x 10'0"
66		FUEL COMPOUND	C. L. M.
~~65.~~	~~28/232A~~	~~[illegible]~~	
66.	WA15/839/42	R.A.F. QUARTERS; R.A.F. & W.A.A.F. SGTS.' MESSES; COMBINED R.A.F. & W.A.A.F. DINING ROOM	
67.	WA15/420/42	SICK QUARTERS & MEDICAL INSPECTION	
68.	WA15/375	WATCH HOUSE	
69.	15476/40	DECONTAMINATION CENTRE	
70,71		AIR RAID SHELTERS (STANTON TYPE)	
72.		FUEL COMPOUND	
73.	WA15/403	GARAGE & CYCLE SHED	
74,75		FUEL COMPOUNDS	
76.		HIGH LEVEL WATER TANK (2,000 gall.)	
77,78		FIRE FIGHTING WATER STORAGE TANKS	
79.	9047/40	PETROL STORE	
80.		ASH PIT (10'0" x 4'0" BRICK)	
81.		INCINERATOR (4'0" x 4'0" BRICK)	
82.	WA15/420/42	R.A.F. OFFICERS' QUARTERS	
83.	WA15/517/41 WA15/420/42	W.A.A.F. OFFICERS' MESS & QUARTERS	
84.	WA15/504/41	BARRACK BLOCK (24 A/M.)	
85.		BARRACK BLOCK (14 A/M.) ("L" TYPE HUT 35'9"x18'6")	
86.		CONTRACTOR'S HUT & YARD	
87.	WA15/807/41	ADMINISTRATION OFFICE	
88.		A.M.W.D. OFFICE & YARD (TIMBER HUT 30'0"x18'0")	
89	9024/41	R.A.F. BARRACK HUT	
90,91.	WA15/835/41	W.A.A.F. BARRACK HUTS	
92.	WA15/864/41	INSTITUTE & N.A.A.F.I. STAFF QUARTERS	
93.		CYCLE SHELTER	
94.	WA15/957/42	FIRE TENDER HOUSE	
95.	504/94A/43	SEWAGE DISPOSAL WORKS	
96.	WA15/298/41	EQUIPMENT STORE	
~~97.~~		~~DRYING ROOM (11'6"x11'0" BRICK CONST)~~	
98.			
99.			
		~~A.A. TROOP HEADQUARTERS~~	
~~00.~~		~~ARMY PILLBOX~~	
01.		GUN CREW ACCOMODATION (L TYPE HUT 60'6"x18'6")	
02.	WA15/878/41	HEADQUARTERS PERSONNEL BARRACK HUT	
03.	WA15/878/41	MESSING HUT (NISSEN HUT)	
04.	WA15/878/41	LATRINE	
05.		OFFICERS' MESS & QUARTERS (NISSEN 36'x16')	
06.	WA15/878/41	OFFICE & BARRACK ROOM (NISSEN)	
07.		SEPTIC TANK	
~~08~~		~~LATRINE~~	

TRANSFERRED TO M. OF W.

72 Douglas Wood site plan.



SCALE :- 1/2500

0 100 200 300 400 500 1000 1500 FEET

GIVEN "A" No. SHOWING AMENDMENTS TO DATE (JULY 1952)

GIVEN "B" NO " " " " (" 1957)

DOUGLAS WOOD

A. M. E. S. TYPE I

RECORD PLAN OF STATION

I. SHAW
73 Granville Drive
Cambuslang
LANARKSHIRE

SECRET		D. of W.
NO.	No. 15 Works Area June 1944	WA15/163B/44 AIR MINISTRY

completed satisfactorily in March, but were still awaiting commissioning at the end of the month (TNA, AIR 26/103).

On 14 July 1944 a Type 55 radar became operational. This was a high-power centimetric radar mounted on the 200 foot platform of one of the 350 foot steel towers and replaced the low-power Type 31 set at The Law. With the closure of Aberdeen and Pitreavie NPRs, the Type 55 ceased plotting surface vessels at 12 pm on 26 May 1945, but continued to report aircraft (TNA, AIR 26/92).

Work began on one of the CH transmitters during December 1944 to fit an experimental megawatt amplifier and thereby greatly increase the transmitter output power. The modification was designed by Warrant Officer Rous, but it is not certain that this ever became operational. The CH ceased reporting on 21 July 1945 and was placed on care and maintenance. Thereafter Douglas Wood was used as an Educational and Vocational Training (EVT) School. Lectures by Dundee Civic Council and tours to places of interest were arranged, hobbies were encouraged and organised sports were held every afternoon. Despite the early success of the EVT School, it closed down early in 1946 (TNA, AIR 26/92, AIR 26/93, AIR 26/96).

All operational personnel were accommodated at HQ No 70 Wing at RAF Tealing from 27 February onwards, travelling daily to go on duty at Douglas Wood. The Type 55 radar at Douglas Wood ceased operating on 15 March 1946, and this ended operational activity at the station (TNA, AIR 26/93).

Drone Hill

Type	Radar station
Subtype	Chain Home (AMES Type 1)
Region	Berwickshire (Scottish Borders)
NGR	NT 8462 6651
NMRS	NT86NW 70
In use	28 September 1938 – 7 November 1945

Drone Hill was the first radar station to be built in Scotland. The station was set up under an emergency programme in response to the Munich Crisis in September 1938, using equipment planned for use overseas. Work began on 23 September, when the site was set out and ground prepared for the huts. The transmitter and receiver were working by 28 September, with 70 foot steel masts carrying the aerials. This equipment gave a range of 60 miles on an aircraft at 7,000 feet, giving Edinburgh approximately 20 minutes' warning of air attack. Also on 28 September the first RAF personnel arrived on the site: Flight Sergeant F A Ridge (i/c the station), Corporal J Evans and Leading Aircraftman E R Jeffries (TNA, AVIA 7/299). With the handover to the RAF crew, Drone Hill went onto continuous operation, with the station acting as its own filter room until the opening of Stanmore Filter Room at Headquarters, Fighter Command (Air Ministry, 1950 (1): 46).

Soon after the station became operational, work was begun to build a more permanent installation. However, conditions were far from ideal and when N Smith, a member of the scientific research staff from Bawdsey Research Station, visited Drone Hill in November 1938, he noted there was:

far too much interference on the receiver due to poor engine noise suppression … There is no test equipment on the station beyond an Avometer … There is a serious lack of telephone communications with Stanmore … There is no sign of the electric power supply arriving at the station, neither is there any great progress in road-making, both of which will prove difficult to complete with the bad weather coming on. It will be <u>*impossible*</u> *to get to the site in winter if the road is not available soon … The present huts have had to have steel hawsers fitted over the roofs to prevent lifting of the roof in gales …*

240 ft Towers, Receiving. These are in the course of erection. One has completed foundations, another is ready for concrete, another has foundations excavated and the other is in the process of excavation. If the line of shoot for these towers is to be 58° then there will be a 22° error with the R towers, which are in a line of 126°. Work in the latter has gone too far to make alterations. (TNA, AVIA 7/299)

The Intermediate CH station, the 240 foot wooden towers of which are mentioned above, replaced the Advance CH station set up in September 1938 and became operational during the spring of 1939. However, the equipment was still experimental and giving a performance much lower than required. After inspecting Drone Hill on 11 and 12 March 1939, R V Whelpton from Bawdsey Research Station reported that

the gear in operation at this station is of a highly experimental nature, the receiver being a Bawdsey made RF2 and the transmitter a TF3 with a lash-up high-tension supply unit. In addition, the station is operated from a Meadows generator, the control of which involves the most extraordinary and complicated measures to obtain a steady load. The fluctuating mains volts and frequency adversely affect the performance of the station … The transmitter output power is considerably less than that of the MB [Mobile Base] type transmitter, 25 kilowatts being the absolute maximum. (TNA, AVIA 7/299)

At 4.07 pm on 15 October 1939 the transmitter at Drone Hill failed because of internal sparking of an amplifier valve. Stanmore Filter Room was informed by Drone Hill that the station was off the air. Due to confusion over who exactly was responsible for the provision of spares, as a result of the *ad hoc* development of the radar organisation, it was after 11 am on 17 October before Drone Hill was fully operational again (TNA, AIR 2/3143). These problems had the misfortune to coincide with an attack by nine Junkers Ju 88s of I/KG 30 against Royal Navy vessels in the Firth of Forth (Ramsey, 1987: 38). This has led to claims that the failure at Drone Hill was responsible for no air-raid warning being issued and that intercepting fighters had no radar information on which to act. According to Peter Wykeham in his book, *Fighter Command*, Drone Hill went off the air due to a power failure, 'leaving the fighters without direction until the Observer Corps sighted the enemy' (Wykeham, 1960: 86–7). However, Hugh Barkla, who was at Stanmore Filter Room at the time, recalls:

There was continuous cover of the tracks of the raiders by the radar chain; everyone that I knew was pleased with the way that they performed … It [the lack of an air-raid warning] was entirely due to the C-in-C over-ruling the statutory procedure, and taking on himself alone the decision on whether the radar tracks were to be given the identification 'hostile'. The junior *officers and the scientists in the Fighter Command Filter Room at the time were in no doubt, but Sir Hugh Dowding, incomprehensibly, held back. Fortunately the consequences were not serious, though earlier warning to the fighters might have enabled them to shoot down more bombers.* (Hugh Barkla, pers comm)

Although the official records of the technical failure at Drone Hill are somewhat contradictory, it appears that rather than there being no radar warning, Drone Hill was actually operating on reduced power at the time. Whether this was indeed the case or not, there is no doubt that other stations in the chain, most likely including Douglas Wood, did plot the incoming hostile aircraft. A report of the confusion and long delay experienced in trying to get Drone Hill back on the air reached Fighter Command Headquarters. Air Chief Marshal Dowding wrote a letter to the Chief of the Air Staff deploring the situation on spares, and this incident was to be a contributory factor in the decision to form, on 23 February 1940, No 60 (Signals) Group to deal with such matters (TNA, AIR 2/3143).

At 8.36 am on 28 October 1939 Drone Hill first plotted Raid X40. It was tracked north-west and crossed the coast near Earlsferry before going west to the Firth of Clyde, where the crew had been ordered to photograph shipping. Due to cloud cover this was not possible, and the aircraft returned east from Helensburgh. At 9.16 am Red Section of No 602 Squadron took off from RAF Drem to patrol over the Firth of Forth. Heinkel He 111H-2, serial number 5449, with code-letters 1H+HJ, from Kampfgruppe 26 was shot down by the Spitfires of Nos 602 and 603 Squadrons, and crashed at Long Newton Farm, Humbie, at 11.15 am. This was the first enemy aircraft to crash on mainland Britain during the Second World War (TNA, WO 166/2127; Ramsey, 1987: 40).

Although this photo-reconnaissance Heinkel was unable to complete its mission, others had been able to do so, and Drone Hill had been photographed at some point before 2 October 1939. However, the exact role of the station was unknown to German Air Force Intelligence, which described it as a *Küstenfunkstation für die Marine*, or a Coastal Radio Station for the Fleet, presumably believed to be for ship to shore communications.

Late in 1939 the Intermediate CH station was replaced by the Final CH station, with the transmitting aerials suspended from the cantilevers of 350 foot high steel towers, and the 240 foot wooden towers of the Intermediate CH station used for the receiving aerials of the Final station.

On 9 July 1940 Francis Jones, the AMRE representative at Drone Hill, wrote a report on the performance of the station:

Curves have been obtained to obtain the range of the station for single aircraft at various heights on the line of shoot. The result for a 1000' aircraft is extraordinary in that plots can be easily obtained out to 55 miles. The performance on 2000 and 3000' aircraft is poor, the optimum height being about 10,000' at which height aircraft can be seen out to 120 miles. At 15,000' aircraft can be seen to 140 miles, and a 30,000' aircraft should be visible from 50 to 80 miles. (TNA, AVIA 7/493)

Margaret Quinn (Lawrence), who was posted to Drone Hill in 1941 and became the sergeant i/c operations, remembers one plot from May that year:

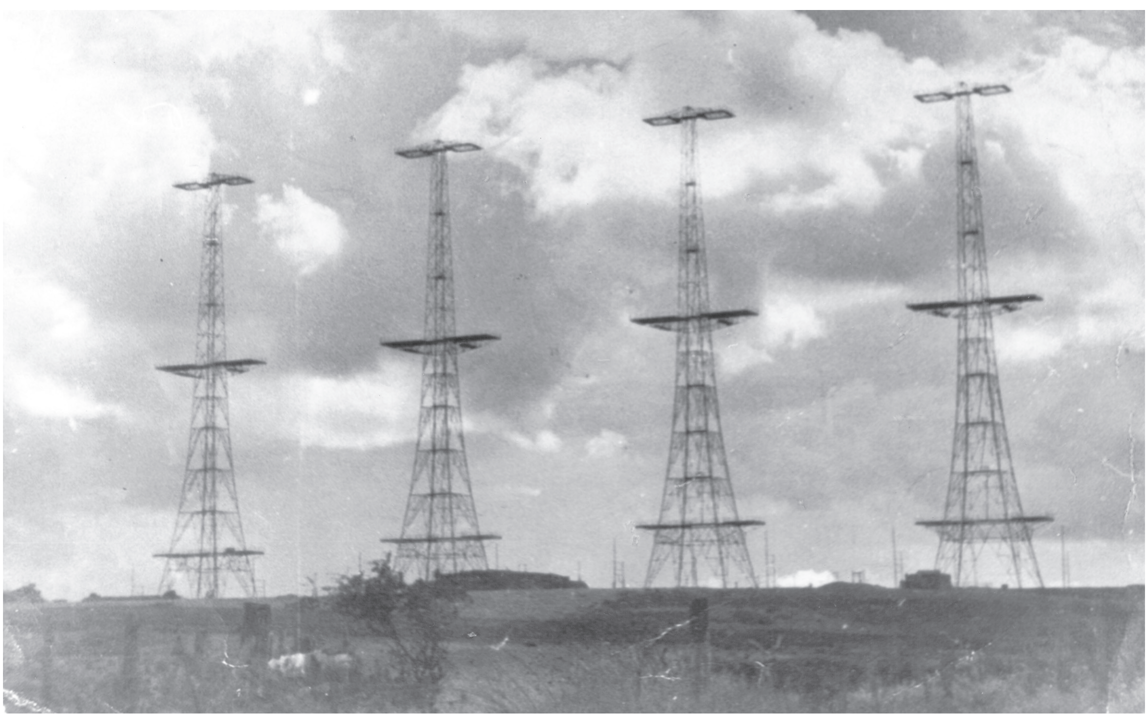
I found, operationally, this station was not very exciting. The only hostiles I remember were the 'Photo Freddies'. Flights which had a hostile *designation flew high and hugged the coast. The Hess flight was very different and that is why I remember it – one small hostile plane flying in at almost right angles to the coast – very unusual. However, there was no great excitement. We didn't know the import of this flight until the Filter Officer came through and told us who the pilot was.* (Margaret Quinn, pers comm)

Margaret Quinn also recalls:

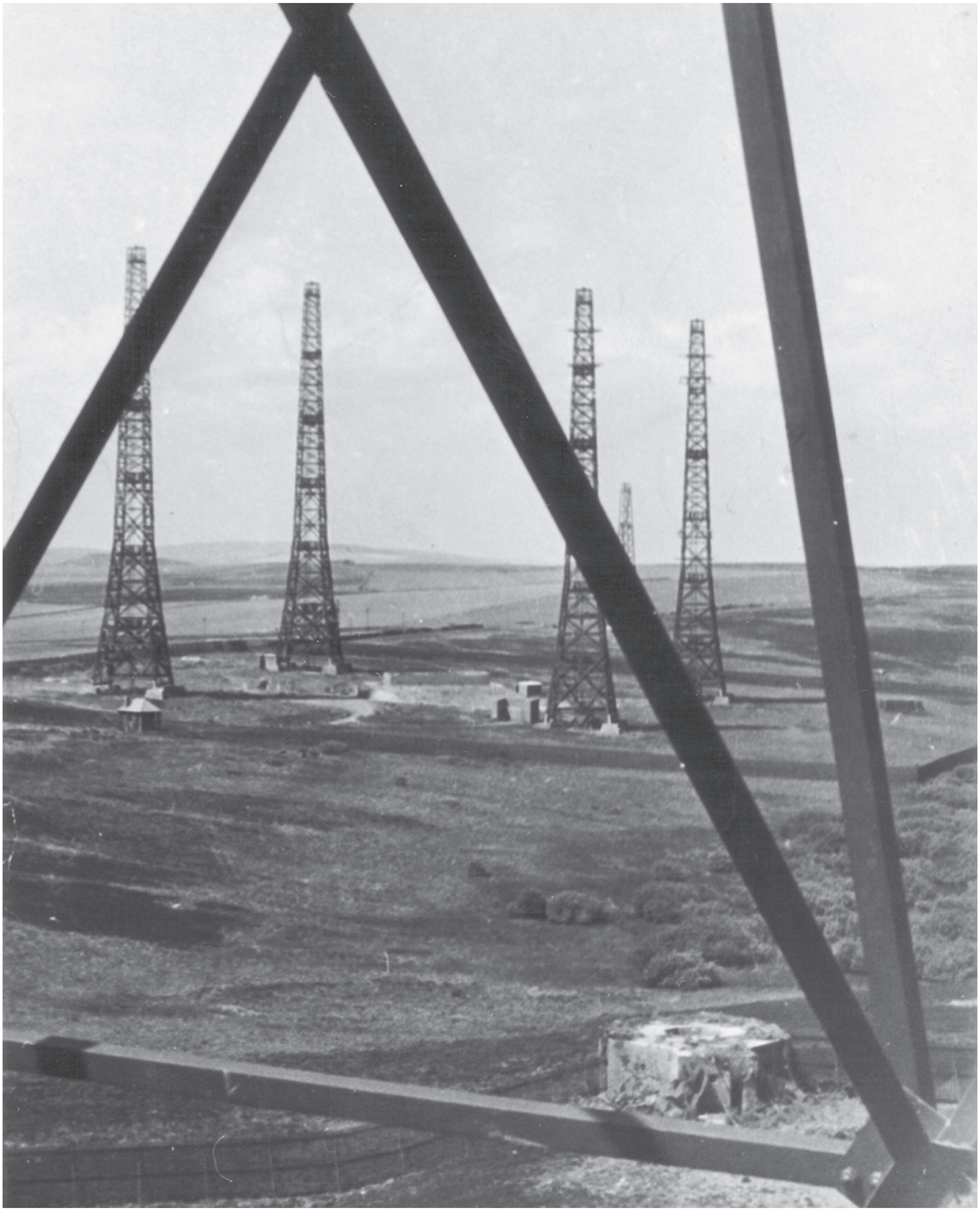
I do remember some girls who became 'Mechs Mates' helping the mechanics. I went with them once in wintertime when we had to check underground equipment – the first time I knew we had an underground Ops Room. We had to hack away the icing from the trap door but, even so, we hadn't the strength to slide it open and, reluctantly, had to call for male assistance. (Margaret Quinn, pers comm)

The underground operations room to which Margaret Quinn refers was the Buried Reserve. Its transmitter was lined up and adjusted by Metropolitan-Vickers on 2 July 1941 ready for commissioning (TNA, AVIA 7/372). Work on the Buried Reserve continued during July, but the seepage of water into the buildings continued to be a problem. It was only solved by the installation of extensive drainage. On 7 February 1943 the Buried Reserve came into use after azimuth and height calibration. It was used operationally that month. However, it was of limited value and was being dismantled by October 1943 (TNA, AIR 26/103).

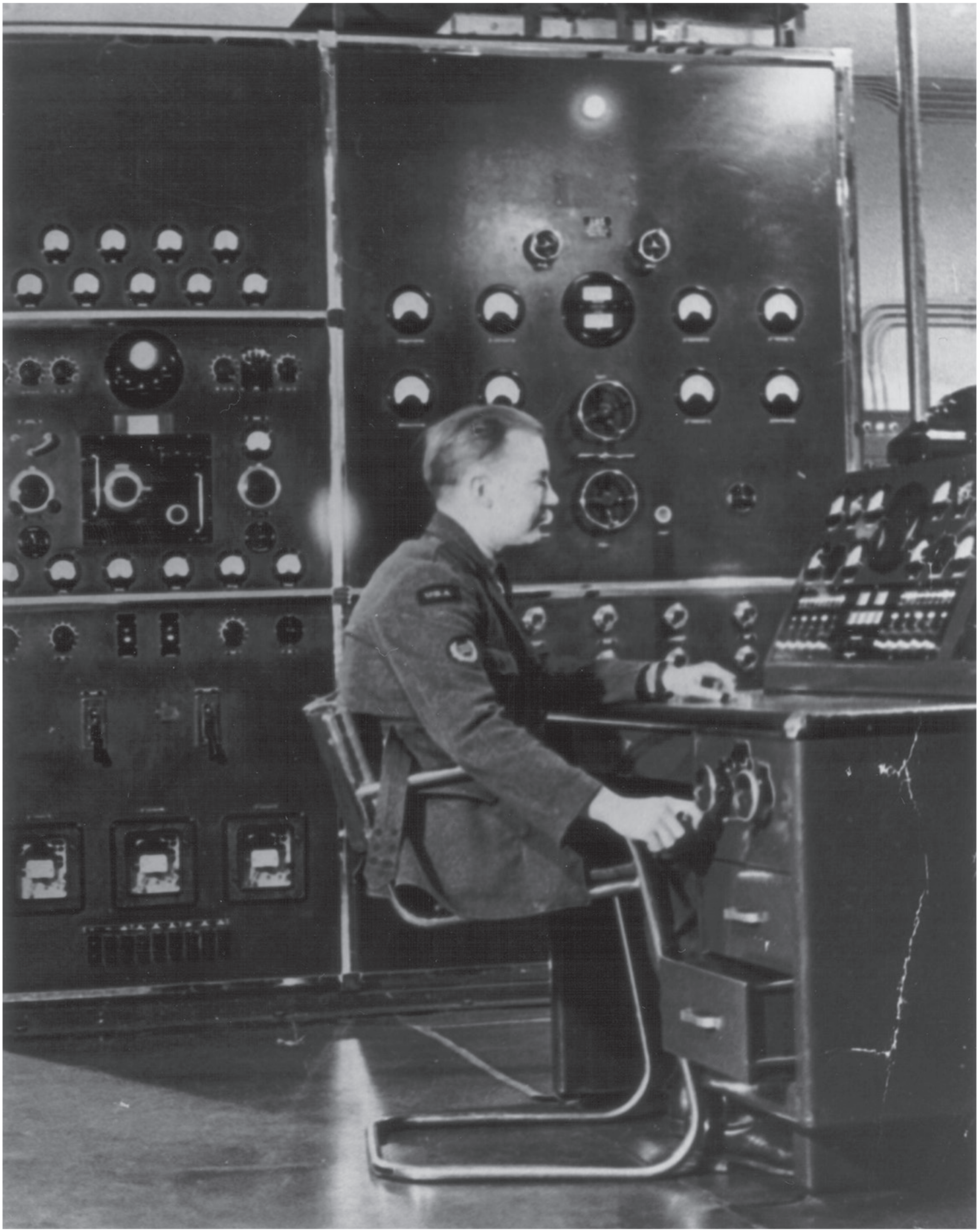
As well as the lining up of the Buried Reserve, other work being carried out in July 1941 included the erection of the curtain array, which was the transmitting aerial array that was slung between two towers, forming a curtain between them. The first Final CH



73 The four steel 350 foot transmitter towers at Drone Hill, photographed in January 1942. (© Ray Bennett)



74 Drone Hill Receiver Site, photographed in January 1942 from one of the transmitter towers. The four 240 foot receiver towers can be seen, as can the 120 foot Receiver Buried Reserve tower. Note also the Type 27 pillbox in the foreground, draped with camouflage netting. (© Ray Bennett)



75 Leonard 'Tex' Woodall, a member of the US Civilian Technical Corps, at the control desk of one of the transmitters inside the Transmitter Block at Drone Hill in January 1942.
(© Ray Bennett)

height calibration was checked by No 72 Wing on 8 July, with the curtain array becoming fully operational soon thereafter (TNA, AVIA 7/372).

On the night of 24/25 March 1943 there was a raid on northern England and southern Scotland. It was plotted by several stations, including Drone Hill, which plotted 16 separate tracks. The official report sized the raid at 25 aircraft (TNA, AIR 26/103).

Operations at Drone Hill ceased with effect from 12.30 pm on 7 November 1945 and the station was placed on care and maintenance (TNA, AIR 26/92). Margaret Allan (Morrison) recalls she

was posted to RAF Drone Hill (CH) on Coldingham Moor, Berwickshire, in November 1945, which was in the process of going on care and maintenance and obviously wasn't operational as the war was over … I was only there for four months (and a bleak four months they were on that very exposed site) from November 1945 to February 1946 …

At Drone Hill, although I was really a Radar Supervisor Officer, I doubled up as WAAF Admin Officer – there was a mixture of WAAFs and RAF there, but mainly RAF. There was very little to do, and time hung heavy on everyone's hands … so an 'educational' programme was devised, and the theory was that one could prepare oneself for 'civvy street' by swotting up on a new career and learning the basics, or perhaps learn a new craft such as woodwork, etc. This was all very well in theory, but … was not very practical on isolated sites … Almost every day someone would be posted away to be demobbed and this in itself was unsettling to those left behind … Camp entertainment in the form of ENSA shows, etc, had ground to a halt virtually, and at Drone Hill one had little to do but walk down to the pub at Ayton – probably 5 miles there and 5 miles back. Hitch-hiking was not exactly a successful pastime on that moor! So my main memory of Drone Hill was trying to deal with a rather discontented group of men and women! (Margaret Allan, pers comm)

Dundee

Type	Research establishment
Subtype	Air Ministry Research Establishment
Region	Angus (City of Dundee)
NGR	NO 3986 2998
NMRS	NO32NE 44
In use	September 1939 – May 1940

In 1936 the Air Ministry bought Bawdsey Manor and Estate in Suffolk for the use of the research team developing radar under the leadership of Robert Watson Watt. By 1939 it was anticipated that when war came Bawdsey would be immediately bombed, and therefore the Air Ministry issued instructions that Bawdsey Research Station would be evacuated somewhere safer on the outbreak of war (Bowen, 1987: 83). Various locations were proposed, and it was A F Wilkins who suggested that accommodation might be available at University College, Dundee (Bragg, 2002: 131). Consequently, when German forces invaded Poland on 1 September 1939, the evacuation of Bawdsey Research Station to Dundee began.

A P Rowe, Superintendent of the Bawdsey Research Station, found that upon their arrival in Dundee plans for their accommodation were not as developed as had been thought:

We started badly enough. On my arrival at the buildings we understood we were to occupy, I was confronted with the news that there was no accommodation for us and that our equipment was being dumped in the open. My representations to those responsible for the buildings, who incidentally were guiltless in the matter, produced a slight but totally inadequate concession. I was told … that if we could not be welcomed we would be tolerated and, in this spirit, two rooms were offered us … though I never discovered whether we were entitled to the parking space occupied by our packing cases.

Fortunately, a partial solution was found within a day. Hearing of our plight, Professor McClelland, the Principal [actually Director of Studies] at the Dundee Training College, cleared a floor and a half of his spacious and attractive building and, until we left Dundee, continued to give all assistance in his power … The reasons for the unsuitability of Dundee were not in doubt; the middle of a great city, with its electrical disturbances and its lack of open spaces, was about the last place to choose for radar research. (Rowe, 1948: 54–6)

Despite the inauspicious start the Bawdsey team, now renamed the Air Ministry Research Establishment due to the change of location, quickly settled in, occupying the top floor, hall and workshops of the Training College in Park Place from 6 September 1939 (University of Dundee Library, Minute of Meeting). The maximum strength of AMRE during the time it was at Dundee totalled 400 (Rowe, 1948: 57), with the scientific and technical staff numbering around 200 (W S Robertson, pers comm).

Sidney Jefferson recalls:

I was in charge of transmitters, receivers and display. Also anti-jamming, but I had completed all the development that seemed possible at Bawdsey. The receiver work was aimed at improving signal/noise ratio and operating on shorter wavelengths. A Canadian, AG Ward, joined my receiver group and began looking towards working on centimetre wavelengths. The transmitter group were trying to increase power levels and improve pulse shapes. Display … began the work on PPI. (Sidney Jefferson, pers comm)

The work on the PPI began in December 1939, when G W A Dummer was asked to design and construct an experimental display with a radial, rather than linear, time base. This was a rotating, map-like radar display, rather than a display with a horizontal line and a 'blip' indicating a response. The prototype, occupying all of a 6 foot Post Office rack, was completed by May 1940 (Lovell, 1988: 470–1).

J R Whitehead had been a member of the IFF Group since August 1939:

Derek Ritson and I used to conduct tests on IFF Mk II between the roof of the Teachers' Training College and a van parked at Broughty Ferry …

FC Williams was in charge of IFF … As we were both Lancastrians, whenever he could get away for the weekend he would offer me a lift home to Great Harwood on his way to Manchester so I got to know him very well at the outset. It was through this that I found myself being given more and more responsibility for the airborne IFF transponder, even at the Mark II stage. The Mark II production was in Manchester, at

Ferranti Ltd, so it worked out rather well for both of us.

In order to identify itself to radar, every aircraft would have to have not only an IFF set (transponder), but a suitable antenna. As we were then dealing with wavelengths of 10 metres or so, the aircraft antenna had to be a compromise – a cut and try sort of thing. We first used an airfield at Scone, near Perth, and did some of the first antenna experiments on a Fairey Battle … I personally drilled holes in the tailplane, put bolts through and connected wires which went forward to the mid-section of the fuselage to form a sort of triangle. I flew in the Battle to ensure that the IFF transponder was operating correctly and to measure the strength of the irradiating pulse at various ranges. It was my first flight ever. (Rennie Whitehead, pers comm)

Closely allied to the use of IFF was the development of a radar beacon, which enabled radar-equipped aircraft to locate a specific point on the ground. R H A Carter was involved in the experimental use of a radar beacon:

I built a set in the laboratory and then climbed to the roof of the Dundee Training College (where we worked for eight months) early in the morning, in time for a Coastal Command aircraft to use it as a marker beacon on its way back to base after a night patrol over the North Sea. Having got thus far, it was a simple flight to hop across the Tay to base [at Leuchars]. (Burns, 1988: 160–1)

W H Penley joined AMRE on Thursday 8 February 1940:

After signing the usual papers – Official Secrets Act, etc. – I was taken to the library to read the RDF 'Bible'. This typewritten folder gave the reader the outline of the sequence of events which had led to the development of RDF. There was reference to the choice of frequencies to seek the maximum reflected signal from aircraft targets, and the development of the CH stations which formed a protective chain in the most vulnerable parts of the east and south coasts and were still being manufactured and installed. I think I was given the rest of the day and the next day to read and ask any questions about RDF.

Next Monday, as I had been working on high power oscillators, I was taken to a lecture room where work was being done on transmitters. This team was being run by Jim Phillips, who had come from GEC, and seemed to be understudied by Don Preist. I was intrigued to see work being done to make major reductions in the size of transmitters by using micropup valves and smaller tuned circuits and components …

I did not get an opportunity to see if I could help as I was taken to join a team which was being set up to put a CHL aerial system on the 200 ft platform of one of the 360 ft steel CH transmitter towers at the CH station operating at Douglas Wood. As a transmitter expert ('T-man') I was to deal particularly with the transmission side, which was to involve getting the transmitter power up the tower to a transmitter aerial mounted under the 200 ft platform. The idea was for the receiver aerial to be mounted above the platform, and if the simple tests with fixed aerials were successful, the concept for operational use was for them to be mounted on some kind of turning gear operating through the platform and turning them together. (W H Penley, pers comm)

This CHL work was led by Denis Taylor, who was also in charge of the team modifying a CHL set to perform the ground control function, although it was not until AMRE had left Dundee that a GCI set was completed (Bowen, 1987: 130). Other work started at Dundee which would not see fruition until later was the development of centimetric radar, on a wavelength of 10 cm. H W B Skinner was put in charge of this group in March 1940, the only other member being Jim Atkinson:

There was a great conflict of interest between doing better at the wavelengths for which equipments had already been shown to work, and exploring others. Rowe kept the centimetric work out of view as he was convinced that the Air Ministry would tell him to stop it and concentrate on immediate equipment problems … We were the only two members of the Group – Denis Robinson et al were all working on 50 cm. (Jim Atkinson, pers comm)

E H Cooke-Yarborough joined AMRE on 4 March 1940 and was later assigned to a group working on airborne radar at Dundee:

At the time, the work on airborne radar was centred at RAF St Athan in South Wales. The particular equipment which was of interest to Lewis [A P Rowe's deputy] was the Mark III Air Interception (AI) equipment, intended to enable night fighters to find and attack enemy aircraft. This equipment was installed in Blenheim aircraft, and transmitted pulses at 200 MHz from an aerial in the nose. The four receiving aerials were located above and below one wing, and on either side of the nose … The problem was that, as the target was approached, the time interval between the transmitted pulse and the echo became so small that the echo signal merged with the tail of the transmitted pulse and became lost. This was apt to occur at target ranges of 1,000 feet or more, and before the pilot could make visual contact with the target, so that contact might be lost.

Lewis had the idea that if the tail of the transmitted pulse could be shortened, then the minimum detection range would be reduced. Consequently, he arranged for several Mark III AI sets to be delivered from St Athan to Dundee, so that experiments could be carried out …

The first test flight took place from RAF Leuchars, with Lewis and myself sharing the cramped space in the after part of the Blenheim … The results were inconclusive, partly because of the difficulty of independently measuring the range at which the echo signal disappeared. Later we were to devise a simple optical range-finder to overcome this problem … We got down to minimum ranges of under 500 feet, but eventually [after AMRE left Dundee] it became clear that EMI were getting better and more consistent results. Their equipment became Mark IV AI and the Mark IIIA system was dropped. (E H Cooke-Yarborough, pers comm)

In summary, AMRE achieved a considerable amount during the months spent in Dundee. Both height-finding for CHL and the PPI display were completed and would make the introduction into operational service of GCI in October 1940 possible. A start was made to centimetric research which would eventually become of major importance. Although criticism has been made in some sources that little was achieved at Dundee (Bowen, 1987: 91), clearly this was not the case. The period spent at Dundee was a very fruitful one indeed.

Towards the end of April 1940, AMRE staff were told that they were to move to Worth Matravers early the following month (W H Penley, pers comm). AMRE vacated the Dundee Training College on 5 May 1940 and moved to a purpose-built site at Worth Matravers in Dorset (University of Dundee Library, Minute of Meeting).

Dunnet Head

Type	Radar station
Subtype	Coast Defence U-Boat/Chain Home Low (AMES Type 2), AMES Type 57, Naval Type 273 (AMES Type 30)
Region	Caithness (Highland)
NGR	ND 2049 7653
NMRS	ND27NW 7
In use	15 December 1940 – 7 November 1945

Dunnet Head was the last of six stations built as part of the Somerville Scheme, devised by Vice-Admiral Sir James Somerville to provide a chain of CDU (the Naval version of CHL) stations to detect U-boats attempting to leave the North Sea on the surface north of the Scottish mainland. The station, Admiralty Experimental Station (AES) No 6, was intended to provide cover over the Pentland Firth and to the west and east of Orkney (HRA, Naval Shore Radar).

Work began on AES 6 in the summer of 1940, with the T Hut and R Hut being built of brick with concrete roofs and the turntables set directly on the roofs. Metal aerial frames were used. The engine house was constructed of wood. The building work continued through the autumn and installation began in November. Dunnet Head became operational on 15 December 1940 with the aerials hand turned, using a bicycle chain drive (HRA, Naval Shore Radar).

During May 1941 the chain drive to the aerial was replaced with Hopkins turning gear. In October new higher-power valves, VT98s, were fitted in the transmitter and a common aerial system installed, with feeder lines run from the Transmitter Hut. These feeders snapped on 3 December and were replaced with stronger wires. An annexe was built to the Receiver Hut in May 1942 and the transmitter was moved. The now redundant Transmitter Hut was then used to house a Type 273S centimetric radar. Installation of this equipment started during May and it became operational on 5 August 1942 (HRA, Naval Shore Radar).

Work had already begun, in October 1941, on construction of the 1941 Type CHL building. The work was delayed for various reasons and it was not until September 1942 that the equipment was finally installed. Lack of communications held up the start of operations, which did not begin from the new T & R Block until 6 December 1942. The new gantry was not very strong and a report noted: ‘the whole outfit sways and rocks in a gusty wind and its days are numbered’. They were indeed numbered. Twenty-two days later, on 28 December, there was a sudden lull in the wind during a gale and the release of tension in the turning gear caused the aerial to recoil and break the turning ring. The decision was taken to install stronger turning gear, but this did not arrive until July 1943 and it was 11 August before the 1941 Type CHL was put back into commission (HRA, Naval Shore Radar).

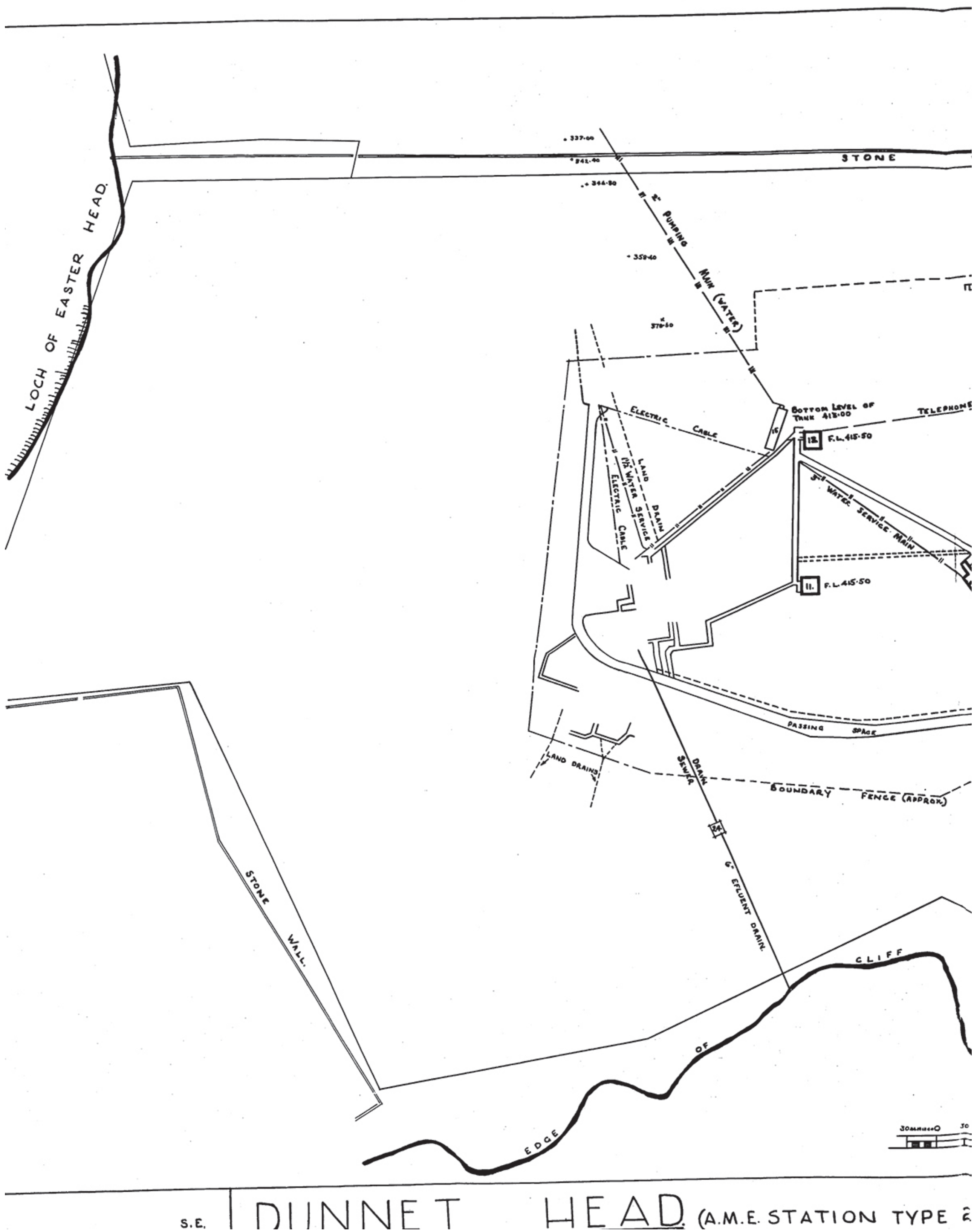
Dunnet Head was notable because of its ability to plot shipping, with either the CHL or the Type 273, when the vessels could not be seen visually. From the start of operations at AES 6, it was noted that ships steaming across Sinclair Bay, although out of sight for part of

76 Transmitter Hut of the CDU station at Dunnet Head, photographed in June 1965. Note the ring on the roof for the Perspex lantern which housed the Naval Type 273 radar paraboloids.
(© Richard Feachem)

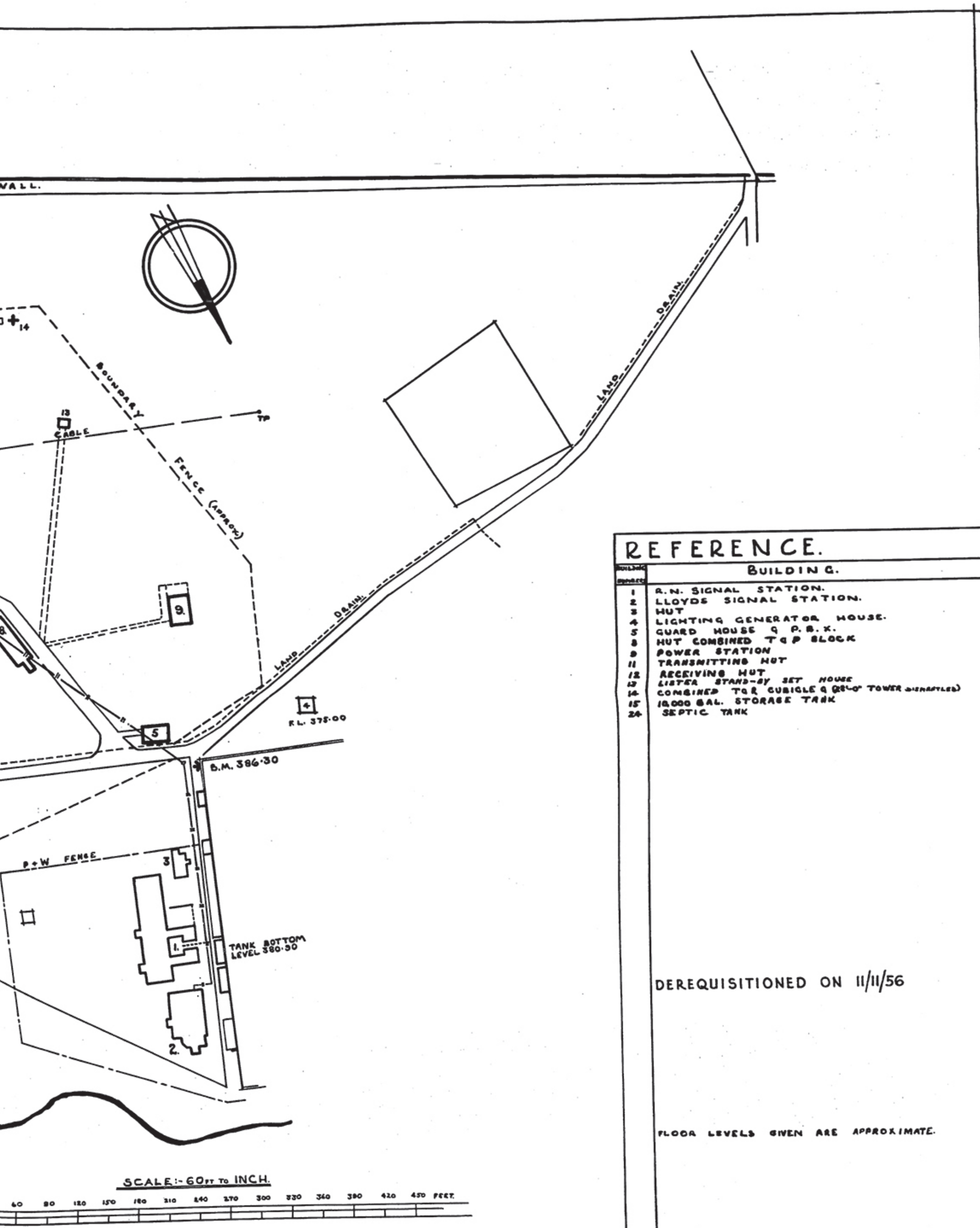
their journey, were nonetheless continuously visible on the radar screens. The station was mostly plotting convoys heading through the Pentland Firth and also ships entering and leaving Scapa Flow or Scrabster.

AES 6 also plotted high-flying enemy aircraft on the regular tracks over southern Shetland and the Fair Isle passage. Hostiles in the area of Orkney were also detected. During June 1941, at about 2 am each day for five days that month, six hostile aircraft were plotted from north-west of Orkney, heading south-east towards Cape Wrath. These aircraft appeared to be searching for coastal convoys heading northwards through the Minch, and the hostiles would then be plotted heading for home through the Pentland Firth. Subsequent to these tracks, most hostile plots were regular tracks to the north of Dunnet Head, as well as reconnaissance flights over Scapa Flow (HRA, Naval Shore Radar).

Dunnet Head was transferred from the Navy to the RAF in October 1943 (HRA, Naval Shore Radar). On 26 May 1944 a Type 57 centimetric radar became operational to watch for those very low-flying aircraft entering Scapa Flow that were missed by RAF Crustan (HRA, Naval Shore Radar; TNA, AIR 26/92). Dismantling of the 1940 type hand-turned CHL began on 21 February 1945. At 12 pm on 26 May 1945 the centimetric equipment ceased plotting surface vessels, although a full watch was continued on aircraft, with the Type 30 (Naval Type 273) acting as a stand-by for



77 Dunnet Head site plan. (© Historical Radar Archive)



REFERENCE.

BUILDING NUMBER	BUILDING.
1	R.N. SIGNAL STATION.
2	LLOYDS SIGNAL STATION.
3	HUT
4	LIGHTING GENERATOR HOUSE.
5	GUARD HOUSE & P.B.X.
8	HUT COMBINED T & P BLOCK
9	POWER STATION
11	TRANSMITTING HUT
12	RECEIVING HUT
13	LISTER STAND-BY SET HOUSE
14	COMBINED T & R CUBICLE & (80'-0" TOWER DISMANTLED)
15	10,000 GAL. STORAGE TANK
24	SEPTIC TANK

DEREQUISITIONED ON 11/11/56

FLOOR LEVELS GIVEN ARE APPROXIMATE.

SECRET Nº	D. of W.
	WA15/6/50

& 30.)

the Type 57. The Type 30 was placed on care and maintenance on 12 July and the Type 57 followed at 12.30 pm on 29 August. The decline and fall of Dunnet Head concluded at 12.30 pm on 7 November 1945 when the CHL ceased operating and was placed on care and maintenance the following day (TNA, AIR 26/92).

Dunragit

Type	Radar station
Subtype	Ground Control of Interception (AMES Type 8)
Region	Wigtownshire (Dumfries and Galloway)
NGR	NX 117 578
NMRS	NX15NW 150
In use	June 1942 – January 1943

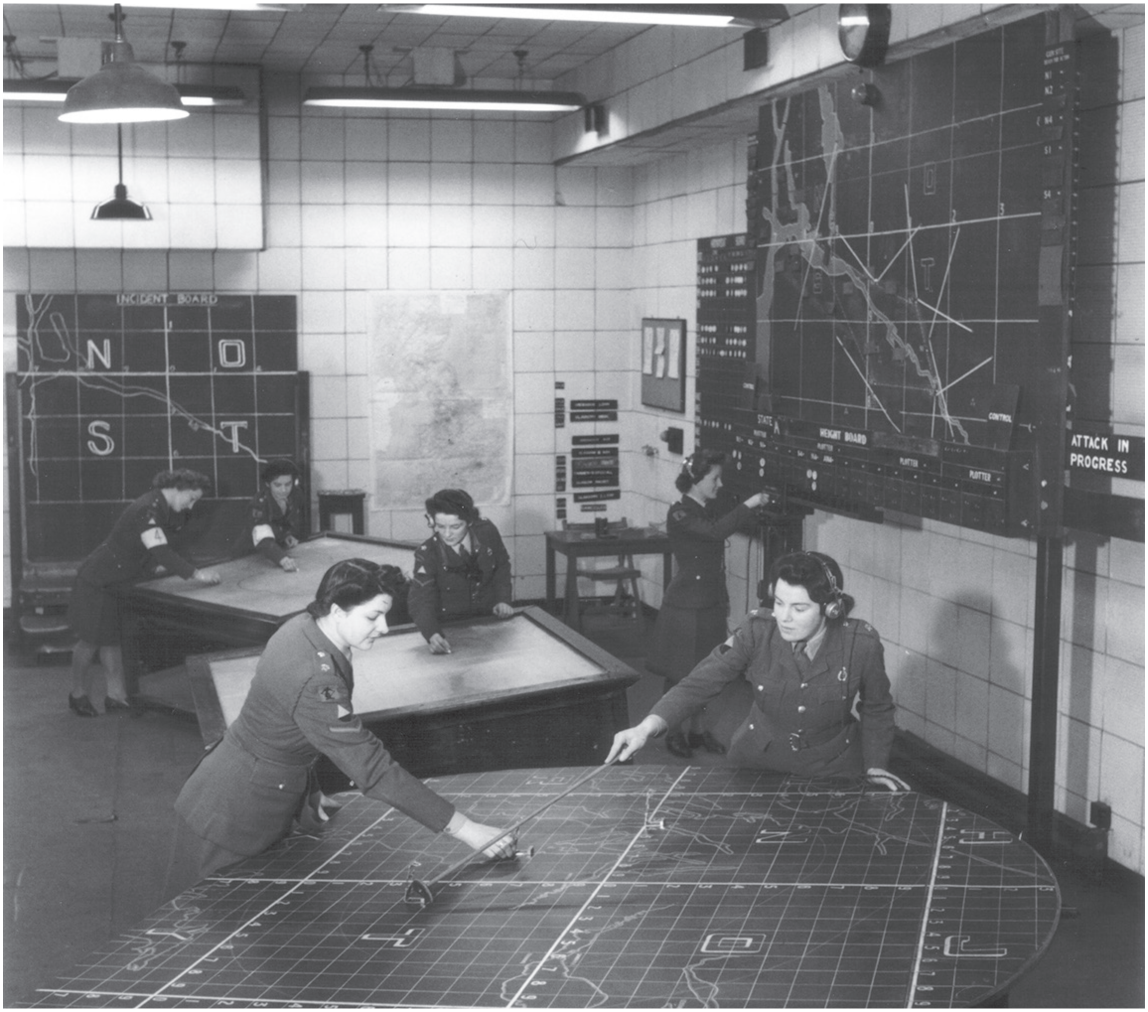
Work began at Dunragit during April 1942 and the mobile GCI convoy arrived in May. Air Ministry Experimental Station No 34G, Dunragit became operational in June (TNA, AIR 26/103), but was placed on care and maintenance in January 1943.

East Kilbride

Type	Radar station
Subtype	Ground Control of Interception (Army) (AMES Type 8)
Region	Lanarkshire (South Lanarkshire)
NGR	NS 666 535
NMRS	NS65SE 48
In use	January 1942 – 1944/5

In the early part of the Second World War there was no means for an Area Commander of Anti-Aircraft Command to receive an accurate picture of aircraft movements in his area. To resolve this problem, AA Command obtained several GCI radars from the RAF and these were officially adopted as Army equipment and designated AA/GCI, or AA No 5 Mk I (Sayer, 1950: 99).

One of these mobile GCI radars was set up near East Kilbride, 6 miles from No 404 Gun Operations Room at Aikenhead House, King's Park, Glasgow, during January 1942. Although operated by Royal Artillery personnel, the station, designated G503 and given the call sign 'Sugar 20', was maintained by RAF personnel from No 72 (Signals) Wing. Information about this station is sparse and no record has been found concerning its activities. The station closed down in late 1944 or early 1945 (TNA, AIR 26/103).



78 404 Gun Operations Room, Aikenhead House.
(© Imperial War Museum London H41499)

Eorodale

Type	Radar station
Subtype	Chain Home Low (AMES Type 2), AMES Type 31 (CD No 1 Mk V)
Region	Lewis (Western Isles)
NGR	NB 5327 6259
NMRS	NB56SW 63
In use	24 November 1941 – 24 November 1945

Work on the construction of Eorodale began in the summer of 1941. On 6 July the gantry erection was completed and two days later the technical buildings and wiring were finished

(TNA, AVIA 7/372). Eorodale was a 1941 Type CHL and installation was completed on 16 September and personnel provided. However, the station was unable to go on the air as there were no facilities for passing plots. W/T equipment was installed but for a variety of reasons it was not possible to plot to Kirkwall Filter Room. The station began plotting to Inverness Filter Room via the teleprinter service from Stornoway on 24 November 1941, and the maximum range achieved before the end of the month was 100 miles (TNA, AIR 26/92).

During January 1942 the station achieved a maximum range of 119 miles, and 136 miles the following month. This increased to 148 miles in March and to 180 miles during April, with a maximum that month of 25 miles on surface vessels. The German photographic and meteorological reconnaissance aircraft continued their flights through the area around Orkney and Shetland, and during April 1942 approached within 40 miles of the Butt of Lewis. This provided hostile activity for Eorodale and interceptions were attempted but without success (TNA, AIR 26/92).

The maximum achieved range of the station was extended farther during July 1942 when Eorodale managed a plot at a range of 200 miles on a German reconnaissance aircraft. This was extended slightly during August when a range of 203 miles was achieved. Perhaps as a result of these good performances, a course was held at Eorodale for CHL NCOs which was completed at the end of September 1942 and quickly improved operational efficiency at CHL stations throughout northern Scotland (TNA, AIR 26/92).

During May 1943 installation was begun of a CD No 1 Mk V centimetric radar (given the RAF designation AMES Type 31). It had originally been planned to start this in January, but it was delayed because the equipment had not arrived on site. The radar became operational at the beginning of June, providing additional surface cover over the Minch and the north-western approaches. Arrangements were made for the plots to be passed to Lyness NPR (TNA, AIR 26/92).

Bob Stuart, a Royal Canadian Air Force (RCAF) Radar Mechanic, recalls his posting to Eorodale in 1943:

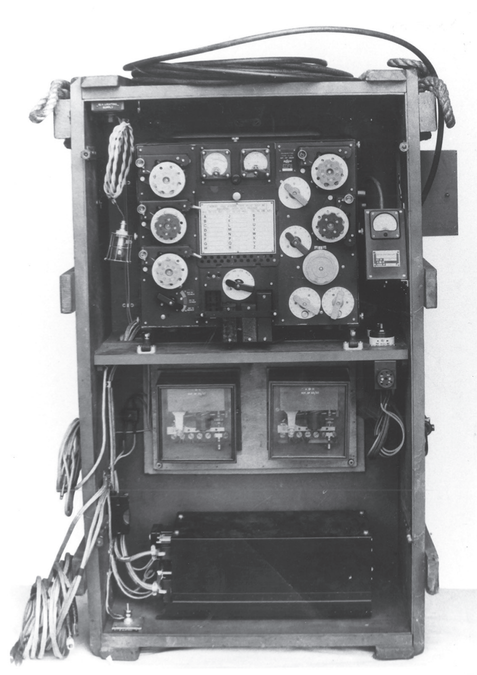
79 Eorodale Domestic Site in the centre of the photograph, taken on 18 September 1942. (© Crown Copyright Royal Air Force Museum W1/7/2 Eorodale)

Lots of wind & rain up on this point. We had CHL, CD & IFF gear & covered a lot of shipping, air-sea rescue patrols & air traffic from north. A trick that German subs used was to surface & put up various canvas strips to make them look like a fishing boat – this was to enable them to remain on the surface to charge their batteries. A keen watch on the radar screen had to be kept to spot them.

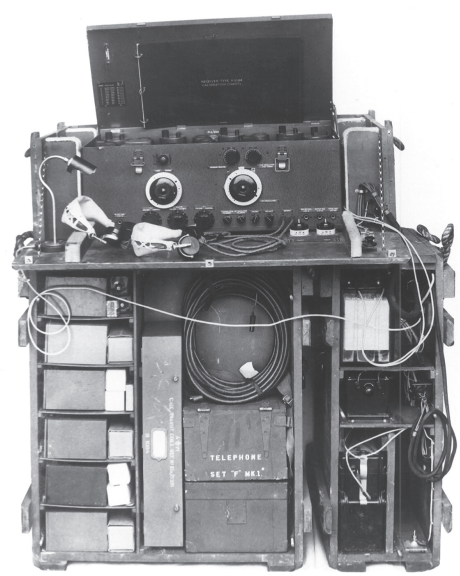
Back in those days the CD 1 short-wave radar, which we had on the station, was considered pretty hot stuff. The Admiralty was testing their newly developed non-acoustic one man subs – the purpose being that these could slip in undetected & cut through the submarine nets protecting two German warships holed up in a Norwegian fjord & place plaster bombs on their hulls. We were to see if we could detect these little subs on a trial run. Shortly before test time, the 400 volt dc generator for the CD 1 unit broke down, necessitating a mad 30 hour scramble to dismantle it, obtain parts & get operational. However, got back on air in time and 'higher ups' not too happy when the CO was able to pick them up & pass plots on them. Never did hear the outcome of the actual raid. (HRA, R A Stuart, 'Outline of Service with RCAF Radar')

The midget submarines plotted by Eorodale were probably the four-man X-craft which were based at Kylesku, and trained in Loch Cairnbawn and the surrounding waters, between June and September 1943. On 11/12 September 1943 the submarines X-5 to X-10 left Loch Cairnbawn to attack *Tirpitz*, *Lützow* and *Scharnhorst* in Kaafjord. Only the *Tirpitz* was in its berth when they reached Norway, but the attack by X-6 and X-7 seriously damaged the German battleship, which remained out of action until March 1944 (O'Neill, 1981: 60–3).

September 1943 was one of the busiest months in Eorodale's history, with concentrated



80 T1154 W/T transmitter used at Eorodale for communications.
(© Quinton MacMillan)



81 R1084 W/T receiver used at Eorodale for communications.
(© Quinton MacMillan)

activity from US aircraft arriving from the north-west. Plots were first picked up at 150 miles and faded 80 miles south and south-west of the station. Most of the aircraft landed at Stornoway. During one of the busiest days 1,170 plots were passed in 4½ hours (TNA, AIR 26/92).

No 13 Group Bulletin recorded in October 1943: 'No CD station has reached Eorodale's standard of last month when they tracked "a feathery response" identified later by means of a visual as a school of porpoises' (HRA, HQ No 13 Group Bulletin).

Improved turning gear was fitted to the CHL gantry and became operational on 26 January 1944. Concerns were expressed, however, that the gantry was not rigid enough to carry the extra weight. As a result, shoring of the gantry took place between 21 and 23 March (TNA, AIR 26/92).

The Type 31 (CD No 1 Mk V) ceased to pass surface vessel plots on 14 November 1944 and remained operational for the purpose of plotting aircraft only. This appears to have been the beginning of the end for the Type 31, which closed down at 6 pm on 19 January 1945, and authority was received on 23 January to dismantle the equipment. The CHL station ceased reporting at 9 am on 24 November 1945 and RAF Eorodale was placed on care and maintenance (TNA, AIR 26/92).

Fair Isle

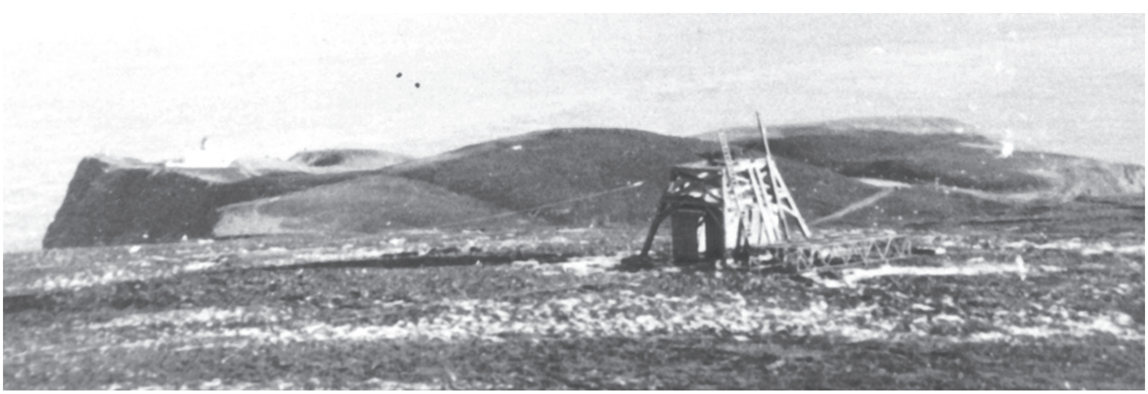
Type	Radar station
Subtype	Coast Defence U-Boat (AMES Type 2)
Region	Shetland
NGR	HZ 2098 7344 (Fair Isle North)
NMRS	HZ27SW 217
In use	1 March 1940 – November 1942, August 1944 – 12 June 1945

Type	Radar station
Subtype	Coast Defence U-Boat (AMES Type 2)
Region	Shetland
NGR	HZ 2085 7341 (Fair Isle South)
NMRS	HZ27SW 217
In use	26 February 1940 – August 1944

Type	Radar station
Subtype	Chain Home Low (AMES Type 2), Naval Type 273, Naval Type 277
Region	Shetland
NGR	HZ 2088 7340 (Fair Isle III)
NMRS	HZ27SW 217
In use	November 1942 – 4 August 1945

The two CDU radar stations built on Fair Isle were set up as part of the Somerville Scheme devised by Vice-Admiral Somerville to detect U-boats attempting to leave the North Sea on the surface north of the Scottish mainland. The original intention had been to place the two stations at opposite ends of the island: Ward Hill in the north and Malcolm Head in the south. However, Sub-Lieutenant J A Lewis inspected the island on 7 November 1939 to prospect for sites and decided that it would be more advantageous to have both stations on Ward Hill, with Admiralty Experimental Station No 3 (Fair Isle South) on the summit and AES No 2 (Fair Isle North) on a shelf a few yards below, and to the north-east of, the top. The construction of the station was an engineering challenge, with all materials having to be brought in by boat and, until the contractor brought over a Ford lorry, transported by ox-cart. As an example of the work involved, each of the four gantries (one transmitter and one receiver for each station) had each of its four legs planted in 64 cubic

82 Erecting the aerial frame, all done by block and tackle, planks and manpower, at Fair Isle North Transmitter Hut, early 1940.
(© Eric Parker)



83 Fair Isle North Receiver Hut under construction, early 1940.
(© Eric Parker)

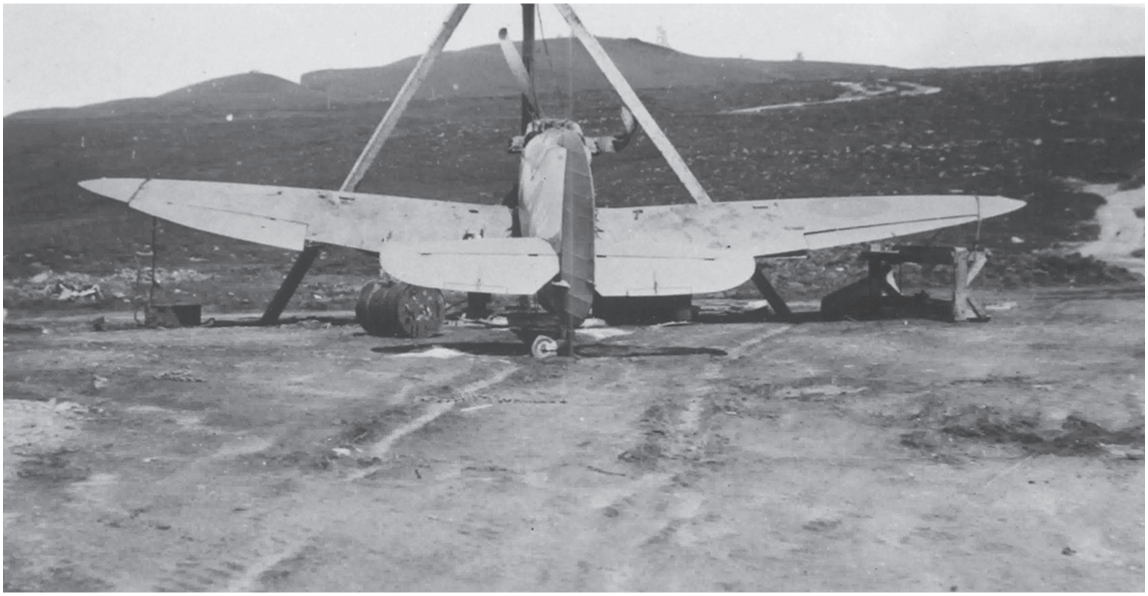
feet of concrete; thus, 16 times this weight of sand, cement and water had to be carried up the hill for one small part of the job (HRA, Naval Shore Radar).

The ratings and the station CO, Sub-Lieutenant R W Feachem, arrived on 23 January 1940. Construction and installation were so well advanced that tests were carried out in January with a submarine which proved satisfactory. However, severe bad weather delayed progress: AES 2 lost one aerial array that month, and both stations lost aerial frames in early March. Despite these problems, AES 3 commenced operating on 26 February and AES 2 on 1 March. Plots were passed by telephone to the W/T hut lower on Ward Hill and then passed to Scapa. In late 1940 the General Post Office (GPO) completed a relay system on a new Shetland–Orkney cable, with relays in a hut on the Level. After this installation was completed, plots were passed by telephone to Kirkwall Filter Room (HRA, Naval Shore Radar; HRA, G C Evans, 'The Origin of the Admiralty Experimental Stations').

Almost immediately the two stations on Fair Isle were to prove their value. On 8 and 10 April 1940 Fair Isle, along with AES No 1 at Sumburgh, detected large formations of German bombers heading towards Scapa Flow in an attempt to destroy the Home Fleet (HRA, Naval Shore Radar). These attacks could have been as devastating to Britain's naval forces as the attack on Pearl Harbour was to US naval power, and their detection was vindication of the effort put into the construction of the stations on Fair Isle.

The equipment used on Fair Isle comprised receivers hand-made at the Cavendish Laboratory, Cambridge University, and transmitters that were modified gun-laying sets. As such, their performance was not as good as desired: in March 1941 AES 2 plotted regularly

84 Fair Isle North (AES 2) showing the results of gale damage in January 1940.
(© Eric Parker)



85 Supermarine Spitfire Mk III X4501 being dismantled in 1941.
(© Richard Feachem)

at over 50 miles and occasionally at over 70 miles; AES 3 rarely plotted at ranges more than 40 miles (HRA, Naval Shore Radar). In April new transmitters and receivers were installed at both AES 2 and AES 3 by RAF personnel of No 70 (Signals) Wing (TNA, AIR 26/92). As a result of this work, the performance of the stations improved dramatically: AES plotted up to 117 miles, and on 2 June AES 3 plotted a hostile at 151 miles east-south-east, a new long-distance record for that type of CHL station (TNA, AIR 26/100).

The work of the station in co-operation with fighter aircraft took an unexpected turn on 12 July 1941 when Supermarine Spitfire Mk III, serial number X4501, which was a photo-recce aircraft of No 1 Photographic Reconnaissance Unit, suffered an engine failure and made a wheels-up landing on the airstrip at Fair Isle. Although struck off charge, the aircraft was repaired by Scottish Aviation Limited and eventually returned to service (Morgan and Shacklady, 1987: 92).

During December 1941, 394 aircraft were plotted, of which 13 were hostile. At 2 pm on 8 December a German aircraft dropped three bombs on Fair Isle South Lighthouse and strafed it with cannon fire (TNA, AIR 26/100), killing Mrs Catherine Sutherland, aged 22, the wife of the Assistant Lighthouse Keeper (Fair Isle South Lighthouse memorial plaque).

Also that month the transmitters at both stations had their VT58 valves replaced with higher output VT98s. This had a marked effect on the size of echoes from surface vessels. A total of 98 ships were plotted during December, including one of particular interest on the 16th. It was a small, fast vessel which proceeded down the east coast of the island and turned south-west. It was tracked for 38½ nautical miles at an average speed of 28½ knots (TNA, AIR 26/100).

The good performances were to continue. During January 1942 a total of 341 aircraft were plotted, of which 16 were hostile. On

9 January the meteorological reconnaissance aircraft known as 'Weather Willie' was intercepted and AES 2 received praise from the filter room because it was the only station plotting the hostile at the time of interception, although the aircraft was not shot down (TNA, AIR 26/100).

At 4 pm on 21 January 1942 Fair Isle South Lighthouse was attacked again. A Junkers Ju 88 approached from the west and dropped two bombs, one of which hit the living quarters of the lighthouse (TNA, AIR 26/100). This attack resulted in the deaths of Mrs Margaret Smith, aged 60, the wife of the Principal Lighthouse Keeper, and their daughter, Greta Smith, aged 10, as well as 27-year-old Gunner William Morris, who managed to achieve hits on the Junkers with the Lewis machine-gun mounted near the lighthouse (Fair Isle South Lighthouse memorial plaque; TNA, AIR 26/100).

Further modifications to the stations were carried out when they were converted to common transmitting and receiving aerials. Thus, rather than using two separate aerial arrays, one for transmitting and one for receiving, a single array at each station would carry out both functions. AES 2 had an annexe built alongside the Receiver Hut to house the transmitter. A sliding hatch was cut in the dividing wall so that the cathode ray tubes on the receiver could be seen whilst adjusting the transmitter. In contrast, AES 3 had an open feeder run from one hut to the other, the transmitter remaining in situ. The conversion of AES 3, being simpler, was carried out in March 1942 but that at AES 2 was not completed until 6 May (HRA, Naval Shore Radar; TNA, AIR 26/100).

On 21 May a Coastal Command Air to Surface Vessel (ASV) beacon became operational on Ward Hill, and this probably led to the appearance of Hostile 289, first plotted at 40 miles south-east at 10.30 pm on 23 May. The aircraft flew a large 'square' round the island before flying off, and it was considered significant that this took place immediately after the erection of the ASV beacon. Enemy activity continued and on 31 May 1942 a hostile was intercepted and claimed as probably destroyed 70 miles south-east of the station. AES 3 had contributed a lot of plots to the track, plotting almost continuously from 120 miles' range at 300°, towards Scapa Flow and then out to the point of interception (TNA, AIR 26/100).

Construction of the 1941 Type station, which would eventually become known as Fair Isle III, began in June 1942 and was completed in November. Shortly afterwards AES 2 was dismantled and AES 3 retained as a stand-by equipment. Further advancement came with the Type 273 centimetric radar equipment which became operational in the new CHL T & R Block on 1 March 1943 (TNA, AIR 26/92); the 1941 Type CHL became operational at 9.40pm on 14 April 1943 (TNA, ADM 166/4987).

In January 1944 the AES 3 aerial was blown down. It was suggested that power turning of the aerial and a PPI display should be installed in AES 2 by the Royal Navy with assistance from No 70 (Signals) Wing, which would allow AES 3 to close down and AES 2 to become the stand-by for Fair Isle III 1941 Type CHL radar. Flying Officer Roberts, Corporal Ollett and Corporal Faine from No 70 Wing flew to Fair Isle on 16 July to install the Caledon turning gear in AES 2 planned in January. The gantry provided was incomplete and insufficiently strong, so was modified on site using pieces of scrap girder. The work was completed on 30 July. A party from Caledon arrived on 28 July to strip the old gantry and turning gear to give the Type 273 radar better operational coverage. IFF Mk 3 equipment for AES 2 was commissioned on 30 July.

Following the completion of this work, AES 2 became operational again in early August as the stand-by for Fair Isle III (TNA, AIR 26/92).

A Type 277S was installed at Fair Isle in 1944 but it was not completed until 1945 (HRA, Naval Shore Radar; TNA, AIR 26/100). On 12 June 1945 the CHLs closed down and, with the closure of Lerwick NPR, the Type 273 and Type 277 radars plotted aircraft movements only (TNA, AIR 26/92).

Although maintenance of the Fair Isle stations was passed to the RAF in March 1940 (HRA, Naval Shore Radar) the operators remained Naval personnel until Fair Isle was transferred to the RAF in August 1945 (TNA, ADM 116/5790); it closed down on 4 August (TNA, AIR 26/92).

Ernie Pickles recalls:

I finished up on Fair Isle, but by now hostilities had ceased and there I was commissioned to dismantle two CHLs … the first television that I had was home made, home designed and used six-inch green tubes that came from Fair Isle with a picture about postcard size. They fell off a wagon! … I was there and in charge when the war ended and … we had begun to dismantle the southern one when I came home. I can't remember how far we had got but naturally from then on I didn't care! (Ernie Pickles, pers comm)

Fearn

Type	Radar station
Subtype	Ground Control of Interception (AMES Type 8)
Region	Ross and Cromarty (Highland)
NGR	NH 841 759
NMRS	NH87NW 21
In use	August 1945 – date unknown

During August 1945 a Royal Navy party were installing a GCI station at RNAS Fearn. Unfortunately, no further information is known about this station (TNA, AIR 26/92).

Fidra

Type	Radar station
Subtype	Naval Type 273
Region	East Lothian
NGR	NT 511 860
NMRS	NT58NW 140
In use	1942–3

The Admiralty set up the Fidra Type 273 centimetric station in 1942 to guard against enemy minelaying operations in the Firth of Forth (TNA, WO 166/6035; Kingsley, 1995:

208). Alan Patrick was Port Radar Officer, Rosyth, from 1941 to 1944:

I was there when the site for the station was selected, supervised its installation and provided logistic support from Rosyth Dockyard during its fairly short life … It was on the mainland nearby [to Fidra island]. Fidra was, in fact, rather a nuisance because the station, being a fixed one, 'painted' the permanent echo from Fidra at every rotation of the antenna. The result was that the phosphor on the CRT became a black spot on the tube. (Alan Patrick, pers comm)

It has not been possible to establish exactly when the station closed down but, as Alan Patrick notes, it was not operational for long and it probably closed down in 1943.

Fifeness

Type	Radar station
Subtype	Gun-laying Modified
Region	Fife
NGR	NO 612 091
NMRS	NO60NW 396
In use	1 November 1939 – 16 January 1940

A meeting was held at the Air Ministry on 19 October 1939 to discuss improvements to the radar chain. At that meeting it was decided that an MB radar, originally intended to be set up at Wick, would be diverted to the Firth of Forth area (TNA, AVIA 7/299). The Fifeness area was surveyed on 23 October and a site acquired the following day. Gun-laying Modified (GM) equipment, rather than the MB mentioned previously, was diverted to Fifeness and set up with aerials on a 70 foot mast, with the station becoming operational on 1 November (TNA, AVIA 7/301; Air Ministry, 1950 (1): 84).

Plans were drawn up for the station at Fifeness to be used for experimental trials by AMRE staff at Dundee:

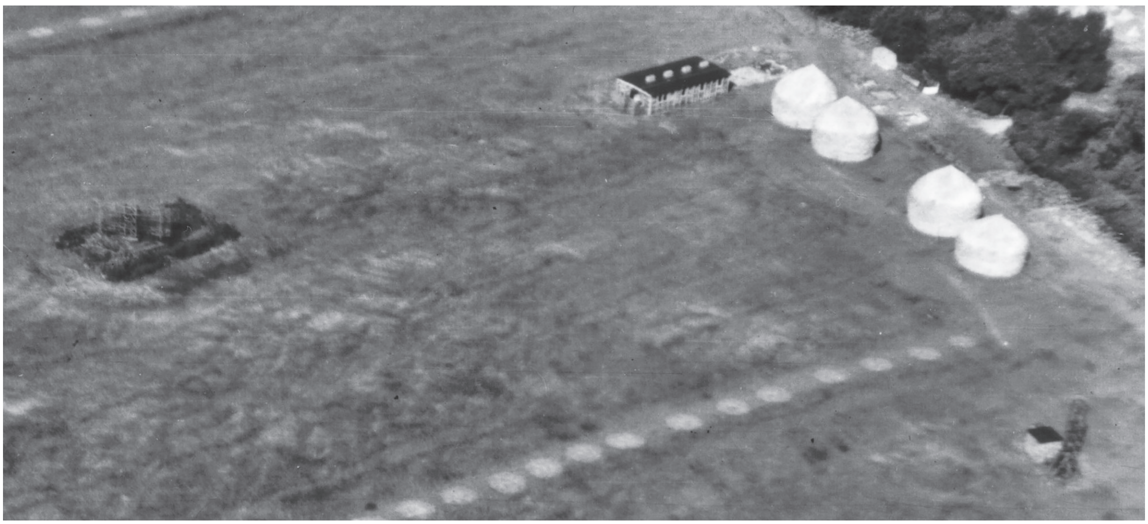
In connection with the operation of this station, we would like to carry out certain experiments which can only be performed by stationing an assistant for a few days on the Isle of May. This assistant would use only light poles, rods and wire for these experiments and, if satisfactory results were obtained, the slight structure which he would erect would be required as long as the Air Ministry station at Crail is in operation. (TNA, AVIA 7/301)

No objection to these experiments was raised by the Chief of Staff of Rosyth Naval Base, although it has not been possible to determine their exact purpose, nor whether they were ever carried out (TNA, AVIA 7/301).

Due to the low-lying ground on which the station was sited, the aerials at Fifeness had been mounted on a 70 foot mast. During a gale on the night of 15/16 January 1940 the mast blew down and was not considered worth repairing. Consequently, the station went off the air and did not reopen. Flight Lieutenant J T Bain and his crew from Fifeness took over the former Royal Navy radar station at Anstruther in January 1940 (TNA, AVIA 7/709; Clifford Evans, pers comm).

Forth

Type	Radar station
Subtype	Ground Control of Interception (Army) (AMES Type 8)
Region	Midlothian (City of Edinburgh)
NGR	NT 1595 7513
NMRS	NT17NE 125
In use	October 1942 – December 1944



86 Forth GCI, with the aerial array in the centre left of the photograph, the Operations Block in the upper centre, and the IFF tower and cubicle in the bottom right, taken on 31 August 1950. (© Historic Environment Scotland)

In the early part of the Second World War there was no means for an Area Commander of AA Command to receive an accurate picture of aircraft movements in his area. To resolve this problem, AA Command obtained several GCI radars from the RAF and these were officially adopted as Army equipment and designated AA/GCI, or AA No 5 Mk I (Sayer, 1950: 99).

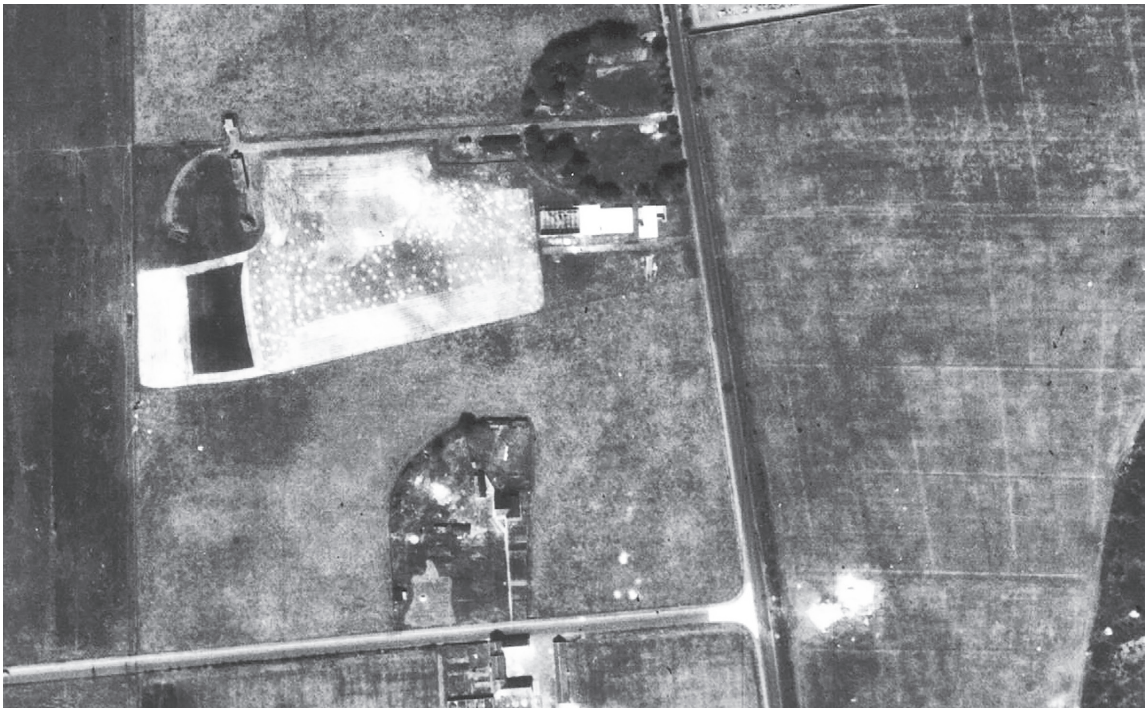
One of these mobile GCI radars was set up near to No 403 Gun Operations Room at Craigiehall, South Queensferry Road, Edinburgh, during October 1942, the equipment having come from RAF Fullarton. Although operated by Royal Artillery personnel, the Forth station, designated G510, was maintained by RAF personnel from No 72 (Signals) Wing (TNA, AIR 26/103).

Authority was received from No 60 (Signals) Group on 9 December 1944 for the removal of the mobile GCI from Forth to No 70 (Signals) Wing Technical Detachment at Douglas Wood, and the station was duly closed down (TNA, AIR 26/92).

87 403 Gun Operations Room, Craigiehall.
(© Imperial War Museum London H41498)

Fullarton

Type	Radar station
Subtype	Ground Control of Interception (AMES Type 8A)
Region	Ayrshire (North Ayrshire)
NGR	NS 3265 3662
NMRS	NS33NW 385
In use	13 January 1942 – 18 August 1944, 20 September 1944 – 31 January 1946



88 Vertical aerial photograph of Fullarton, taken on 1 August 1945, showing the Happidrome at upper centre as a white shape. Note the main operations room on the left side is not roofed, indicating clearly that the building is unfinished.
(© Historic Environment Scotland)

On 13 January 1942 the mobile GCI convoy from St Quivox was established at Fullarton, near Irvine, approximately 8 miles from its former site. It was under the operational control of Fighter Sector Headquarters, Ayr (TNA, AIR 29/167). The equipment was also converted to common aerial working (TNA, AIR 26/103).

Eric Folkson had served at St Quivox and moved with the unit to Fullarton:

This was a major upheaval, not only regarding the equipment but all personnel would no longer enjoy the facilities of RAF Heathfield [Ayr]. Fortunately, only about a mile from the new GCI site there was a small army camp which had been vacated. This consisted of several well-built Nissen huts, cookhouse, ablutions, etc.

Our operators & mechanics were now supplemented by other trades to make us self-supporting – cooks, service police, wireless ops, etc. RAF Heathfield was still our parent unit & rations etc delivered to us weekly.

I believe that at this time we received our first consignment of WAAF Radar Operators. They were billeted in a local golf club house.

Our newly acquired cook contacted me to say he had been approached by the owner of an adjacent smallholding to ask if we were prepared to swap some of our standard ration of beef for a quantity of chickens & ducks. I told him to go *ahead as long as he got a good deal. As a result everybody had a treat, cooked to perfection by the cook who had been a West End chef. I can recall eating a duck – done to a turn – with my friend & colleague, George Hall. Somehow or other we scrounged a bottle of wine to go with it.* (Eric Folkson, pers comm)

Work commenced on the Intermediate Mobile GCI in March 1942, with the construction being well under way in April. Calibration was completed in May (TNA, AIR 26/103) and the Intermediate station was brought into use on 2 September 1942 (TNA, AIR 29/167).

Construction began on the Final GCI buildings on 10 September 1942, but all work on them ceased at the end of December 1942 in accordance with the Fighter Command decision that Fullarton would remain operational as an Intermediate station only (TNA, AIR 29/167).

On the night of 24/25 March 1943 there was a raid on northern England and southern Scotland. Fullarton had five or six aircraft in the Glasgow area at varying heights. Three interceptions were attempted but these were abandoned because of very poor responses from the aircraft, which were assumed to be flying very low (TNA, AIR 26/103).

On 10 May 1943 operational control of Fullarton passed to Fighter Sector Headquarters, Turnhouse, on the closing of FSHQ, Ayr (TNA, AIR 29/167).

A school for GCI controllers was established at Fullarton in May 1943 and nine courses were held by March 1944 with reasonable success, notwithstanding an inadequate supply of aircraft. To help with the training a Ward Trainer was built and came into operation on 23 May 1943. It was superseded on 24 September by the Type 29 Trainer (TNA, AIR 29/167).

Assistance was given on many occasions with the homing of lost aircraft, usually of the transatlantic service. On 16 June 1943 a 90 cm searchlight was installed to link up with the 'Sandra' lights at Ayr. With the assistance of the searchlight, on 1 October two Consolidated B-24 Liberators were homed to Prestwick aerodrome, whilst a third was intercepted by Mudlark 19 (a night fighter from No 96 Squadron) and led to RAF Ayr. Again, on 5 October with the help of the searchlight, four Fairey Barracuda aircraft from RNAS Machrihanish landed at Ayr in very bad weather conditions (TNA, AIR 29/167).

RAF Fullarton Intermediate Mobile GCI station closed down operationally at 12.01 am on 18 August 1944 and was dismantled (TNA, AIR 28/286). However, it was required by the Admiralty for training purposes and was therefore re-installed and went back on the air on 20 September, with the exception of the Mk III IFF, which was not operational until 1 October (TNA, AIR 26/92).

RAF Fullarton was transferred from the Admiralty to No 60 Group control with effect from 31 January 1946. The station was reduced to care and maintenance, and further instructions were later issued to dismantle the equipment and dispose of the land and buildings. Dismantling of the station was completed on 27 May (TNA, AIR 26/93).

Gaitnip

Type	Radar station
Subtype	Chain Home Low (AMES Type 2)
Region	Orkney
NGR	HY 4479 0616
NMRS	HY40NW 41
In use	March – 3 July 1940

On 5 March 1940 it was noted that there was already 'a CHL station at Gaitnip to cover Scapa for Air Ministry purposes' (TNA, AVIA 7/257).

Quinton MacMillan recalls his posting to Gaitnip in April 1940:

The site consisted of two huts, each about 12 ft by 8 ft side by side and sitting on top of each one was a large frame, wooden about 8 by 4 ft by 2 ft [actually 26 feet 7 inches by 10 feet] covered in wire netting. They were sited on top of the hill … and opposite the approach side the land sloped steeply down to a cliff overlooking Scapa Flow and, just a distance away, the buoys marking the position of HMS Royal Oak, *sunk by a submarine that crept in through an unguarded inlet.*

To furnish power there was a trailer holding a Meadows engine and generator and, remembering the state of things in the 30s, nobody knew a thing about engines apart from the fact that they had something called sparking plugs in them.

Into the huts we went to have the working explained by this civvie and a demonstration to show that it did work and then Bill Boyd signed for the whole lot. Can you imagine a Corporal signing for thousands of pounds worth of highly secret equipment? But that is what happened. And what was inside?

On opening the door through a right-angled lobby, one entered a room about 12 ft square and on the opposite wall was a window, shuttered from the inside, which looked out over Scapa Flow … The floor was of uncovered cement, which gave off a cloud of dust as it had not been sealed and which covered everything in the hut with a fine coating.

In the middle of the hut was the black painted console containing the receiver (Rx) with the tube (CRT) and positioned to the left of it was a seat placed so that the tube was visible. The aerials were rotated manually and this was accomplished by using a bicycle frame set upside down in the floor, bottom bracket uppermost and the pedals replaced by handles. The crank was fitted with a long chain disappearing through the roof and, by means of a gear box rotating the crank, rotated the aerial. At that time the aerial was only able to turn about 200° as the amount of current received back was very, very small and the connection to the aerial was solid so as not to lose any of its strength. Slip rings were used much later as the technology improved. To the left of the frame was a galvanometer, a device which interprets discrepancies in voltages and this looked like a normal dial, needles centred and + and – each side. The purpose of this was to synchronise Rx and Tx aerials. As the Rx aerial revolved … the Tx aerial had to cover the area being swept by the Rx and the operator in the Tx Hut had to maintain the needle in the centre of the dial … This particular task in the Tx room was incredibly boring and as so little was being picked *up on the screen, the motivation was somewhat lacking. To cap it all there was no communication apparatus between the two huts to let the Tx man know what was going on, except that the cable connecting the galvanometers ran through a duct of earthenware drainage pipes and a hefty shout was guaranteed to wake up the poor fellow on the Tx.*

There was no direct telephone link between Gaitnip and the Filter Room in Inverness; all plots had to go via the main CH station at Nether Button using a field telephone, a system which was entirely unsatisfactory. By the time an aircraft was plotted and the grid reference reached Inverness, the plot had moved miles. Remember that Norway had been invaded and Luftflotte 5 was encamped there and kept up raids on the Navy in Scapa and, although remote from the main field of action, the Battle of Britain was also being fought out up there … While working 24 hours cover we were still sleeping in the C of S [Church of Scotland] canteen and lying there, and listening to the wireless, heard Anthony Eden broadcast, asking for volunteers for the Local Defence Volunteers, the LDV, later the Home Guard …

Because we seemed to be scattered about in our billets and it was making things difficult for our driver to keep up his schedules, an alteration was made to watch times. We had the usual Monday 0800 to 1300, 2300 to 0800 on Tuesday morning and then 1700 to 2300 Tuesday evening, completing the series with 1300 to 1700 on Wednesday. There was so little activity on the tube anyway whatever was happening outside, so we thought that we could do Monday 1800 to 0800 Tuesday morning, 1300 to 1800 on Tuesday and 0800 to 1300 on Wednesday, but it turned out to be useless because we had so little time between some of the watches and that was soon scrapped. The worst job was sitting in the Tx room watching the galvanometer and following the needles first one way and then the other so that sometimes it felt like one of those fairground games.

The only equipment available for testing consisted of an avometer and a neon tube on a bit of plastic tubing. The latter was used to verify that the Tx was throwing out its supposed signals, and it did so by being placed close to the feeder tubes leading up to the Tx aerial and it then glowed if the signal was there. At one time I was outside the hut because it was maintenance hour and the sentry, a young Gordon Highlander, was standing there also and watched as Bill Boyd climbed onto the roof to carry out this procedure, and the look on his face as the neon light glowed with no apparent contact between it and anything else was a sight for sore eyes, as his mouth dropped open and his eyes threatened to pop out of their sockets. I had to assume a blasé attitude to it but I was just as surprised as he was.

When we entered the site for the first time there was a large wooden box in the Tx room and, upon opening it, we found that it was full of what were called in those days 'Comforts for the Services', ie knitted garments, books, magazines, etc. This package had a gramophone (one of those wind-up portables) with a few records, and the only recollection of the records is of a singer called Evelyn Dall singing with Ambrose and his orchestra … Included in the written offering was a pile of magazines which unluckily for us were 'Women's Weekly' and the only item in there that captured our attention was the page devoted to the agony aunt of her day. Mrs Marryat … The world passed us by pretty well, no newspapers much and no wireless, so to a certain extent we were ignorant of what was going on in the outside world. The invasion of Norway was the important reason we had been transferred to our present position and the invasion of Holland almost passed us by.

But the war went on and the Fleet Air Arm *had an airfield at Hatston down by the harbour from which they flew Blackburn Skuas. Now for some reason the Navy was short of Telegraphist gunners to man these aircraft in their rather forlorn attacks on Norway and a signal was sent to us requesting the names of those who had been passed fit for flying and familiar with the radio equipment. This was me, Ellis and a couple of others whose names I have forgotten, but we were taken to Hatston, given a quick course on the Vickers Gas-Operated machine gun and then we operated in attacks on the harbours of Stavanger (twice) and Bergen (once) by which time the Navy had received replacements so that we were no longer needed. The ratings had their issue of rum but we did not; they also received duty free fags, we were not allowed to buy them …*

My remembrances of the islands are kindly ones: a meeting of new people who welded-together not entirely as one unit, but as several separate groupings of like-minds who worked as a watch and came together finally as a unit. Alas, all good things come to an end and with the findings that Gaitnip was useless in the role for which it was intended, ie locating the low flying aircraft attacking the fleet in Scapa Flow, we were posted away to the mainland of Scotland. (HRA, Quinton MacMillan, memoirs)

In a letter from Squadron Leader Ian Orr-Ewing for the Deputy Director of Signals 4, dated 27 July 1940, it was noted:

We received instructions on the 3rd July to dismantle the CHL station which was operating at Gaitnip (near Netherbutton) and to move the personnel to Thrumster where a new CHL station is being erected. This has been done. (TNA, AIR 2/5476)

It had been found that Gaitnip was of limited use due to excessive permanent echoes and the station was re-erected at Deerness (TNA, AIR 2/5476).

Gin Head

Type	Radar station
Subtype	CD/CHL (AMES Type 2)
Region	East Lothian
NGR	NT 5906 8529
NMRS	NT58NE 58
In use	spring – winter 1942

During the spring of 1942 Gin Head, designated M27, became operational as a CD/CHL, with the dual-role function of surface watching and plotting low-flying aircraft.

Lieutenant Bruce Stenhouse, stationed at Fidra Coast Defence Battery in the spring of 1942,

was instructed to pay a visit to a radar station at Canty Bay … This was on a cliff-top with a view over a wide expanse of sea. I think that HQ, Forth Defences, wanted to arrange for a static artillery unit near at hand to be available for advice or assistance to this small RA [Royal Artillery] unit. (Bruce Stenhouse, pers comm)

No 72 (Signals) Wing, RAF, took over maintenance of the station in October 1942 and RAF mechanics were posted to the station (TNA, AIR 26/103). Gin Head was closed down before the end of 1942, being listed as 'redundant' (Air Ministry, 1950 (1): 577–8).

Greian Head

Type	Radar station
Subtype	Chain Home Low (AMES Type 2)
Region	Barra (Western Isles)
NGR	NF 6579 0464
NMRS	NF60SE 46
In use	3 April 1942 – 7 March 1945

Preliminary work on the installation of a CHL station at Greian Head began in July 1941. The station was completed in December but there were no communications to allow plots to be passed. Greian Head finally became operational on 3 April 1942, with a landline to the Tiree SFR from where plots were passed by W/T (TNA, AIR 26/103).

On 19 March 1943 an aircraft was plotted from 50 miles west of Greian Head to Benbecula. The aircraft was in difficulties and the plotting was congratulated by the Tiree SFR. Greian Head recorded ranges of over 130 miles during April 1943. One track was plotted for 200 miles. Also that month the station commander received a letter of appreciation from the Corps of Military Police for the assistance given by Greian Head personnel in the rescue of four survivors from a merchant ship torpedoed in the Atlantic (TNA, AIR 26/103).

The Barra Home Guard was paraded on 16 May 1943 and Captain Compton Mackenzie, OBE (better known as the author of *Whisky Galore* and numerous other books), invited Flying Officer J M McPhail to address the company. Twenty airmen also participated in the parade (TNA, AIR 26/103).

Greian Head began plotting directly to the Stornoway SFR on 24 July 1943, using a T1190 transmitter and RCA receiver newly arrived on the station (TNA, AIR 26/92).

A message was received by R/T at 6 am on 5 September 1943 instructing the station to call out Castlebay lifeboat. All communications between Barra and the mainland had failed due to a heavy gale and Greian Head's R/T was the only available link. The message was passed on and the estimated position of the wreck given to the lifeboat, which proceeded there with all speed. A considerable number of lives were saved and great appreciation was expressed by all concerned for the co-operation provided by Greian Head (TNA, AIR 26/92).

At 5 pm on 8 December 1943 the homing searchlight was commissioned. This was used to point the direction towards the nearest aerodrome in order to assist lost aircraft to land safely (TNA, AIR 26/92).

On 13 June 1944 Greian Head was reduced to a two-watch system, and was thereafter only operating from 10 am to 2 am each day (TNA, AIR 26/92).

During September 1944 arrangements were made to fit a steel and concrete gantry for the

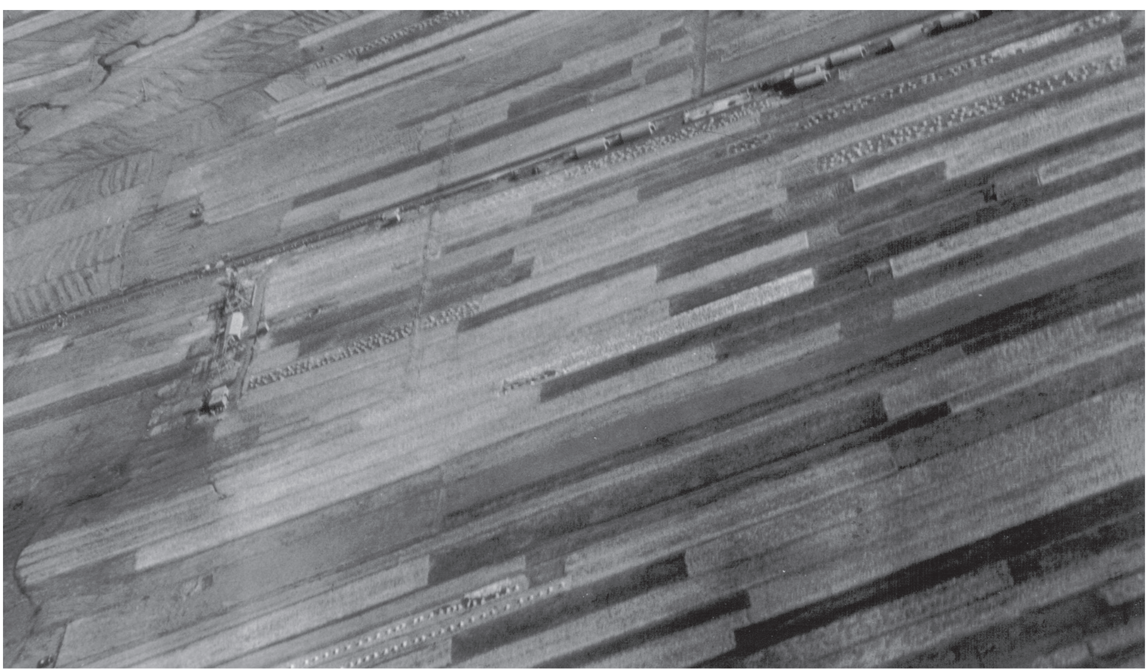
CHL at Greian Head. The strengthening of the gantry commenced on 1 November (TNA, AIR 26/92).

Greian Head CHL was placed on Care and Maintenance Stage I at 12 pm on 7 March 1945. This meant that the station was to be maintained in such a state of readiness that it could return to operations at 14 days' notice. This was reduced to Stage II during August 1945, which meant that a return to operations would require six months' notice (TNA, AIR 26/92).

Habost

Type	Radar station
Subtype	Chain Home Beam (AMES Type 8)
Region	Lewis (Western Isles)
NGR	NB 5096 6286
NMRS	NB56SW 73
In use	April 1942 – 4 February 1944

Construction of the T & R Block, Stand-by Set House and aerial gantry for the CHB station at Habost was completed during February 1942. Caledon installed the turning gear and aerial frames. Also that month the receiver and transmitter were installed and connected



89 Habost, photographed from the air on 18 September 1942, with the T & R Block and aerial arrays at centre left.
(© Crown Copyright Royal Air Force Museum W1/6/8 Habost)

to the power supply, with two fixed and two mobile generators being delivered to the site and cables run from the Power House to the T & R Block. In March aerials and feeders were erected. Habost became operational during April and showed considerable promise after the operators became familiar with the equipment (TNA, AIR 26/92).

CHB consisted of a GCI station which passed information into the reporting network, rather than controlling fighters directly, and was used to provide early warning coverage, with height information, in locations where there was insufficient room to erect a CH station.

During May 1942 it was noted that ventilation in the R Hut was inadequate and it was felt that extractor fans would be useful, particularly since the existing ventilators were inefficient at keeping light out and were usually blocked up. Despite such discomforts, the station achieved a maximum range that month of 100 miles, a very creditable performance for the type of equipment (TNA, AIR 26/92).

The installation of a preamplifier (equipment to amplify weak signals) and a general clean-up of the station during January 1943 resulted in a very noticeable improvement in Habost's performance, which was remarked upon by Stornoway SFR (TNA, AIR 26/92).

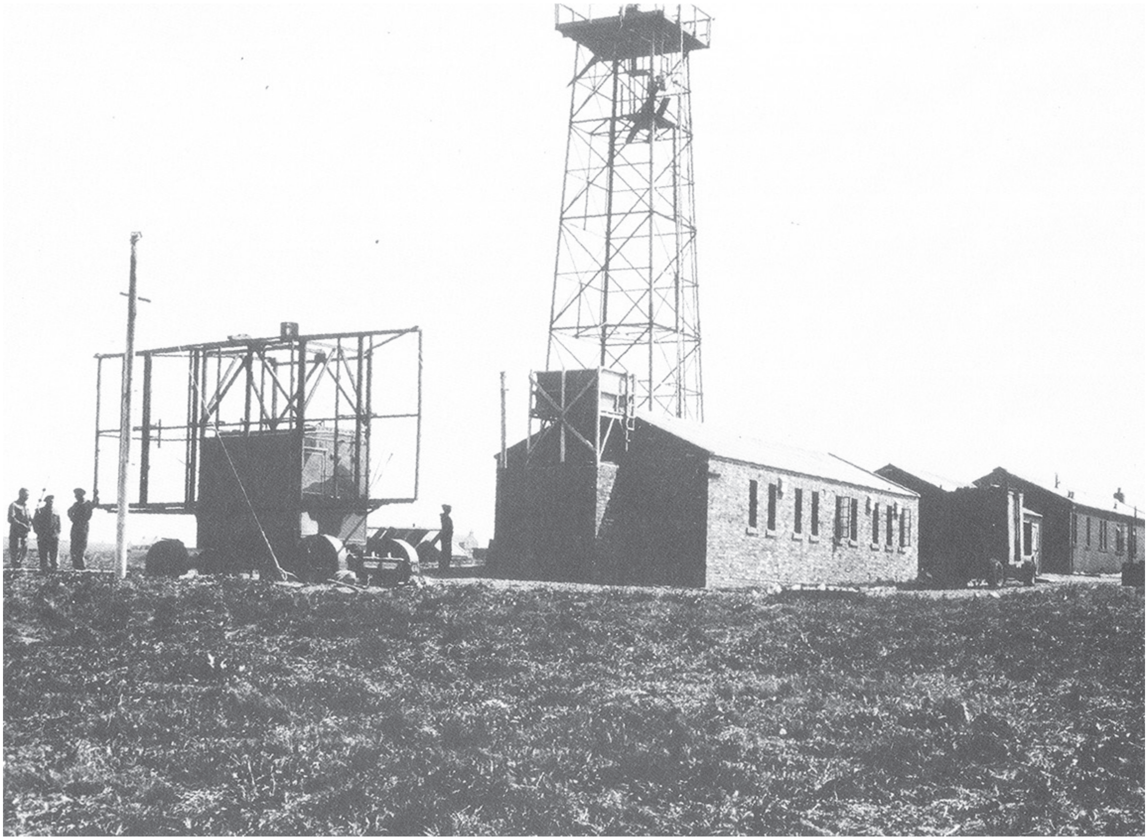
At 3.30 am on 21 October 1943 a Vickers Wellington bomber with a crew of six crashed into the Minch. Two survivors were picked up from a dinghy and told their rescuers that two other members of the crew were in the water somewhere, but they could not be seen in the darkness. At 12.45 pm the Filter Officer asked the station to carry out a search of the coastline. A search was duly carried out between 1.30 and 6.00 pm covering between 8 and 10 miles of coastline, but without success (TNA, AIR 26/92). The aircraft was Wellington Mk III DF595 of No 20 Operational Training Unit, which was on a night cross-country training flight when it crashed in the Minch. Although the two men were rescued, sadly the four others were killed (Chorley, 2002: 257).

Habost CHB ceased operations at 12 pm on 4 February 1944 and dismantling of the station commenced four days later (TNA, AIR 26/92).

Hesta Geo

Type	Radar station
Subtype	Ground Control of Interception (AMES Type 8A), Naval Type 277S
Region	Orkney
NGR	HY 2546 2863
NMRS	HY22NE 37
In use	12 April 1943 – August 1945

On 12 April 1943 Hesta Geo became operational as a mobile GCI station, and was the ground control radar used by the Fighter Direction School based at RNAS Twatt, which itself opened on 10 May 1943. The first fighter direction exercise was carried out with No 771 Squadron, Fleet Air Arm, the bomber being a Vought Chesapeake and the fighter directed to intercept it a Gloster Sea Gladiator (TNA, ADM 116/5790).



90 Hesta Geo GCI station.
(© The National Archives ADM 116/5790)

Lieutenant Commander Cyril Burke, the CO of No 771 Squadron, recalls, 'the Fighter Direction School at Twatt provided initial training using imaginary aircraft but training using real aircraft was subsequently given at Hesta Geo' (Cyril Burke, pers comm). Keith Remmington, a pilot with No 771 Squadron from October 1943 to July 1945, remembers that Hesta Geo 'was a Fighter Direction School and teams from ships in Scapa went there for training. Aircraft provided by 771 Squadron were controlled by Hesta Geo for both radar and visual interception training' (Keith Remmington, pers comm).

A Type 277S (AMES Type 50) centimetric radar became operational on 18 January 1945. However, the performance of this equipment was not satisfactory and an Admiralty party visited the station during March to investigate the reason for this. As a result of the visit, changes were made to the waveguide layout. The equipment broke down on 14 March and had to wait for a pulse transformer to come the following day before going back on the air. Also that month a new Type 8A aerial trailer arrived to replace the existing equipment, which had a warped frame. However, it would not have much more of an operational life, with both the Type 8 and Type 50 radars closing down in August 1945 and the station being placed on care and maintenance (TNA, AIR 26/92).

Hillhead

Type	Radar station
Subtype	Chain Home (AMES Type 1), AMES Type 9 Mk V
Region	Aberdeenshire
NGR	NJ 9450 6165
NMRS	NJ96SW 30
In use	December 1939 – 15 March 1946

On 23 November 1939 Mr Banwell from AMRE at Dundee surveyed three sites near Fraserburgh for potential radar stations, Hillhead being 'much the most suitable' (TNA, AVIA 7/257). By early December the site had been selected and GM equipment for the Advance CH station was shipped to Hillhead on 6 December (TNA, AVIA 7/304), with the station finally going on the air later that month (TNA, AVIA 7/257).

The original layout of the station had to be modified due to the insistence of Air Marshal Joubert, Assistant Chief of the Air Staff (Radio), that Hillhead should have a line of shoot of 45°, rather than the 30° originally planned, in order to give greater warning of hostile aircraft approaching Scapa Flow from the south-east. However, AMRE still preferred a line of shoot of 30° instead of 45° because the increased range of the latter 'will only amount to 10–15 miles beyond that afforded by a line of shoot of 030° and, in addition, the cover in the Moray Firth north of the Banffshire coast will be considerably reduced'. However, the scientific advice was overruled and Joubert's change of line of shoot was adopted (TNA, AVIA 7/304).

Known to German Air Force Intelligence as Smiddyseat and allocated the target number GB 49 806, Hillhead was photographed from the air on 16 September 1940 whilst the Final CH station was under construction. The photo interpreters noted that the site was a '*Noch im Ausbau befindliche Funkstation*', or a radio station still being extended, with '*Erdarbeiten*', or excavations, in the area of the Transmitter Block. It was also noted that there were '*2 Funkmaste (Gittermaste) etwa 95 m hoch*', two radio masts (lattice masts) about 95 metres (315 feet) high.

The first issue of No 60 (Signals) Group's newsletter, RDF Bulletin, noted:

Kirkwall tells us of a grand job from Hillhead – a plot of 172 miles on Feb 22nd [1941] which set up a record for the MB1A. They were also runners-up for their own record when they plotted a Noss Hill test aircraft at 155½ miles N and 15,000 feet. They are quite blasé about a meagre 110 miles for Hostile No 272 on the 9th March. (HRA, RDF Bulletin, April 1941)

The equipment was performing well and on 6 September 1941 Hillhead achieved a record with their MB1A transmitter and RF6 receiver when an aircraft was plotted out to a distance of 210 miles. In the meantime, work was well advanced on the Final CH station, with new transmitters installed by 3 May 1941 and the erection of 325 foot transmitter masts taking place at the same time. However, it was not until 19 October that the new transmitter was tested with the RF7 receiver, with the test being completed on 23 October, having given good results. Following the completion

91 *GB 49 806 Smiddyseat Funkstation*, as Hillhead was known to German Air Force Intelligence.
(© Imperial War Museum London GB 49 806)

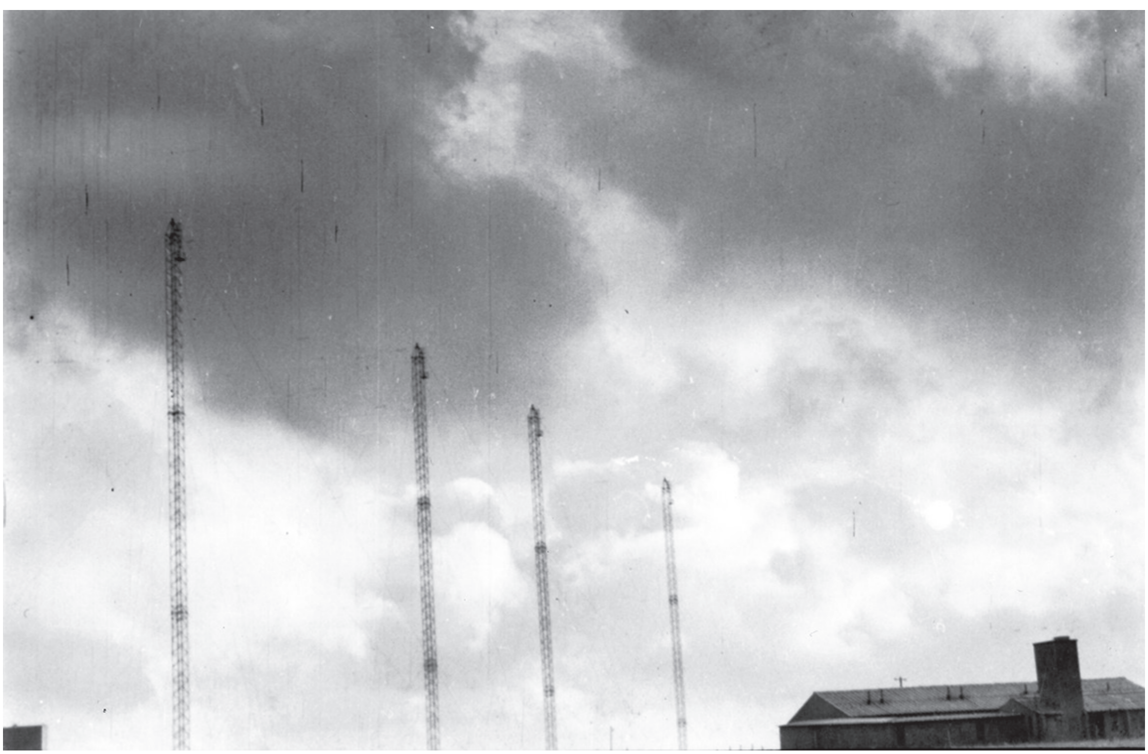
of calibration, the Final CH station became operational on 3 March 1942. The Marconi curtain transmitter aerial array did not become operational until April, with a corresponding increase in the power output. During June the station passed plots up to 199 miles in range, and achieved a range of 205 miles in July. Even this was exceeded in August, with a range of 229 miles on the 29th. Technicians from Metropolitan-Vickers modified the transmitters during January and February 1943 and the peak power output was increased to 600 kilowatts (TNA, AIR 26/92).

Murray Cass was a Canadian Radar Mechanic posted to Hillhead on 9 August 1943. He recalls the power of the transmitters:

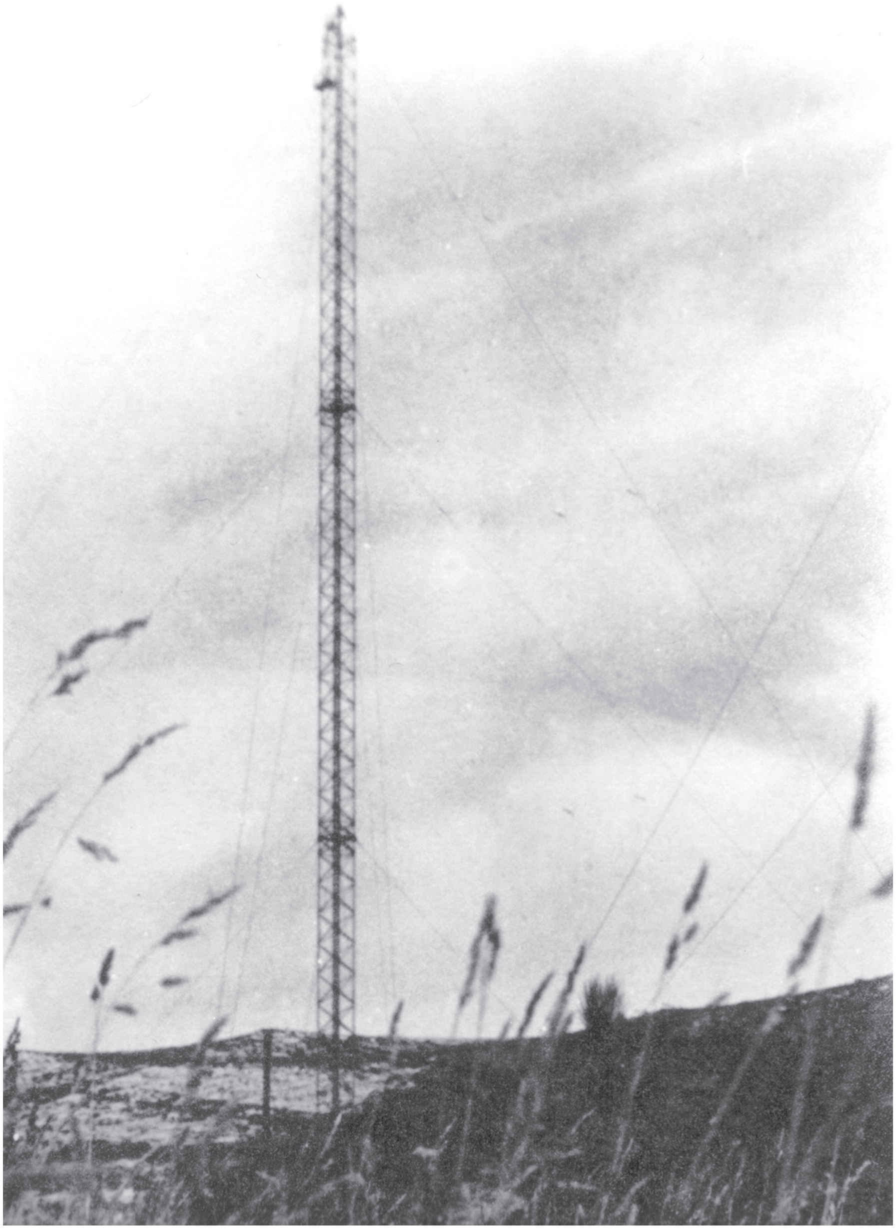
While maintaining a transmitter I sustained my only wartime injury. My wrist contacted a live terminal above my head which I thought was dead. I froze on the spot and my arm gradually contracted making a two inch tear in the skin of my wrist but it pulled me clear of the contact. I was very fortunate to get clear because I was completely helpless. (Murray Cass, pers comm)

The performance of the station continued to improve, with R31U plotted out to 235 miles on 14 November. The transmitter power on this track was increased after the response became faint at 190 miles (HRA, HQ No 13 Group Bulletin).

Dismantling of the receiver aerials of the Intermediate CH station was completed on 26 November 1943 and the Intermediate CH thereby ceased to be a stand-by equipment. Dismantling of the transmitter aerials was completed on 2 December. The dismantling



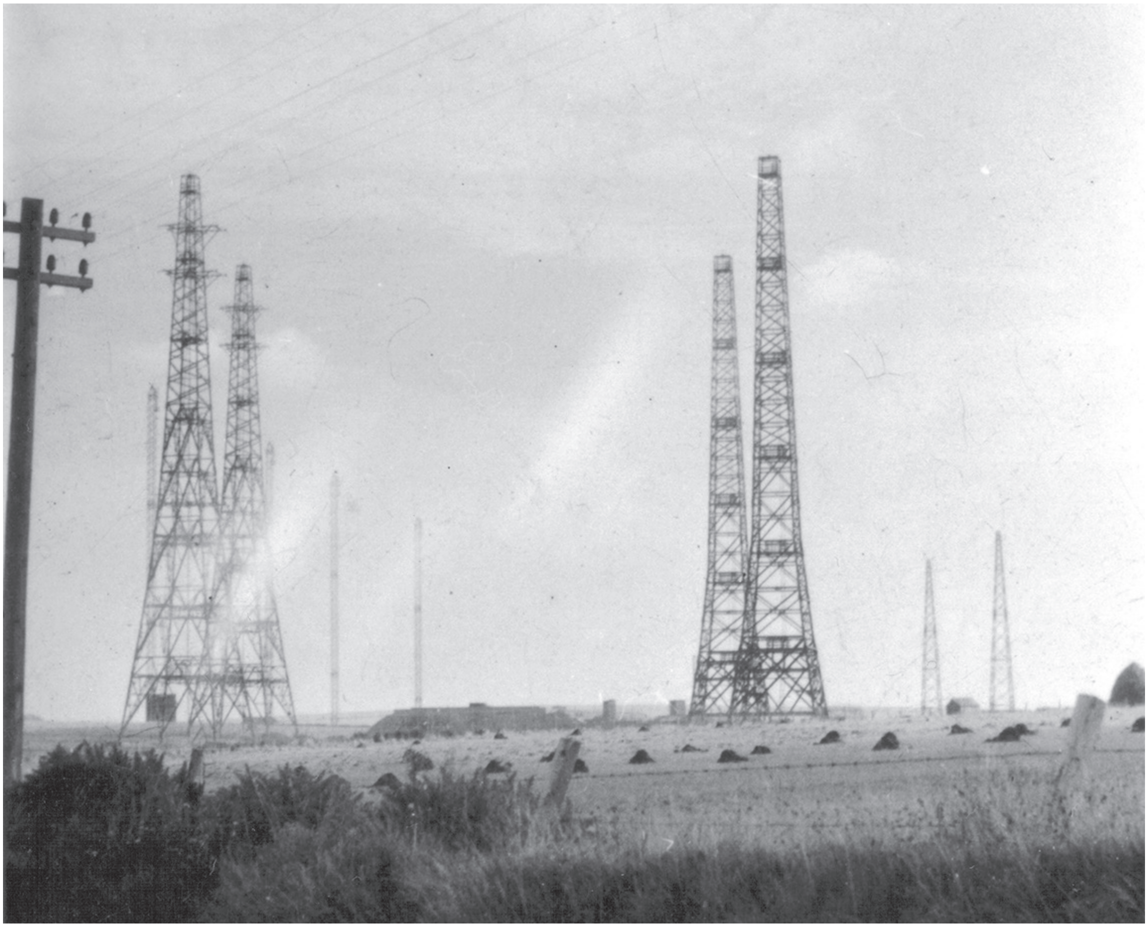
92 The four 325 foot transmitter masts at Hillhead.
(© Alan Aitken)



93 One of the four transmitter masts at Hillhead, with the guy lines just visible. (© Alan Aitken)

of the transmitter and receiver aerials on the Remote Reserve began on 14 December and was completed on 11 February 1944 (TNA, AIR 26/92).

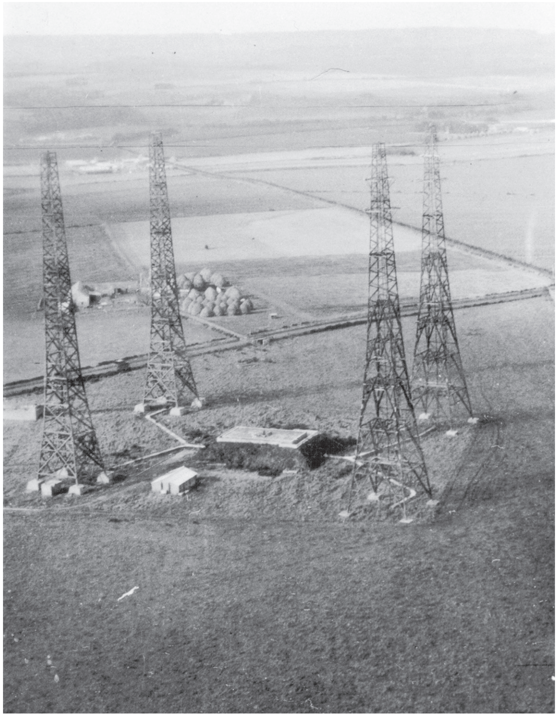
Mr Naismith of the National Physical Laboratory visited Hillhead on 14 May 1945 in connection with plans to use the station for observations of ionospheric backscatter



94 Hillhead CH station, with the four receiver towers in the foreground and the transmitter masts behind. (© Alan Aitken)

during the solar eclipse in July that year. Experiments were carried out to determine the best way of observing backscatter echoes, and a set of operational instructions were developed. During June an AMES Type 9 Mk V MRU arrived at Hillhead which would also participate in the solar eclipse observations. These were carried out from 1 to 16 July, with the eclipse itself occurring on 9 July. Readings were taken of the range, amplitude and duration of representative examples of scatter and the Type 9 equipment filmed the scatter on its trace. Analysis showed there was no noticeable decrease in scatter during the eclipse itself, although there was a decrease each day towards sunset (TNA, AIR 26/92).

Hillhead ceased operating on 15 March 1946. However, the station came back on the air between 19 and 22 March for round-the-clock observations of ionospheric backscatter. Dismantling of the station had started before the end of March 1946 (TNA, AIR 26/93).



95 Hillhead Receiver Site, photographed from one of the transmitter masts in 1944.
(© Alan Aitken)

96 One of the receiver towers at Hillhead, showing the receiver dipole aerials mounted on supports from the tower.
(© Alan Aitken)

97 Hillhead Receiver Block with a receiver tower behind, taken from underneath one of the receiver towers.
(© Alan Aitken)

98 Guard room and Air Ministry policeman at the entrance to Hillhead.
(© Alan Aitken)

Inchkeith

Type	Radar station
Subtype	CA No 2 Mk I
Region	Fife
NGR	NT 294 826
NMRS	NT28SE 5.09
In use	19 January 1944 – date unknown

A single CA No 2 Mk I set became operational in its Gibson Box on Inchkeith on 19 January 1944, covering an arc from 20° to 110°. Possibly another set was installed on the island. Certainly, in a memorandum from the War Office to Scottish Command dated 2 June 1944, it was noted:

Approval in principle is given to the execution of the Works Services required in connection with the installation of a CA No 2 Mk I equipment at Inchkeith (Radar Serial F12) at a total civil estimated cost of £748 … This approval is given on the understanding that the work will be carried out by civil labour from within your regional allocation. (TNA, WO 199/1133)

'F' Battery Fire Command Post had a CA No 2 Mk I radar installed. This set was described as covering the whole water area to a range of at least 30,000 yards under normal conditions. Its primary use was to give the Fire Commander a tactical picture of the location of all shipping in his water area (TNA, WO 192/251).

Islivig

Type	Radar station
Subtype	Chain Home Low (AMES Type 2)
Region	Lewis (Western Isles)
NGR	NB 0014 2939
NMRS	NB02NW 31
In use	24 November 1941 – 24 November 1945

Construction of a CHL station at Islivig on the west coast of Lewis began during July 1941. The station became operational, plotting via the teleprinter service from Stornoway to Inverness Filter Room, on 24 November (TNA, AIR 26/92).

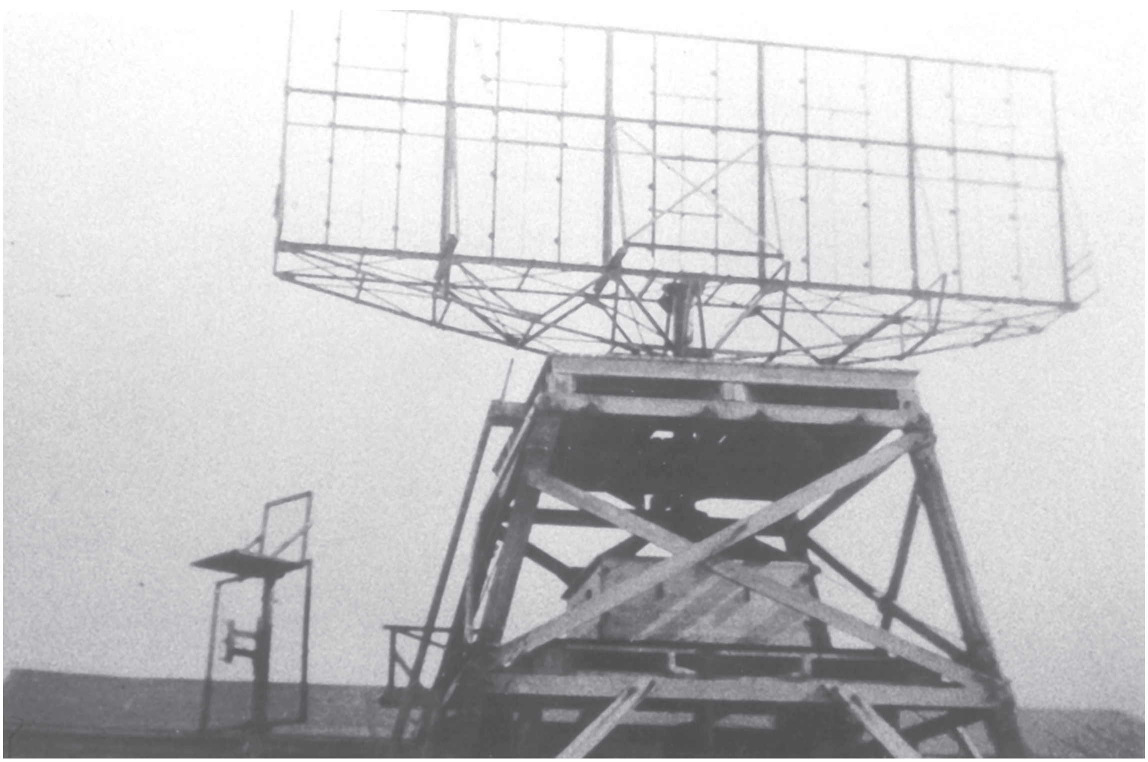
Islivig achieved a maximum range of 109 miles during December 1941 and 150 miles during January 1942. This was extended to 163 miles in February 1942 and then to 170 miles in April (TNA, AIR 26/92).

The combined domestic site for Islivig and Brenish was visited by medical staff of No 70 Wing on 6 May 1942. The site was still under construction but nearly completed, although the sick quarters were behind schedule. The biggest remaining item to be installed was the sewage works (TNA, AIR 26/92).

The station was commended by No 70 Wing during September 1942 on being the best maintained CHL station. It was to prove its value on 22 July 1943, when Islivig gave good performances on hostile aircraft. At 12.38 pm it picked up a track on 286° at 140 miles and plotted it north-east for 45 miles until it faded on 305° at 140 miles. The estimated height of the aircraft was 12,000 feet. Later that day, at 9.12 pm, another hostile was picked up on 020° at a record range for the station of 209 miles. It was plotted due west for 115 miles until it faded on 350° at 210 miles' range at 10.03 pm. The estimated height of this aircraft of 26,000 feet coincided with the filtered height. The station was congratulated by the Filter Officer on its handling of this track (TNA, AIR 26/92).

On 21 October 1943 Islivig's searchlight was first used. This light was provided to point the direction to the nearest aerodrome and thereby assist lost aircraft to land safely. At 1.53 am Bomber 542 was first plotted at 91 miles west-north-west of Islivig. The plot faded at a range of 105 miles but reappeared at 92 miles. At 2.09 am the Filter Officer requested that the searchlight be exposed because the aircraft was lost. This was duly done and the aircraft was then plotted to within 4 miles of Islivig, at which point it was directed to RAF Stornoway (TNA, AIR 26/92).

The good performances achieved by Islivig continued during November 1943, and the HQ No 13 Group Bulletin noted that: 'stations have shown several good examples of continuous tracking, including Islivig following A535 for 467 miles' (HRA, HQ No 13 Group Bulletin).



99 The CHL gantry and aerial array at Islivig, taken in 1946 when the station was on care and maintenance. (© Jim Russell)

The cover given by the Hebridean radar stations being no longer required, Islivig CHL ceased operating at 9 am on 24 November 1945 and was placed on care and maintenance (TNA, AIR 26/92).

Kendrom

Type	Radar station
Subtype	Chain Home Low (AMES Type 2), AMES Type 31
Region	Skye (Highland)
NGR	NG 4517 7376
NMRS	NG47SE 21
In use	5 February 1942 – 26 January 1944

Although construction and installation of the Kendrom station had been completed by the end of 1941, there were no communication facilities to Stornoway SFR. R/T equipment was installed during January 1942 and Kendrom CHL became operational on 5 February (TNA, AIR 26/92). This was a 1941 Type CHL, with common aerial working (a single aerial array for both transmitting and receiving) and power turning for the aerial array.

Before the end of February 1942 Kendrom had achieved a range of 114 miles and this was extended to 160 miles the following month. May 1942 saw this increased to 166 miles (TNA, AIR 26/92).

Leading Aircraftman J P Hodges was stationed at Kendrom from autumn 1942 until spring 1943. His son recalls that, although a lover of the outdoors, his father did not care for the rugged experiences of being sent to Kendrom, particularly because he was there over winter. However, the one good aspect to the posting was that it gave LAC Hodges 'overseas service' points that hastened his release after the end of the war (Mark Hodges, pers comm).

During January 1943 a CD No 1 Mk V (AMES Type 31) centimetric radar was installed at Kendrom and became operational at one minute past midnight on the morning of 1 February 1943. The crew for the new radar were drawn from other CHL stations within the area of No 70 (Signals) Wing and were given two or three days on the equipment before it became fully operational. The Type 31 covered shipping movements and also some low-flying cover over the entrance to Loch Ewe and the Minch. Plots were passed in code by R/T to Stornoway SFR and from there to Stornoway NPR. Although there were a few teething troubles with the equipment, it settled down after a few weeks and gave a satisfactory performance. However, Stornoway NPR closed down in June 1943, and consequently the Type 31 ceased operating and was put on care and maintenance that month (TNA, AIR 26/92).

Kendrom CHL ceased operating on 26 January 1944 and the homing searchlight, which had been installed for directing lost aircraft to the nearest airfield, was dismantled on 2 February (TNA, AIR 26/92).

Kilchiaran

Type	Radar station
Subtype	Chain Home Low (AMES Type 2), AMES Types 31, 52
Region	Islay (Argyll and Bute)
NGR	NR 2062 6150
NMRS	NR26SW 93
In use	11 January 1941 – 30 July 1945

Although construction of Kilchiaran CHL station had started back in 1940, it was not until 11 January 1941 that the station began passing plots by W/T to North Cairn, in code using a fictitious grid. The plots were decoded by North Cairn and passed to Preston Filter Room (TNA, AIR 29/141). The station performed well and during October 1941 plotted a friendly aircraft flying west out to a distance of 178 miles, an impressive achievement for a hand-turned, twin-gantry CHL station. Surface vessels were also plotted well, with one track in December 1942 being held for 40 miles. Large convoys were plotted by the station on 20 December (115+ vessels) and 25 December (100+ vessels) (TNA, AIR 26/103).

The new power-turned, common aerial CHL, with a single array for both transmitting and receiving, became operational during February 1943, giving excellent results straight away, with a maximum range that month of 170 miles. With the new equipment on air, the old CHL equipment was no longer needed, although it had been used as a stand-by. It closed down on 30 April and work to dismantle the equipment began on 1 May (TNA, AIR 26/103).

On 19 February 1943 a CD No 1 Mk V (AMES Type 31) centimetric radar became operational and during the rest of the month gave good ranges on surface vessels. During March the Type 31 continued to perform well and on the 24th plotted a convoy out to 56 miles at 318° (TNA, AIR 26/103).

The installation of a searchlight was completed on 25 November 1943, to be used to direct lost aircraft to the nearest suitable airfield. It was used on 12 December to point a Boeing B-17 Flying Fortress towards RAF Port Ellen. Two nights later the searchlight was used again, to direct to RAF Bowmore a Short Sunderland flying boat with only three engines running (TNA, AIR 26/103).

Due to a shortage of personnel, Kilchiaran was reduced to working on a two-watch basis from 26 June 1944 and only operated from 8 am until 11.59 pm each day. The CHL station ceased reporting at 12 pm on 7 March 1945 and was placed on Care and Maintenance Stage II, which meant that it was maintained in such a state of readiness that it could return to operations with six months' notice. However, this was balanced by the fact that an AMES Type 52 high-power centimetric radar became operational on 23 April 1945, for plotting surface vessels only. The Type 52 did not have a very long operational life, as it went off the air and was placed on care and maintenance on 12 July 1945. The Type 31 did not survive much longer, going onto care and maintenance on 30 July, and hence RAF Kilchiaran ceased all operations (TNA, AIR 26/92).

Kilkenneth

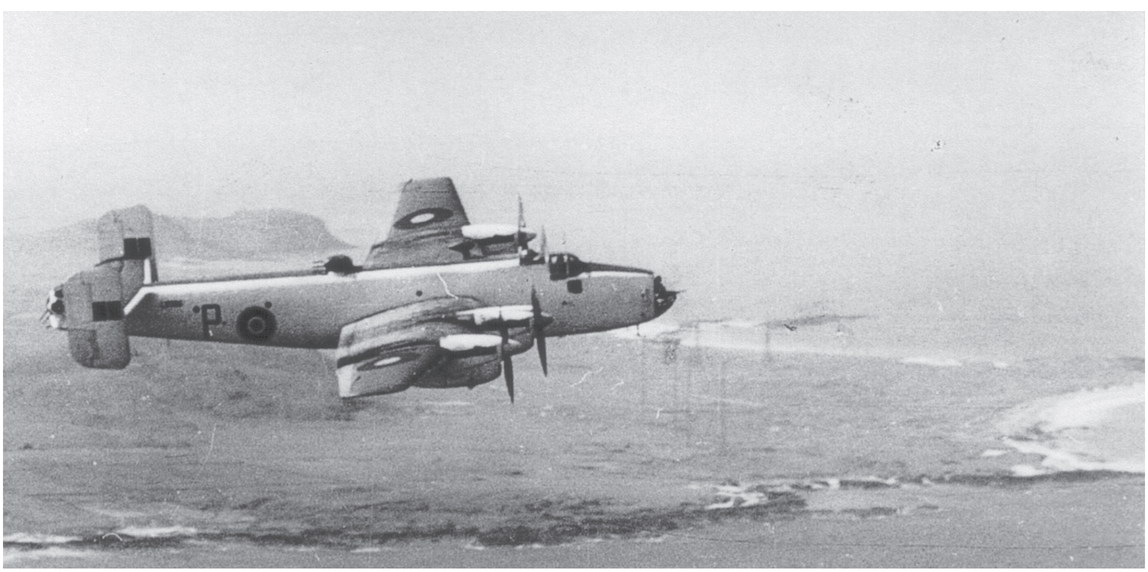
Type	Radar station
Subtype	Chain Home (AMES Type 1)
Region	Tiree (Argyll and Bute)
NGR	NL 9444 4694
NMRS	NL94NW 9
In use	8 October – later October 1942

Preliminary work on the construction of a CH station at Kilkenneth began in July 1941, and it became operational as Air Ministry Experimental Station No 82 on 8 October 1942. At the same time the Advance CH station at Port Mor was closed down and its transmitter moved to Kilkenneth, with the complete operation being carried out in under 10 hours. Reporting from Kilkenneth was by W/T to Nos 14 and 82 Group Filter Rooms (TNA, AIR 26/103).

Wylie Barrett, a Sergeant Radar Mechanic at Port Mor, recalls:

During my six months on Tiree, our ACH radar was closed out and the equipment moved into the new concrete transmitter and receiver blocks and connected to the typical aerial arrays. The two receiver towers being of wooden construction 240 feet high. The transmitter arrays were supported as curtain arrays between pairs of steel towers 325 feet in height above the ground.

Calibration flights for the new station were producing some unlikely results. At times the aircraft would disappear when, according to theoretical polar diagrams, it should not. There being no radio communications between



100 The transmitter masts and receiver towers of Kilkenneth just visible below the nose of a Handley Page Halifax of No 518 Squadron taking off from Tiree.
(© W Diamond and Mr Campbell, via Mike Hughes)

station and aircraft made it necessary to get re-runs by arrangements through Wing HQ. This introduced delays in calibration as scheduling the aircraft was difficult. So it was arranged that I would fly on the calibration aircraft and, using the T.1083 and R.1082 transmitter and receiver on the Mk IV Blenheim aircraft, communicate with the supervisor at the radar station during the calibration flights. This was a good move. We found out the mystery of the disappearing aircraft. The crew were apparently not aware of how important it was to maintain azimuth and altitude on the pre-arranged radials, and sometimes went down to get a look at a fishing boat or test the machine guns at gulls flying at little more than wave top level. (Wylie Barrett, pers comm)

Although Kilkenneth CH station only became operational on 8 October 1942, it was withdrawn from operations and placed on care and maintenance later that month. Calibration of the station continued, however, and this was completed for the main line of shoot (260°) during January 1943 (TNA, AIR 26/103). However, in November 1943 it was decided that the CH station was to be dismantled (Air Ministry, 1950 (1): 516).

Kilkenneth

Type	Radio Navigational Aid station
Subtype	Gee Slave (AMES Type 100)
Region	Tiree (Argyll and Bute)
NGR	NL 9444 4694
NMRS	NL94NW 9
In use	23 March – 1 November 1945

Kilkenneth was chosen for the site of the 'C' Slave station in the North Western Type 7000 Chain. This was the ground component of the Gee radio navigational aid system.

The station was designated Air Ministry Experimental Station No 7422 and aerial installation commenced on 8 February 1945. The main technical equipment arrived on site at 2 pm on 26 February, and installation of these two Light Transportable Type 100 sets and associated aerials was completed at 5 pm on 7 March. At 9 am the following day tests and checks began, and a period of operational testing, operating 22 hours per day, began at 2 pm on 10 March. This ran until 23 March and the station finally became fully operational at 6 pm that day (TNA, AIR 29/167).

An aircraft on a training flight to Rockall on 10 April 1945 reported on the performance of the North Western Gee Chain, commenting:

Using the North Western Chain, good signals were received up to 10° W (150 miles range), after which the 'A' signal began to weaken. Fixes were obtained, however, to within 15 miles of Rockall, a distance of over 250 miles from the stations. The aircraft was flying at a height of 2,000 feet. (TNA, AIR 29/167)

On 30 April the station Operations Record Book recorded:

So far as can be judged in the absence of any reports from users, the station has performed satisfactorily from an operational aspect … Reception of the

Master Station has been consistently good. Slight W/T and R/T interference has continued, but has not impaired operational efficiency. Repeated unserviceability of telephone lines during the month has proved a handicap, but fortunately has not caused any operational failures. (TNA, AIR 29/167)

After operating for only 7½ months, the North Western Type 7000 Chain closed down at 6 pm on 1 November 1945, and dismantling of the equipment began later that month (TNA, AIR 26/92).

Kilmacolm

Type	Radar station
Subtype	Mobile Radio Unit (AMES Type 9)
Region	Renfrewshire (Inverclyde)
NGR	NS 343 709
NMRS	NS37SW 259
In use	January – 6 May 1941

In January 1941 the C-in-C, Naval Forces, Rosyth, requested radar coverage between Glasgow and Rosyth. The Assistant Chief of the Air Staff (Radio) decided that No 237 MRU, at that time at Oban awaiting shipment to Mull, would not be shipped but transferred to the Glasgow area to fulfil the requirements of C-in-C Rosyth (TNA, AVIA 15/256).

Air Ministry Signals sent a postagram to the Deputy Director of Operations and Plans on 24 January which noted:

In order to provide RDF coverage between the Clyde and the Firth of Forth, requested by Admiralty, Air Staff have agreed to divert No 237 Mobile Radio Unit, which was to have been shipped to the Island of Mull. A site has been found Auchenbothie Farm, Kilmacolm, Renfrew … Headquarters, No 60 Group are to arrange movement of No 237 MRU from Oban to Kilmacolm and co-ordinate the erection of the station, which should be 'on the air' by 31/1/41. (TNA, AVIA 15/256)

Considerable difficulty was experienced in obtaining acceptance of Kilmacolm's plots due to the fact that the GPO was unable to provide a line to the North Western Filter Room at Preston. Lines were provided to RAF Turnhouse and RAF Prestwick, but these stations were unused to accepting unfiltered plots. As a result, no use was made of the station. However, Turnhouse and Prestwick were instructed to make use of Kilmacolm plots and to ensure that the information was passed to Rosyth (TNA, AIR 2/4489).

Frank Boyanoski, a Canadian RDF Mechanic, recalls:

I and Geb Hammond were posted to Kilmacolm where we arrived on April 5, '41. There was no radar station in Kilmacolm. It was the place where equipment and personnel were being assembled for a mobile radar unit. We were billeted in the basement of the Kilmacolm Hydro with the service staff. The equipment as I remember was located in two large trailers. The 75' mast was two or three parts on another 4-wheeled trailer.

The radar equip't was of the CHL type with the standard transmitter about 15,000 volts and standard receiving equipment. The antenna mounted on the mast was ½ wave dipole with a ½ wave reflector activated by a sensing relay …

We were at Kilmacolm for about a month. It was quite enjoyable. Geb Hammond and I visited all the towns along the Clyde from Paisley to Gourock! I remember the night that 'Gerry' bombed the Clydeside. Geb and I were on the roof of the hotel. The moon was quite bright so we had quite a good view. The German bombers, after dropping their loads, flew just over the treetops to avoid the searchlights. Pieces of shrapnel were dropping on the roof but no-one was hurt. Geb & I also went skating in the Paisley rink. On the 26th of April we left Kilmacolm for 'Bonnie' Tiree. (Frank Boyanoski, pers comm)

A further postagram from Air Ministry Signals dated 28 April 1941 advised:

Reference is made to our postagram dated 24th January 1941, which announced the erection of a mobile radio unit in the Glasgow area. This station has been operating now for approximately 3 months and experience has been gained of its operational use. It has been decided that owing to the impossibility of providing telephone lines to a proper filter room the station is not serving a useful purpose. Will 60 Group please arrange for the removal of the station. (TNA, AVIA 15/256)

At 2 am on 5 May 1941, during an air attack on Clydeside, German bombers passed over Kilmacolm and dropped a high explosive bomb of approximately 250 kg about 150 yards from the radar station. It was accompanied by a shower of incendiaries which fell in and around the station, but fortunately led to no damage and no casualties (TNA, AIR 26/103).

RAF Kilmacolm was disbanded on 6 May 1941 and all the equipment was moved to No 72 Wing Headquarters for safe custody. That night the former site of the station was again heavily showered with incendiaries (TNA, AIR 26/103).

Kincraig

Type	Radar station
Subtype	CA No 1 Mk II
Region	Fife
NGR	NT 4660 9975
NMRS	NT49NE 44.01
In use	September 1942 – October 1956

On 11 November 1941 the Siting Committee meeting agreed on a CA Mk I set for the Forth, and a site was chosen at Kincraig Battery. It was selected as equally suitable for 150 cm and 10 cm operation, it being satisfactory from all points of view (TNA, AVIA 7/3407).

In September 1942 the CA No 1 Mk II set (No 16) at Kincraig, designated B14, was completed. The Kincraig equipment gave ranges on surface vessels of up to 35,000 feet and was used for fire control for the 6-inch BL Mk VII guns on Mk V mountings at Kincraig Battery (TNA, WO 192/255).

Kincraig Battery remained in use until placed on care and maintenance in October 1950. It continued to be used for training by units of

101 Kincraig CA No 1 Mk II Fire Control radar just to left of centre of the photograph, with the paraboloid aerials visible on the roof of the T & R Block.
(© The National Archives WO 192/255)

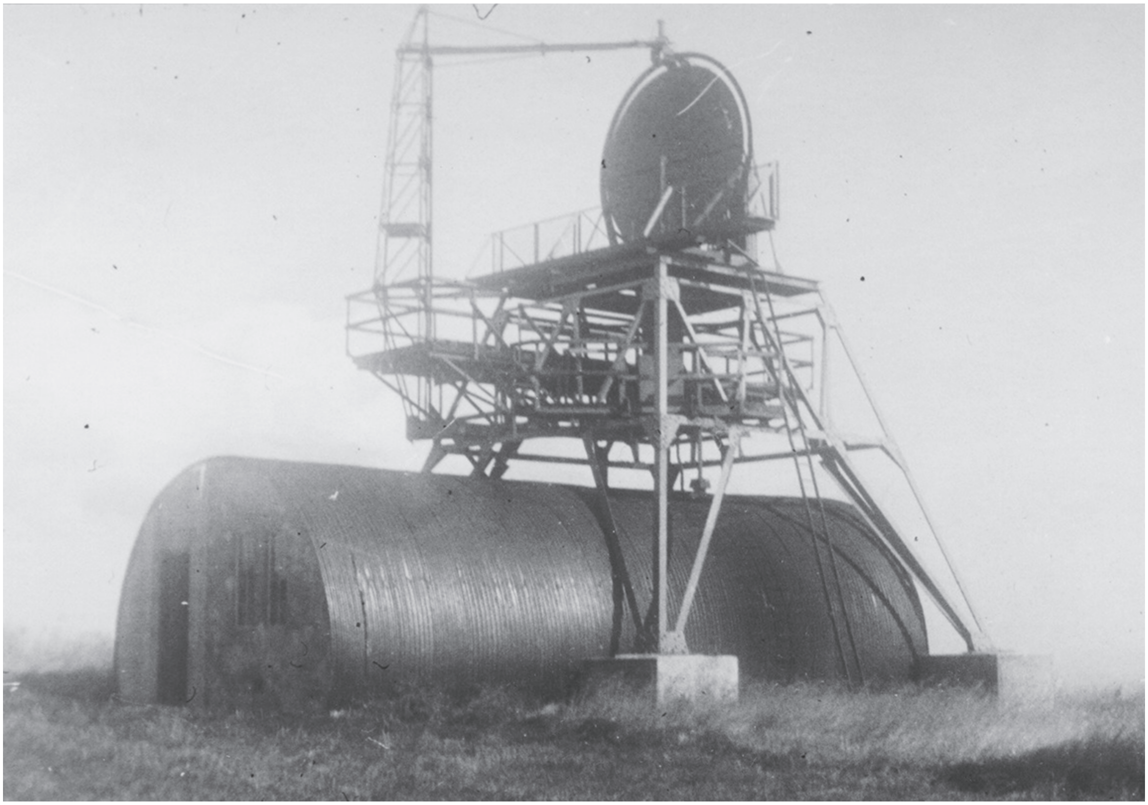
414th Coast Artillery (Forth) Territorial Army. Kincraig finally closed in October 1956, and amongst the equipment sold for scrap was the CA No 1 Mk II radar (Barclay and Morris, 2019: 222).

Lamberton Moor

Type	Radar station
Subtype	CD No 1 Mk V (AMES Type 31), CD No 1 Mk VI (AMES Type 52)
Region	Berwickshire (Scottish Borders)
NGR	NT 9611 5837
NMRS	NT95NE 28
In use	1 January 1943 – 15 March 1946

On 1 January 1943 Lamberton Moor, designated station K156, became operational. The station was equipped with CD No 1 Mk V low-power surface watching radar, with an arc of sweep of 330°–0°–140°. MTB coverage was given as 340°–130° (TNA, WO 199/535). The equipment was taken on charge by 505th Coast Regiment, Royal Artillery, and maintained by the Royal Army Ordnance Corps. The station itself was manned by 88th Coast Observer Detachment (TNA, WO 199/532).

The RAF took over Lamberton Moor from the Army on 6 August 1943 (TNA, AIR 26/103). The CD No 1 Mk V radar (known to the RAF as Type 31) was replaced by a higher-power set, the Type 52, which became



102 Lamberton Moor Type 52 radar, photographed in August 1945.
(© Gerry Funston)

operational at 11.59 pm on 20 June 1944. The new radar was initially plotting on surface vessels only, until an aircraft plotting line could be laid to Cockburnspath. This was installed on 11 September. The Type 31 was removed and sent to No 9 Radio School at Yatesbury in Wiltshire for training purposes in July (TNA, AIR 26/92).

Leading Aircraftman Gerry Funston was an RCAF Radar Mechanic at RAF Lamberton Moor from June 1944 until August 1945. He recalls that, on his arrival,

The station had just been newly commissioned. Both the building and the equipment seemed spotlessly new. I know, initially, I spent a lot of my time preparing board racks to hold tools & spare parts. Also, there was a fair bit of cleaning up & organising of inventory to be done …

German air-raid activity … was minimal in 1944. An occasional 'Weather Willie' would probe the area from bases in Norway. As a result most of the effort was directed to tracking friendly aircraft and surface vessels plodding up and down the east coast …

The unpredictable nature of the North Sea weather created a couple of memorable incidents. One afternoon, with the hilltop buried in fog, a fighter from nearby Charterhall airfield … was returning to base. Its track, being plotted by Lamberton, was bringing it directly over the station. Suddenly, those of us on duty heard a tremendous bang. The plane had been flying too

103 Lamberton Moor, photographed from the gantry of the Type 52 radar in August 1945.
(© Gerry Funston)

104 Gerry Funston in front of the Type 52 radar (note the gantry leg and base on the right) at Lamberton Moor, August 1945.
(© Gerry Funston)

low and had hit the hilltop, just to the north of the station. It missed the Tech Site by about 25 yards and the Living Site and neighbouring farmhouse by an even narrower margin. The pilot was killed outright. The only other casualty was a dead cow. If the plane had been 25 feet higher, it would have cleared the hill. But, if his path had been a little further south, a lot of us would have met a premature end.

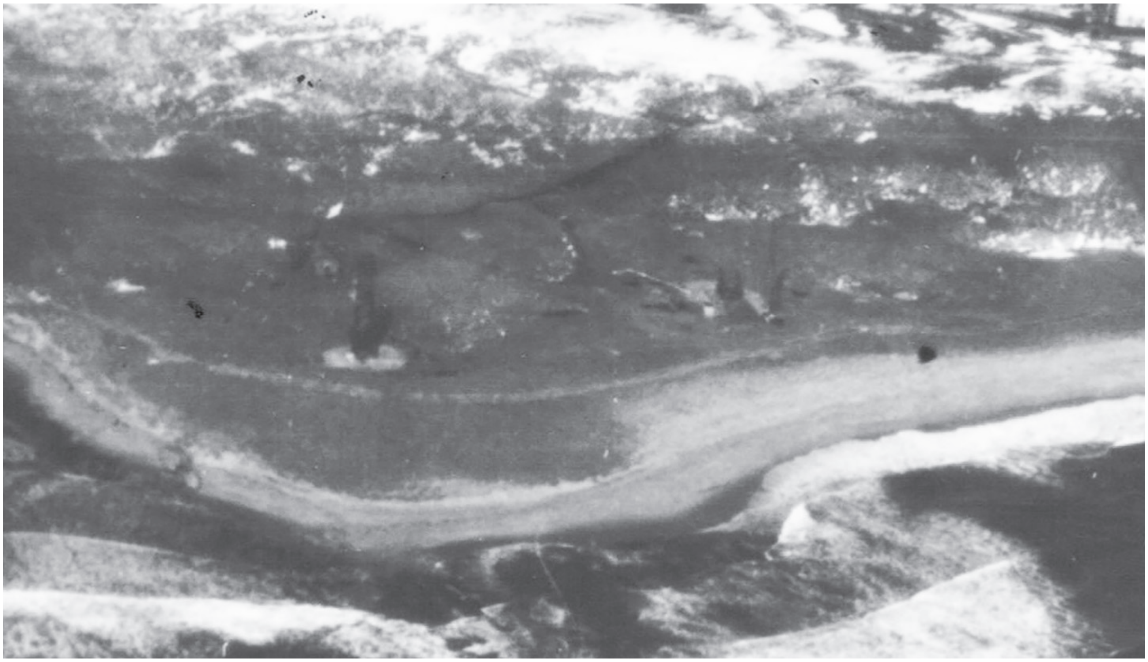
On the second occasion, in the winter of 1944/45, gale warnings were received from Wing. Eddie and I proceeded to 'lash' the aerials in a fixed seaward mode – a standard exercise with all rotating aerials in this weather. Knowing that, under such conditions, the regular mains power might fail and that we might have to start-up the stand-by diesel, Eddie and I stayed up that night, in the billet, fully clothed. If the lights went out, that was our signal to head for the diesel hut. Sure enough, about 11.30 pm the power failed and we struggled up to the diesel, leaning about 45° into the 60 to 70 mph blizzard. After getting the diesel going and the station back on the air, we checked out the Tech hut. All was okay. So, we thought we should take a look at the tool and parts shed, about ten yards away. The door, which due to bad planning, was on the seaward side of the shed, had blown open. Everything was covered with snow. We made a valiant effort to close the door from the inside. Why we don't know, because it opened inwards. Finding it impossible, we stopped for breath and looked up. Even in the stormy darkness of the night, we could see the corrugated tin roof had blown off. Next morning, after the storm had died down, we walked back up to the Tech Site. There, just to the right of the path we had used the previous night and a few yards from the diesel hut, was the tin roof. I still wonder when it blew off and how close we came to being sliced in half. (Gerry Funston, pers comm)

With the closure of Pitreavie NPR, Lamberton Moor ceased plotting surface vessels at 12 pm on 26 May 1945, although a full watch on aircraft continued (TNA, AIR 26/92). In order to economise in personnel, it was decided to house the Lamberton Moor staff at Drone Hill, and the move was completed on 4 March 1946. This was merely the beginning of the end: on 15 March information was received that No 13 Group Filter Room was closing down, and Lamberton Moor ceased reporting at 4.30 pm on that date (TNA, AIR 26/93).

Loth

Type	Radar station
Subtype	Chain Home (AMES Type 1)
Region	Sutherland (Highland)
NGR	NC 9659 1026
NMRS	NC91SE 32
In use	27 February 1941 – 26 April 1944

A survey party examined a site near Loth station in the spring of 1940 with a view to placing an Advance CH station there with an MB1 transmitter on a line of shoot of 138° (TNA, AVIA 7/257). Flight Sergeant Roberts proceeded to Air Ministry Experimental



105 Loth from the air, taken on 29 March 1941, with one tower built and a second just started to the right. (© Historic Environment Scotland)

Station No 48, Loth, on 22 February 1941 in order to open the station (TNA, AIR 26/92), which became operational on 27 February (HRA, RDF in Northern Scotland and the Islands).

Alteration of the line of shoot was carried out between 20 and 26 June 1941, being changed from 138° to 90°. The station achieved a maximum range of 130 miles on 22 October 1941, on track X211, improving on this a few days later with a range of 147 miles on 2 November on Hostile 213 (TNA, AIR 26/92).

Construction began of a permanent station and by the end of March 1942 the technical buildings were built and ready for equipment installation. The receiver and transmitter aerial arrays were erected during March, but the lack of power supply to the station was holding up work. In May, Loth began operating on the main supply and was, in fact, the most northerly point of the British Isles drawing power from the National Grid. The transmitter power was raised by over 50% at the same time, not because of the power supply, but due to conversion to VT114 output valves. This resulted in considerable improvement in performance (TNA, AIR 26/92).

The first WAAFs arrived at Loth in April 1942 (TNA, AIR 26/92). Betty Hogg, who was stationed there soon afterwards, recalls her time as a Radar Operator at Loth:

I was posted to Loth CH in the autumn of 1942 straight from training at Yatesbury. At that time it was a mobile station – a caravan type ops room with manual conversion.

Our main concern seemed to be looking after the learner pilots training on the Moray Firth; 'Weather Willies' – meteorological flights – as far as we could keep them in sight. The lobes must *have been right as we could keep plotting almost to the end of the trace …*

There was always the possibility of air reconnaissance or attack to watch for, but my main memory is of acting as sheepdog & rescuer of the learners who could so easily get lost on first solo flights & would circle & circle & end up in the sea.

The new ops block and towers were in preparation & there was a celebration when we moved into more up to date working conditions – plenty of room and best of all a calculator. The calibration of the new set up was very exciting indeed. (Betty Hogg, pers comm)

Loth Final CH was declared operational at 5.05 pm on 10 October 1942, but reports for the remainder of the month did not indicate a satisfactory standard of performance (HRA, Paul Carment, diaries; TNA, AIR 26/92).

Betty Hogg adds:

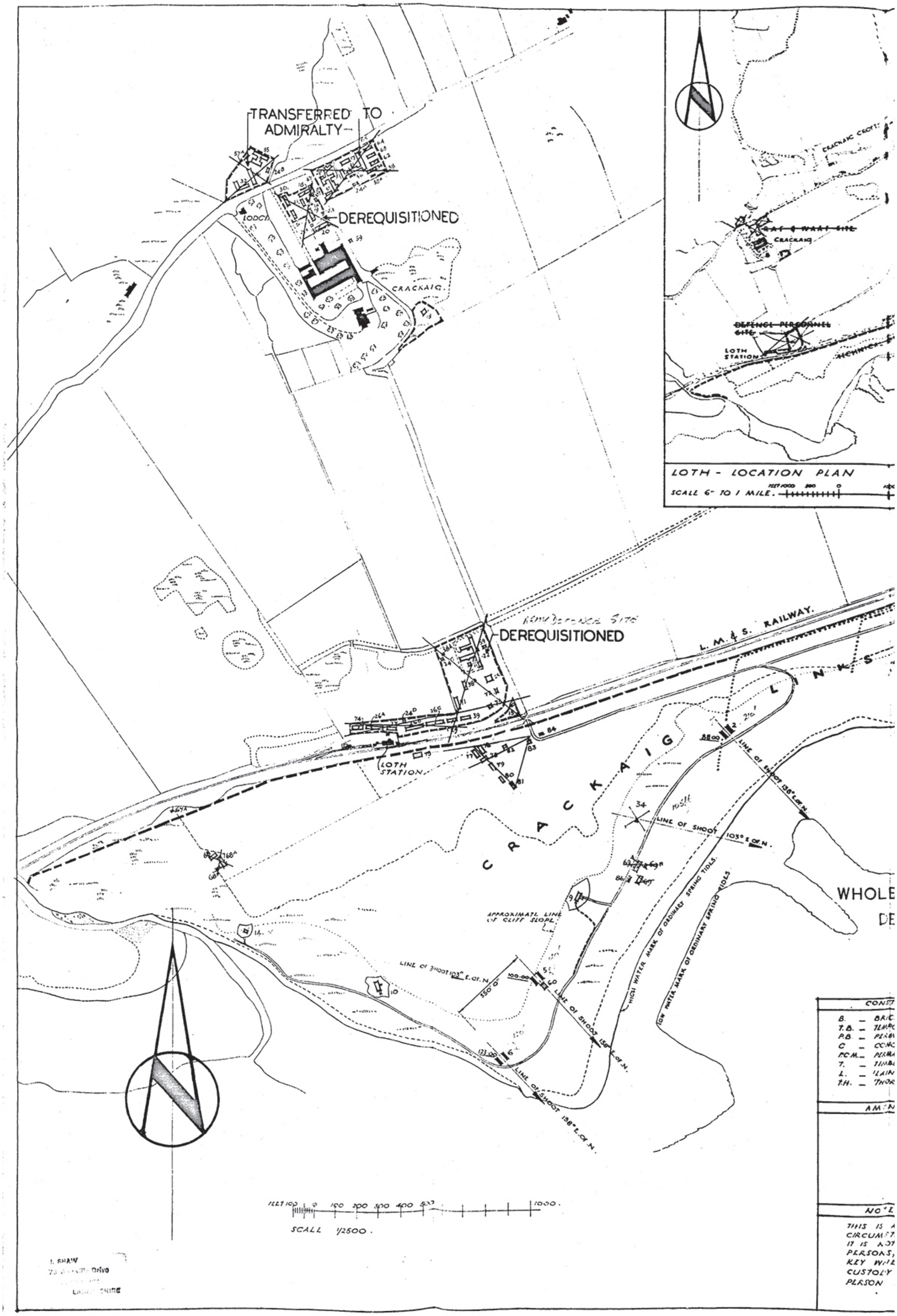
The old mobile was used as stand-by for emergencies & maintenance. When this occurred one operator and one mechanic were despatched with all speed up through the sand dunes. I think we had 5 minutes to do the run & get the generator going & be on the air. Since this seemed to happen at night we had to run the gauntlet of the MPs patrolling the grounds, waiting to challenge any untoward activity. We had a password & found ourselves panting words like 'caterpillar' out loud so that we wouldn't have to waste precious time … The only real excitement – ops wise – was a prolonged show of interference on the tube – not one seen before. This caused much consternation & consultation with HQ. (Betty Hogg, pers comm)

On 26 April 1944 Loth CH station went off the air and was placed on care and maintenance. The station was taken over by No 70 Wing Equipment Section. Loth was also used from February 1945 as the school for all training within No 70 (Signals) Wing area (TNA, AIR 26/92).

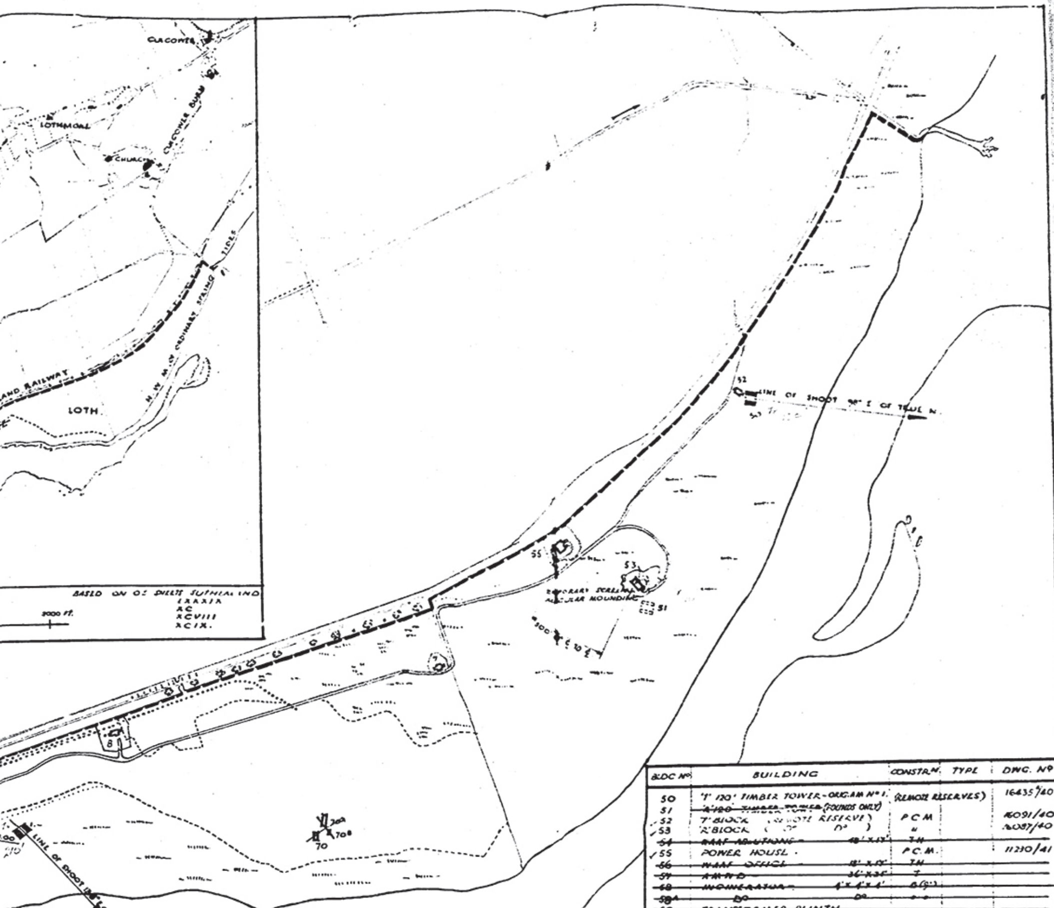
Meg Butler was a Corporal Radar Operator at Douglas Wood CH station:

*In May 1945 several of us from Dougie Wood were sent on a technical course at Loth. Now the European war was over, but of course conflict continued in the Far East, so I suppose there was some purpose in it … The station at Loth was the Wing Stores Depot, so everything in the way of food and accommodation was of the very best. The NCO i/c the catering for the Mess was a trained chef and the food was something to be savoured. We were billeted in what had been a holiday camp. Log cabins with all mod con. (*Meg Butler, pers comm)

During June 1945 several experimental sets were established at Loth by the National Physical Laboratory in connection with observations of backscatter during the solar eclipse on 9 July 1945. Loth was transferred from care and maintenance to caretaking during August and this saw the end of the station's life. The last training was completed on 21 August and the school, along with the Equipment Section Detachment, moved to No 70 Wing Headquarters at Tealing before the end of the month (TNA, AIR 26/92).



106 Loth site plan. (© Historical Radar Archive)



SCHEDULE OF BUILDINGS.

BLDG Nº	BUILDING	CONSTRN	TYPE	DWG. Nº
1	'T' 210' TIMBER TOWER. EX. 240'			3869/40
2	'T' 210' TIMBER TOWER. Dº			3889/40
3				
4				
5	'R' 120' TIMBER TOWER.			16435/40
6	'R' 120' TIMBER TOWER.			16435/40
✓7	'T' BLOCK.	P.C.M.		16091/40
8	'T' BLOCK.	"		16091/40
✓9	'R' BLOCK.	"		16087/40
10	'R' BLOCK.	"		16087/40
11				
12				
13	STANDBY SET HOUSE.	P.C.M.		3017/41
14	SUB-STATION.	"		1137/41
~~15~~	~~WATCH HUT~~	~~L~~		~~1148/41~~
~~16~~	~~OFFICERS QUARTERS. R.A.F.~~	~~L~~		~~1148/41~~
~~17~~	~~SICK QUARTERS W.A.A.F.~~			~~[illegible]/40~~
~~18~~	~~BARRACK HUT R.A.F.~~	~~L~~		~~1148/41~~
~~19~~	~~BARRACK HUT R.A.F.~~	~~L~~		~~1148/41~~
~~20~~	~~BARRACK HUT R.A.F.~~	~~L~~		~~1148/41~~
~~21~~	~~BATHS & ABLUTIONS~~	~~L~~		~~1148/41~~
~~22~~	~~DINING RM. INSTITUTE, ETC.~~	~~L~~		~~1149/41~~
~~23~~	~~FUEL COMPOUND~~			
~~24~~	~~FIRE FIGHTING TANK~~			~~WA15/278~~
~~24A~~	~~Dº Dº Dº Dº~~			~~WA15/278~~
~~24B~~	~~Dº Dº Dº Dº~~			~~WA15/278~~
~~24C~~	~~Dº Dº Dº Dº~~			~~WA15/278~~
~~24D~~	~~Dº Dº Dº Dº~~			~~WA15/278~~
~~25~~	~~M.T. BUILDING~~	~~T~~		~~1148/41~~
~~26A~~	~~MOTOR CYCLE SHED~~	~~T~~		
~~26A~~	~~BARRACK HUT~~	~~L~~		~~1148/41~~
~~26B~~	~~BARRACK HUT Dº~~	~~L~~		~~1148/41~~
~~26C~~	~~BARRACK HUT Dº~~	~~L~~		~~1148/41~~
~~27~~	~~ABLUTIONS & BATH.~~	~~L~~		~~1148/41~~
~~28~~	~~DINING RM. INSTITUTE~~	~~L~~		~~1148/41~~
~~29~~	~~ADMINISTRATIVE BLK. & ORDERLY RM.~~	~~L~~		~~1148/41~~
~~30~~	~~SICK QUARTERS R.A.F.~~	~~L~~		~~1148/41~~
~~31~~	~~W.A.A.F. QUARTERS. ETC.~~	~~L~~		~~1148/41~~ 3771/41
~~32~~	~~OFFICERS' MESS. R.A.F.~~	~~L~~		~~1148/41~~
33	COMBD. T.&R. CUBICLE ~~& 105' TIMBER GUYED MAST~~ (FOUNDS. ONLY)	P.B.		8872/41 15046/41
34	Dº Dº Dº & 105' TRANSPORTABLE TIMBER GUYED MAST	P.B.		8872/41 15046/41 8665/41
~~35~~	~~W.A.A.F. OFFICERS' MESS & QUARTERS~~	~~L~~		~~2047/41~~
~~36~~	~~SITTING SHELTER (CONVERTED INTO TEMPORARY UNMOUNDED DECONTAMINATION CENTRE)~~			
~~37A~~	~~AIR RAID SHELTER~~	~~STIRLING~~		~~WA15/155~~ 139/41
~~37B~~	~~Dº Dº~~	~~"~~		~~WA15/155~~ 139/41
~~38A~~	~~Dº Dº~~	~~"~~		~~WA15/155~~ 139/41
~~38B~~	~~Dº Dº~~	~~"~~		~~WA15/155~~ 139/41
~~39~~	~~EQUIPMENT STORE~~			~~WA15/298/41~~

BLDG Nº	BUILDING	CONSTRN	TYPE	DWG. Nº
50	'T' 120' TIMBER TOWER - ORIGAM Nº 1. (REMOTE RESERVES)			16435/40
51	~~'R' 120' TIMBER TOWER~~ (FOUNDS ONLY)			
✓52	'T' BLOCK (REMOTE RESERVE)	P.C.M.		16091/40
✓53	'R' BLOCK (Dº Dº)	"		16087/40
~~54~~	~~W.A.A.F. ABLUTIONS~~	~~TH~~		
✓55	POWER HOUSE.	P.C.M.		11230/41
~~56~~	~~W.A.A.F. OFFICE~~	~~TH~~		
~~57~~	~~A.M.W.D.~~	~~T~~		
~~58~~	~~INCINERATOR~~			
~~58A~~	~~Dº Dº~~			
~~59~~	~~TRANSFORMER PLINTH~~			
60	ADVANCED CH STATION - 'T' HUT			
~~61~~	~~ADVANCED CH STATION - 'R' HUT~~			
~~62~~	~~BARRACK HUT (WAAF)~~	~~TH~~		
~~63~~	~~Dº Dº Dº Dº~~			
~~64~~	~~Dº Dº Dº Dº~~			
~~65~~	~~CYCLE STORE~~		~~FOR 12~~	
~~66~~	~~CYCLE STORE~~			
~~67~~	~~G.P.O. PILL BOX~~			~~18450/40~~
67A	Dº Dº	"		18450/40
~~68~~	~~MESS, KITCHEN, ABLUTIONS & DRYING RM.~~	~~HUTTING~~	~~1/15~~	~~WA15/213/41~~
~~68A~~	~~BARRACK HUT~~			~~WA15/213/41~~
~~68B~~	~~LATRINE & STORE~~			~~WA15/213/41~~
~~69~~	~~MESS, KITCHEN, ABLUTIONS & DRYING RM.~~		~~1/15~~	~~WA15/213/41~~
~~69A~~	~~BARRACK HUT~~		~~1/15~~	~~WA15/213/41~~
~~69B~~	~~LATRINE & STORE~~			~~WA15/213/41~~
~~70~~	~~MESS, KITCHEN, ABLUTIONS & DRYING RM.~~		~~1/15~~	~~WA15/213/41~~
~~70A~~	~~BARRACK HUT~~		~~1/15~~	~~WA15/213/41~~
~~70B~~	~~LATRINE & STORE~~			~~WA15/213/41~~
~~71~~	~~BARRACK HUT~~	~~TH~~		
~~72~~	~~M.T. OFFICE~~			
~~73~~	~~FIRST AID HUT~~			
~~74~~	~~A.M.W.D. STORE~~			
75	ARMY GUARD HUT 36' X 25'	HUTTING		
~~76~~	~~BARRACK HUT~~			~~WA15/214/41~~
~~77~~	~~Dº Dº~~			~~WA15/214/41~~
~~78~~	~~DINING ROOM~~			~~WA15/214/41~~
~~79~~	~~KITCHEN & DRYING RM.~~			~~WA15/214/41~~
~~80~~	~~OFFICERS QUARTERS~~			~~WA15/214/41~~
~~81~~	~~FIRST AID HUT~~	~~N~~		
~~82~~	~~LATRINE~~	~~N~~		
~~83~~	~~STORE~~	~~N~~		
84	ARMY GUARD HUT. 10' X 10'	HUTTING		
~~85~~	~~Dº Dº Dº~~			
86	CYCLE STORE - 7'9" X 21'6"		FOR 12	
~~87~~	~~105' TIMBER GUYED MAST~~			
~~88~~	~~Dº Dº Dº Dº~~			

BASED ON WORKS AREA DRG WA15/366/42.

OF TECHNICAL SITE

REQUISITIONED 6-2-54.

...UCTION ABBREVIATIONS

...RARY BRICK BUILDING.
...ANENT Dº Dº
...RETE
...NENT CONCRETE BUILDING MOUNDED.
...R HUTTING
...' Dº
...' Dº

...DMENTS

... SECRET DRAWING. UNDER NO ...ANCES MUST IT BE REPRODUCED. ... TO BE SEEN BY UNAUTHORISED ... MUST BE KEPT UNDER LOCK & ...N NOT IN USE & ITS SAFE ... IS THE RESPONSIBILITY OF THE ...O WHOM IT IS ISSUED.

LOTH (A.M.E.S. I).

RECORD SITE PLAN.

SCALE = 1/2500

	SECRET No.	D.G. of W.
S.E.		W.A.15/277/44.
No 15 WORKS AREA H.Q. C.S.W. [illegible]-2-44		AIR MINISTRY.

Machrihanish

Type	Radar station
Subtype	Ground Control of Interception (AMES Type 8A)
Region	Argyllshire (Argyll and Bute)
NGR	NR 6692 2041
NMRS	NR62SE 34
In use	May 1943 – date unknown

Machrihanish (also known as Loch Sanish) was an Intermediate GCI erected near to RNAS Machrihanish. Although the radar was operated by Naval personnel, installation was carried out by RAF staff of No 72 (Signals) Wing. This work began in March 1943 and was completed, with the station becoming operational, in May (TNA, AIR 26/103).

The radar was used for training purposes, allowing aircrews to carry out practice interceptions. To improve the performance of the station the R3101 receiver was converted to an R3202 during August 1945 (TNA, AIR 26/92). It has not been possible to establish exactly when the station closed down.

Mangersta

Type	Radio Navigational Aid station
Subtype	Loran (AMES Type 700)
Region	Lewis (Western Isles)
NGR	NB 0047 3325
NMRS	NB03SW 49
In use	6 March – June 1944, 10 July 1944 – June 1946

Early in 1943 the Admiralty requested the construction of a Loran chain covering the north-eastern Atlantic to provide long-range navigational assistance to North Atlantic and Arctic convoys. It was agreed at a meeting of the Combined Chiefs of Staff in Washington that a three-station chain in the north-east Atlantic would be established, with the Royal Navy constructing, maintaining and supplying the stations and the US Navy providing the Loran equipment. The North East Atlantic Loran Chain consisted of Skuvanes Head, Faroe Islands (Master); Vik, Iceland (Slave); and Mangersta on Lewis (Slave) (Willoughby, 1957: 155–6).

Three US Coastguard personnel assisted with the construction of the station at Mangersta, which was carried out at the start of 1944 (Willoughby, 1957: 156), and the North East Atlantic Chain became operational on 6 March 1944. From 1 May two squadrons of Coastal Command, No 59 Squadron based at Ballykelly and No 518 Squadron based at Tiree, began using the new Loran chain. It proved of great value to the navigators from these squadrons but was switched off just before

107 General view of Mangersta, taken in 1956.
(© Bill Smith)

108 Mangersta, taken in 1956, showing the main technical building.
(© Bill Smith)

the Normandy landings in June 1944, and did not come back on air until 10 July, and then only at the request of Headquarters, Coastal Command (Air Ministry, 1956: 205–6).

At the end of the war in Europe in May 1945, both Coastal Command and Transport Command, as well as US units, were keen to keep the North East Atlantic Loran Chain operational, and it remained so until being handed over to the Ministry of Civil Aviation in June 1946 (Air Ministry, 1956: 207–8).

May Island

Type	Radar station
Subtype	CD No 1 Mk V (AMES Type 31, Naval Type 271P), AMES Type 41 (Naval Type 271Q)
Region	Fife
NGR	NT 6563 9939
NMRS	NT69NE 16
In use	spring 1942 – 1946

May Island was an Admiralty radar station, designated K155, equipped with Naval Type 271P (CD No 1 Mk V or AMES Type 31) (Air Ministry, 1950 (1): 634), operational from spring 1942. This surface watching radar was used to detect shipping or surfaced U-boats attempting to enter the Firth of Forth by night or in poor visibility, in conjunction with the indicator loop across the seabed of the Forth which could detect metal ships passing overhead (William Pettifer, pers comm).

William Pettifer, a signalman on May Island from December 1941 to mid-1944, recalls that the Type 271P:

almost certainly arrived on a landing craft supply boat … and was … manhandled up the hill to the concrete base to the east of the signal station.

It had one revolving dish-type aerial which I believe was rotated by hand … The portable radar cabin had been in operation some time when the brick-built operations room was erected … I do recall the supply landing craft arriving with building materials. (William Pettifer, pers comm)

The brick operations room mentioned appears to have been for the Type 271Q (AMES Type 41), a medium-power version of the low-power Type 271P, although both radars appear to have continued in use, rather than the new equipment replacing the earlier version. Lieutenant Commander Rolf Griffiths, CO Anti-Submarine Fixed Defences, May Island, from January 1945 to February 1946, recalls 'two prehistoric radar sets' on the island. He also remembers one particular incident:

When my Radar PO [Petty Officer] was hurt by a fall and hospitalised ashore I had to make an urgent signal to the C-in-C, Rosyth, for a relief who arrived the next morning: [Mary Cochrane,] a gorgeous blonde who reported to me as my new PO Radar. When I could get my breath I enquired about her experience, to be told that she was reading for her mathematical Tripos at Girton, when the Admiralty put its finger on her, gave her a six months' crash course in radar, and there she was. Having a sex-starved ship's company and no Wrennery, I had to make her a guest of the Wardroom Mess, with my wife as chaperone, to the great satisfaction of my junior officers. (Rolf Griffiths, pers comm)

Although the station was tasked with the plotting of surface vessels, it was also capable of detecting aircraft. In fact, Walrus amphibious aircraft from RNAS Crail were used for calibration flights and on 19 June 1944 the radar detected a low-flying aircraft 60,000 yards east of May Island (HRA, No 5 Log Book).

It is not known exactly when May Island radar closed down, but it was certainly still operating in early 1946 (Rolf Griffiths, pers comm).

109 Petty Officer Mary Cochrane, the Wren described by Rolf Griffiths.
(© Ron Morris Collection)

Navidale

Type	Radar station
Subtype	Chain Home Low (AMES Type 2), AMES Type 31
Region	Sutherland (Highland)
NGR	ND 0375 1580
NMRS	ND01NW 32
In use	27 August 1941 – 8 February 1944

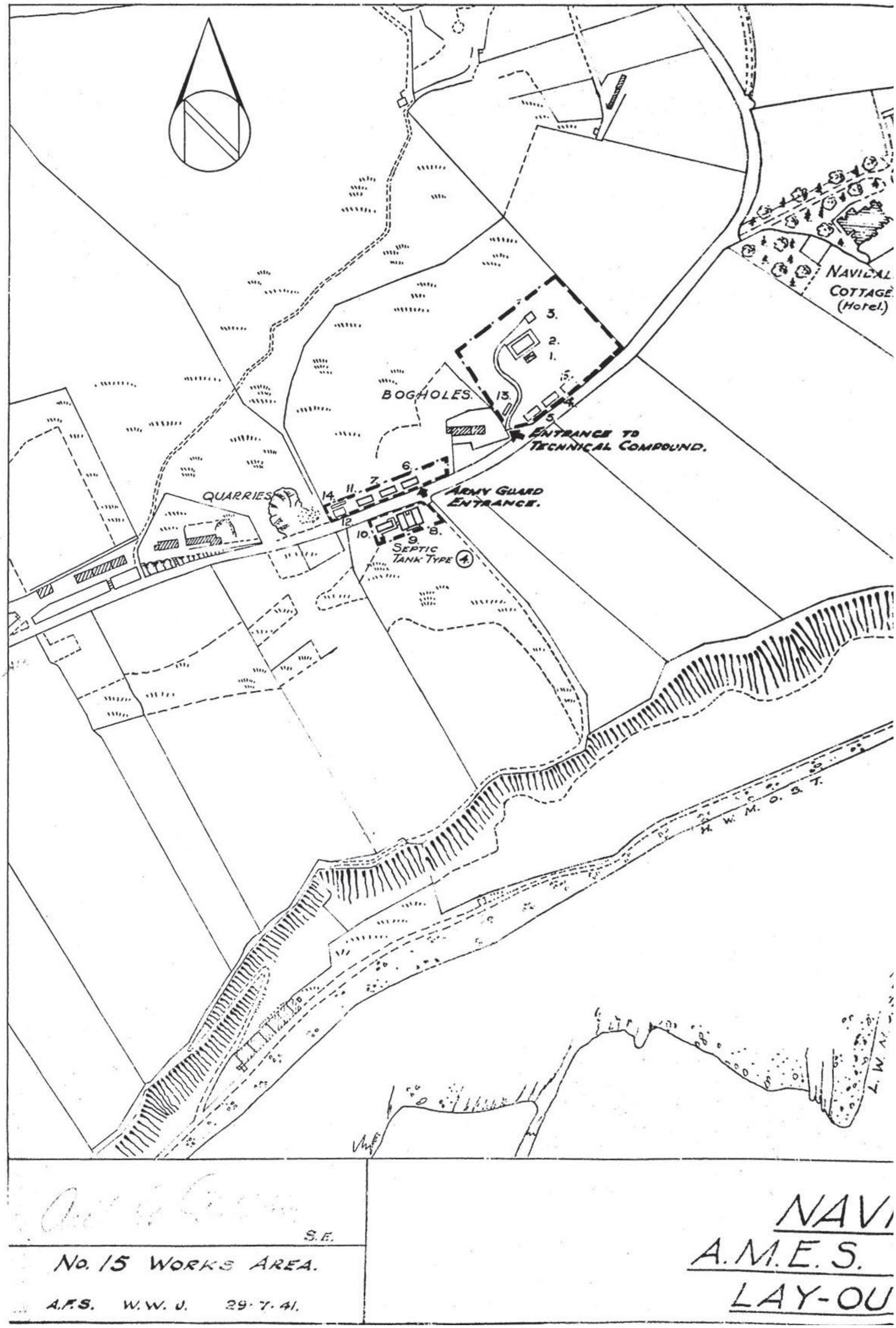
On 21 June 1941 the transmitter and receiver were delivered for the CHL being built at Navidale. They were installed on 5 July and the aerial gantry was erected on the 17th (TNA, AVIA 7/372). Following a few teething troubles with the generators, Navidale began operations on 27 August as a 1941 Type, common aerial working, power-turned CHL. The station was performing satisfactorily, achieving a maximum range in October 1941 of 120 miles, extended slightly the following month to 126 miles and again in December to 132 miles. January 1942 saw further improvement with a maximum range of 141 miles, followed by 164½ miles in February and another month of improvement in March, which took the maximum range achieved to 180 miles (TNA, AIR 26/92).

By October 1942 the majority of Radar Operators were WAAF with WRNS having taken over plotting of shipping, using the second PPI tube. The station also continued to achieve long ranges with plots at 183½ and 202 miles during May 1943 (TNA, AIR 26/92).

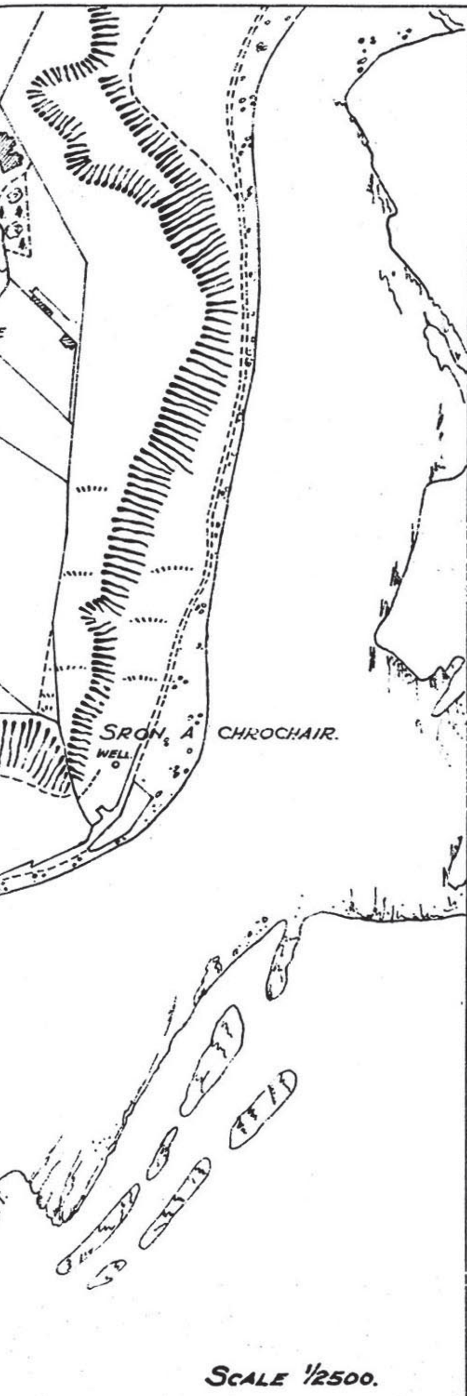
On 30 June 1943 a CD No 1 Mk V (AMES Type 31) centimetric radar became operational at Navidale, improving the cover for surface vessels in the Moray Firth, although the actual installation of the equipment was not finally completed until 1 July (TNA, AIR 26/92).

During August 1943 a searchlight became operational. Radar Operators would use it to point the way to the nearest suitable airfield for aircraft that were lost. On 10 October this searchlight helped direct an aircraft from Lossiemouth, whose crew were lost and about to bail out, back to its home airfield. On 18 November it was again used to help direct a Short Sunderland flying boat from Sullom Voe to land safely at Alness (TNA, AIR 26/92).

The CHL went off the air at 12 pm on 4 December 1943 and was immediately placed on care and maintenance. The Type 31 remained operational, although it was no longer passing on shipping plots. Five days later, all WAAFs were posted away from Navidale and were replaced by RAF operators. The homing searchlight was dismantled on 2 February 1944 and the Type 31 ceased operating on 8 February. Dismantling of the Type 31 began on 13 February, and dismantling of the CHL on 22 February. The Type 31 was removed, with some difficulty, on 18 March and taken to Headquarters, No 70 (Signals) Wing, and the CHL was almost completely dismantled by the end of March (TNA, AIR 26/92).



110 Navidale site plan. (© Historical Radar Archive)



REFERENCE.

No.	DRAWING No.	DESCRIPTION.
1.	432/41.	20'-0" TIMBER GANTRY.
2.	4276/41.	T.& R. OPERATIONS BLOCK 50'x18'
3.	16444/40.	STAND-BY SET HOUSE.
4.	WA15/462/41.	GENERAL PURPOSES HUT.
5.	" "	WATCH HUT & STORE.
6.	" "	BARRACK HUT.
7.	" "	" "
8.	" "	DINING & RECREATION HUT.
9.	" "	KITCHEN
10.	" "	BATH & ABLUTION HUT.
11.	" "	SERGEANT'S QUARTERS.
12.	LOCAL ACTION.	FUEL COMPOUND.
13.	TYPE 'F'	A.R. SHELTER.
14.	" "	" "
15	"TURNERS" CURVED ASBESTOS HUTTING.	BARRACK BLOCK (Defence Personnel)

NOTES.

FOR DETAILED ARRANGEMENT OF TECHNICAL BUILDINGS SEE A.M. DRG. No. 3978/41.
ALL NEW BUILDINGS TO BE COLOURED TO TONE WITH LOCAL MATERIALS.
A.M. BOUNDARIES SHOWN THUS
FOR DETAILS OF SEPTIC TANK TYPE 4 SEE DRG. WA15/411/41.

BUILDING 15 ADDED 29.10.42. & "A" No GIVEN TO PLAN.

O.S. SHEETS SUTHERLAND XC. 3. & 4.

...DALE.
...TYPE II.
...T PLAN.

SECRET No.	D. OF W.
	WA15/407/41. A
	AIR MINISTRY.

Netherbutton

Type	Radar station
Subtype	Chain Home (AMES Type 1)
Region	Orkney
NGR	HY 4621 0440
NMRS	HY40SE 32
In use	2 June 1939 – 7 November 1945

The existence of Netherbutton CH station was the result of a meeting held by the Deputy Chief of the Air Staff in January 1939 to consider extension to the radar chain. At that meeting it was decided to extend the chain northwards to provide early warning of air attack on the Home Fleet (Air Ministry, 1950 (1): 60).

In view of the urgency of this requirement, the decision was taken to equip Netherbutton on an emergency basis, by taking equipment from elsewhere, rather than waiting for new sets to be manufactured. The station at Ravenscar, near Whitby, which had been operating since October 1938, was no longer required, and it was planned to remove all equipment from that site and transport it to Netherbutton as soon as possible. However, Air Chief Marshal Sir Hugh Dowding, Air Officer Commanding-in-Chief of Fighter Command, did not allow Ravenscar to be dismantled early enough to be used for Netherbutton. Consequently, new huts were ordered from the manufacturers, wooden towers for the transmitting and receiving aerials were obtained from Drone Hill, and it was only the aerial systems, the transmitter and the receiver which came from Ravenscar (TNA, AVIA 7/308).

The installation party, accompanied by all the above equipment, arrived on site on 13 May 1939, and the ground installation was completed 12 days later. A test flight carried out on 1 June showed that the station was operating satisfactorily; a Blenheim aircraft flying at 8,000 feet was detected at a range of 60 miles on the line of shoot. At right angles to the line of shoot the aircraft was followed to 30 miles. As a result of these successful flights, Netherbutton was handed over to the RAF personnel on 2 June, less than five months after the decision was taken to erect a CH station in the Orkney Islands (TNA, AVIA 7/308).

However, although the installation had been carried out in an impressively short time, problems as a result of the ‘rush job’ began to manifest themselves even before the station went on the air. The station had to operate from a Meadows electric generator which gave some trouble during the installation and caused a delay of two days to the completion of the work. It was also noted by scientific observers that the only alternating current electricity supply was at that time almost fully loaded. Thus, should the Meadows generator fail, Netherbutton would go off the air for some considerable time (TNA, AVIA 7/308).

The station also suffered from a lack of communications facilities. When scientific staff visited Netherbutton about a week after the RAF took over the station, no telephone communication was available. A temporary public telephone to the site was installed, but this was certainly not ideal. Secure communications separate from the public system were essential, but this would take some time to install (TNA, AVIA 7/308).

At a meeting at the Air Ministry in October 1939 it was proposed to greatly improve the radar coverage of the Orkney Islands. To do this the aerials would be transferred from 90 foot to 240 foot wooden towers and Netherbutton would be converted into an all-round looking station. The latter would be achieved by giving the station four lines of shoot at right angles to each other, rather than the single line of shoot then in operation. Thus, by transferring from one line of shoot to another as required, the station would theoretically be able to plot in all directions. The priority, however, was to get the transmitting and receiving aerials on the 240 foot towers, and this work was completed on 27 or 28 October, with the Intermediate CH station becoming operational as a result (TNA, AVIA 7/308).

Despite the progress being made at Netherbutton, there were still problems to be overcome. One of the most serious took place on 26 November 1939 when the top 80 feet of one of the 240 foot towers was blown down, narrowly missing the Receiver Hut in the process. Temporary repairs were carried out and the station was soon operational using the stump of the tower. In view of the unanticipated strength of the Orkney winds, the engineers used guy lines to support the towers, despite the fact that they were intended as free-standing structures (Hewison, 1990: 281; J Marwick, pers comm).

However, despite such measures, Netherbutton faced one major handicap which it was impossible to rectify. This was that the site was simply not very good. The ideal location for a CH station was ground which was well back from the coast, with a continuous slope towards the sea. Any imperfections in that slope would seriously affect the performance of the station. There is nowhere in the Orkney Islands which completely fits this specification, since it was desirable for the station to be several miles from the sea. Netherbutton was, however, the best available site to provide early warning coverage for Scapa Flow. Nonetheless, despite the best efforts of the scientists, mechanics and operators at Netherbutton, the performance of the station was affected by the limitations of the site.

One particularly fierce critic of Netherbutton was Brigadier G C Kemp, Officer Commanding Orkney and Shetland Defences. He reported on its deficiencies on several occasions and claimed that Netherbutton was obsolete and comparatively useless (Hewison, 1990: 254, 294–5). However, this was undoubtedly not the case, as the AMRE records demonstrate. In a minute to one of his staff dated 30 March 1940, the Superintendent of AMRE, A P Rowe, wrote: 'It has been reported that Netherbutton is giving no useful results. This was certainly not true during the Scapa show, but the Admiralty say that they have got a long range from [HMS] Curlew which is worth half a dozen Netherbuttons' (TNA, AVIA 7/506). As a result of the investigations carried out following Rowe's minute, it was reported:

> *from results on flights in the Orkney area, Nether Button gives greater maximum ranges than Curlew on the average. On a few occasions however, the reverse has been the case. During the attack on Scapa early this week [2 April 1940], Nether Button had a maximum range of 87 miles giving 35 minutes warning. Curlew's maximum range on this occasion was 55 miles.* (TNA, AVIA 7/506)

Despite the difficulties which had been encountered, Netherbutton still played an important part in the defence of Scapa Flow.

A report dated 14 September 1940 noted that along the line of shoot (130°) Netherbutton was able to follow a single aircraft, at the following altitudes, for the stated distances:

1,000 feet	25 miles
2,000 feet	35 miles
5,000 feet	60 miles
10,000 feet	80 miles
15,000 feet	100 miles
20,000 feet	120 miles

This same report, by the Stanmore Research Section which was responsible for assessing the performance of the radar chain, also notes:

Usually two guard ships tell [report plots] into Wick by W/T. The particular ships used change from time to time. Generally their performance is poor compared to the shore stations. Their DF [direction finding] is frequently subject to considerable error, and in some cases there appears to be a range discrepancy. The actual magnitude of the errors is frequently masked by a large and variable time delay. One of the ships which has been telling into Wick during the last few days seems to be putting up a more accurate performance than some of its recent predecessors. I understand that the guard ships were of very considerable assistance some months ago, when the RDF Chain in the north was in a very poor state. One of the early guard ships (the Curlew) is credited here with putting up some very good performances – very much better than other ships which subsequently succeeded her. (TNA, AVIA 7/441)

The performance of Netherbutton improved greatly during 1940. In March the station was only occasionally bettered by HMS *Curlew* and by April Netherbutton was giving the longest-range early warning. This achievement was improved upon as the installation was completed during 1940 and 1941. Netherbutton was also, for some considerable time, the only reliable source of height readings, essential information for intercepting fighters and also for anti-aircraft gunners to correctly set their fuses. Thus, whilst Netherbutton may not always have provided the earliest warning of approaching aircraft, it did so more often than not, and increasingly so as work on the station progressed. Throughout the Second World War it remained one of the most important in the radar chain, responsible as it was for the defence of the Home Fleet.

However, problems at Netherbutton continued. A party from the Directorate of Communications Development visited on 27 February 1941 to supervise the installation of the all-round looking aerial system. On their arrival they found:

None of the necessary gear had arrived at the Orkneys, although it should have left Aberdeen on the 16th.

The GPO Party had arrived on the 17th, but left in disgust on the 23rd as, in the absence of their gear, there was nothing for them to do …

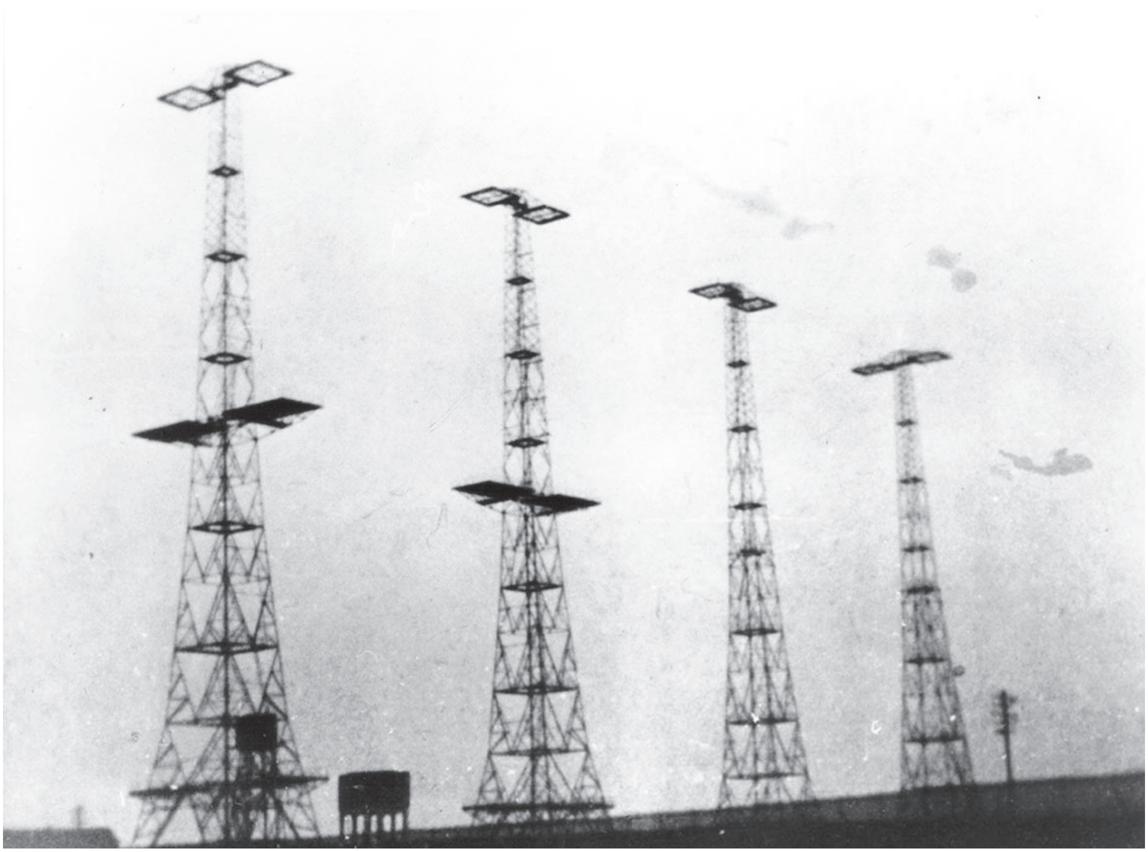
The 'R' Block was in a very backward state of development, and had been so for months; yet when we chased the matter a great deal was done in a very short time, again showing that insufficient effort had been made to complete it quickly …

Netherbutton has been working on the stand-by power station since the Christmas before last; there is no other source of power available, except the 'Meadows' set, which can only supply the TM1 transmitter and the 'R' Hut receiver. If, therefore, the stand-by plant fails, the range of Netherbutton is restricted. The matter is all the more serious as Netherbutton is the only Orkney station which gives height, and guards Scapa. This seriousness is fully appreciated by the station staff and by the Kirkwall Filter Room, and it was *pointed out to a member of Fighter Command during our visit. Yet, in spite of the fact that the stand-by plant is very badly in need of an overhaul – a matter which has been reported by the station several times – nothing has been done to bring one of the two new 125 kW power units already in position into action to relieve the stand-by plant …*

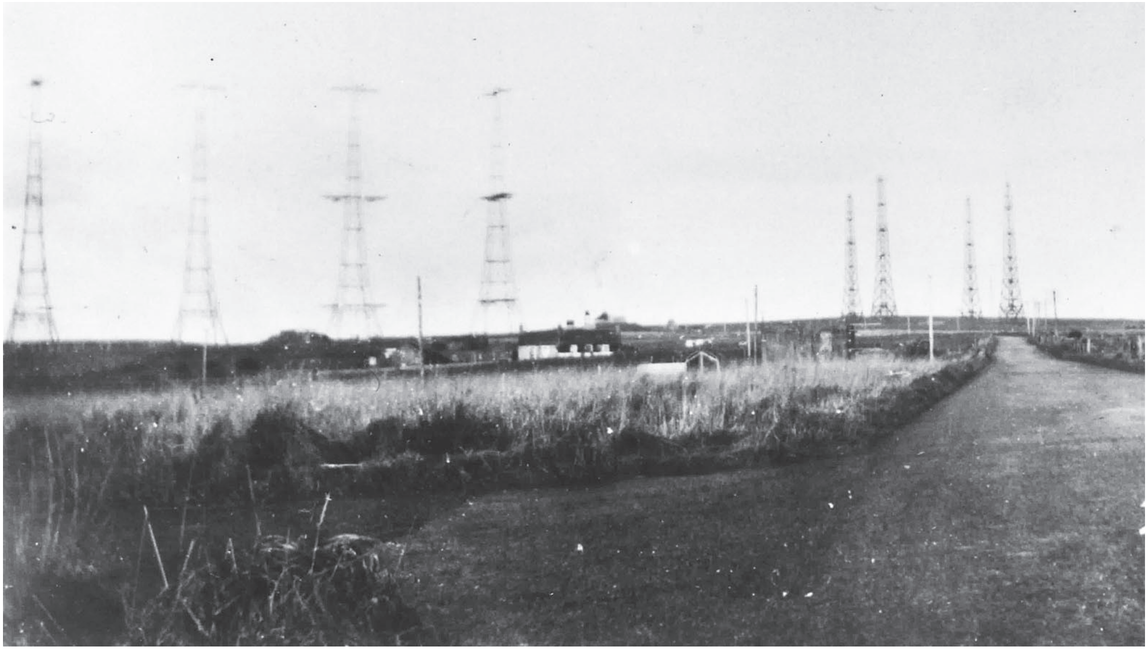
We have done our best to persuade the local AMWD [Air Ministry Works Department] engineer that it is dangerous not to bring into service immediately one of the new units on a 'lash-up' basis. He himself has stated that it could be done in 48 hours, but fails to see any need for doing it until the emergency arises; this means that Netherbutton would be on low power for that time … We feel that the estimate of 48 hours is a most optimistic one …

The reasons for the delay in completing the power station are partly due to enemy action. Fuel tanks and water tanks have been lost in transit. But other reasons for the delay are the fact that the cable for the station wiring was not ordered until very recently. Bad weather has also contributed. None of these reasons, however, would provide an excuse for not starting up one unit on an emergency basis now.

The Orkneys present peculiar difficulties in the way of rapid development compared with mainland stations. Lack of easy and rapid contact



111 The four transmitter towers at Netherbutton, taken in 1950. The different angles of the tower platforms are for the all-round looking station.
(© Orkney Wireless Museum)



112 Netherbutton, with the four 350 foot transmitter towers on the left and the four 240 foot receiver towers on the right.
(© Orkney Wireless Museum)

with the mainland … The shortage of labour and transport are acute. Yet, one finds for example, men busy putting down kerbstones to the concrete way, or putting up a wire fence round a house inside the compound, when much more urgent jobs lie waiting …

Other difficulties which tend to slow up the work are associated with loss [of], or delay in delivering, materials. A case was quoted to us, where goods were addressed to 'LMS Thurso, to be called for,' and Netherbutton was requested 'to provide transport to collect the goods from Thurso' regardless of the fact that the Pentland Firth had to be negotiated. (TNA, AVIA 7/308)

In view of these difficulties, it was all the more important to ensure that Netherbutton was equipped with the most high-powered equipment capable of giving the best performance possible. Plans had been drawn up for the installation of all-round looking aerials during February 1940, the 350 foot steel towers having been erected by this time. However, in January 1941 the Signals Branch of the Air Ministry noted that, 'The all-round looking array for Netherbutton was requested on a high priority a year ago, and it is regrettable that action has been so long delayed' (TNA, AVIA 7/308). It was to be the first week of April before the all-round looking array would be installed (Air Ministry, 1950 (1): 553), but calibration work, which was necessary to ensure that plots were accurate, was not completed until July 1941 (TNA, AVIA 7/372).

Netherbutton had already contributed to the effective defences of Scapa Flow, and this role continued with the improved equipment. For example, at 6.24 pm on 11 July 1941 H264, a Junkers Ju 88, was picked up by Netherbutton 111 miles north-west of the station and tracked in to between 70 and 80 miles, where it was shot down. Netherbutton was the only station giving height information on this track (TNA, AIR 26/92).

New developments continued at Netherbutton, as the *Orkney Blast* recorded on 1 May 1942:

They are young and pretty … The WAAFs are here! … The first contingent of the 'ladies in blue' disembarked on Wednesday after a very pleasant crossing. On their arrival at their billets 'somewhere on the Orkney Mainland', they were very touched to find that the men, by the side of whom they will now work, had prepared a hearty welcome for them.

The arrival of the WAAF had gone well, but tragedy struck within months. On 19 August 1942 a WAAF driver was taking a watch on duty late in the morning in a Standard 10 Utility truck and met a Bedford lorry from a nearby searchlight site. Despite the narrow road, apparently neither driver slowed down, and part of the Bedford's equipment, sticking out the side of the lorry, swept through the canvas canopy of the Standard 10. Gillian Marr (from Warwickshire) and Margaret Munro (from Kilmarnock) were both killed, and Marian Smith and Jean Froggart were seriously injured (HRA, Gillian Dulcie Marr, genealogical records; Margaret Sheila Grace Munro, genealogical records; Jim MacDonald, 'Radar in Orkney').

Eric Crofts was posted as an 18-year-old Radar Operator to Netherbutton in May 1943. He recalls:

Going on watch, and coming off, we travelled in the back of a truck. Its canvas canopy covered us, but the end was open and the cold air could enter. WAAFs could swap their skirts for trousers on evening watches in winter and on night watches throughout the year. So, before 17.45 in winter darkness, we would climb into the truck (the corporal sat in the cab) with our box of bread, margarine, cheese, jam, sugar and cocoa. Everyone wore greatcoats and trousers, the lads might have balaclavas, the girls hats. All would have long woollen scarves wrapped round and round their throats, often over their faces as well. On night watch, we also took a blanket (we could usually manage to sleep on the floor of the transformer room for a couple of hours) and these would be draped over us as we huddled together in the bouncing, smelly, cold truck.

Now, the highlight of my memory of a time when a few minutes of happiness was very important. If there was a dance in the recreation hall in the domestic site, the crew coming home at 23.15 would rush into the hall, dump their empty box, discard their coats and hats and scarves and gloves and swirl around the floor. Too soon, it was time to go to bed, to put off the lights and close the hut.

In 1943 it was decided that the Tx site would be attacked by an Army unit and we would defend it. The WAAFs would act as stretcher-bearers. My mates and I looked upon the exercise as a good old boyhood game of Cowboys and Indians. We stopped the soldiers from the high fence, but in the din of shouts and bangs from blank ammunition and thunderflashes, an umpire told me that I had been wounded. Four wee lassies came with a stretcher (I don't know how they made it through the hail of fire that had cut me down). I was six feet tall and weighed fourteen stones, so insisted that I could walk, but they had their orders. I lay on the stretcher and they lifted me with a great deal of effort. They managed some yards then one collapsed, throwing me off. I think that 'Oh, dear' was the strongest expletive used by those nice girls. They were upset, but I laughed uncontrollably and this infected them, so our little war came to an end with the five of us sitting on the ground

113 'The Six Zephyrs' (Jessie Dolan, Dorothy Cross, Doreen Doyle, Barbara Thornes, Jane McKechnie, Sibell Clay) performing in the Wings over Orkney show in 1943.
(© Sibell Clay)

and laughing our heads off. Then we went for a cup of tea.

There was a sequel to the game. It took place that evening. A guardroom stood at the entrance to the domestic site. One of the lads had saved a couple of thunderflashes. After dark, he was quietly helped onto the flat roof of the guardroom and put them down the chimney, then we fled to our hut and watched from a window. There was a bang and a cloud of smoke from the chimney, then another bang and cloud, then a white-faced RAF policeman shot out the door. Nothing was said except, 'The damn coalminers are always shovelling up bits of gelignite with the coal.' (Eric Crofts, pers comm)

During routine overhauls of both CH transmitters on 18 February 1944, their peak output power was increased to 1.35 and 1.2 megawatts. Preparations were made during May and June 1945 at Netherbutton for the station to make observations between 1 and 16 July in connection with the solar eclipse on 9 July. The modifications included the provision of a 400 mile range on the receiver display, and the second CH channel was used to observe the range, amplitude and duration of scatter. The observations were carried out on behalf of the National Physical Laboratory and showed no noticeable decrease in scatter during the eclipse, but that it did decrease towards sunset each day. Netherbutton ceased operating with effect from 12.30 pm on 7 November 1945 and was placed on care and maintenance the following day (TNA, AIR 26/92).

North Cairn

Type	Radar station
Subtype	Chain Home (AMES Type 1)
Region	Wigtownshire (Dumfries and Galloway)
NGR	NW 9725 7073
NMRS	NW97SE 22
In use	June 1940 – 7 March 1945

Plans were drawn up for a hutted MB station to be set up at North Cairn during August 1940. However, before this could be implemented it was decided to use an MRU: on 26 June No 214 MRU was sent to North Cairn and became operational a few days later (Jack Baigent, service record and pers comm).

North Cairn changed over to an RM3B receiver on 28 September 1940 and an Advance CH transmitter on 4 October. However, on 10 November the receiver mast was blown down and the station had to operate with the stand-by mobile equipment. This was not the end of the station's troubles. The 75 foot mobile transmitter mast had the feeder lines and reflector aerials torn off on 6 December and had to use the 105 foot Advance CH transmitter mast. It was not until 19 December that the station was operating with a 55 foot receiver mast. But despite all these problems, the Advance CH was able to provide ranges of up to 80 miles during December. The 75 foot T mast came back into use on 2 January 1941 to allow the 105 foot T mast to be lowered. On 23 January the station began using an 82 foot R mast (TNA, AIR 29/141).

April 1941 saw a slight improvement in the performance of the station, which had so far been fairly disappointing. During April high-flying aircraft were seen over Northern Ireland at ranges up to 90 miles, but performance away from the line of shoot remained poor (TNA, AIR 29/141).

Construction of the Final CH station was carried out during late 1940 and well into 1941, and by the first week of April the two 350 foot steel transmitter towers and two 240 foot wooden receiver towers were complete. The buildings were almost finished and it was planned for the Final CH station to become operational by the end of May 1941 (Air Ministry, 1950 (1): 554). However, this target was not met, and by the beginning of July the transmitters and receivers had still not arrived on site (TNA, AVIA 7/372).

Doris Pearce was part of the first group of WAAFs posted to North Cairn, arriving there in July 1941:

The first time that we went on watch, we were amazed to discover that the little band of airmen comprising the few operators and the even fewer mechanics, actually formed themselves into a proper RAF squad and marched down the lane between the stone walls and the blackberry bushes. Female speed and short stride soon made marching quite impossible. The end of that method of getting to work ceased immediately, and after that we just walked.

The contractors, who were still on site, had made a road from North Cairn Farm into and through the site. It was firm but not top-dressed. We entered the technical/operational site through a five-barred gate and the rest of the security consisted of coils of barbed wire draped around the perimeter. A temporary wooden guardroom was just inside the gate on the left, but between it and the road ran a narrow, ditch-like stream. In heavy rain, of which we had plenty, it filled with water. On dark nights it was not unknown for somebody to slip into this, with curses and laughter …

The RM3 [receiver] must have been one of the first ever built and had come to us about fifth hand. It was quite a shock to work on one of these clumsy pieces of equipment with its huge rose, short time-base and lack of leg room. However, it was possible to get real shocks off the equipment – not very funny at the time. We were, of course, on manual conversion. With competent operators this was not all that slow …

Plots from Tiree/Islay were relayed to us to pass on, by W/T. Every watch therefore had to have a W/T operator. At one time, WAAF operators *were encouraged to try to learn this art, but none of us were any good and I strongly suspect had no intention of being.*

When we were on stand-by during maintenance, we had to use an old caravan-type mobile. It bore all the signs of having been in the wars, literally. You entered up a short flight of steps. The floor shook and bounced. The equipment was an even more elementary type of RF3 on which we saw very little as everything was so ill-defined. The sea-plane base in Loch Ryan was still being finished but was in use. The response from a Sunderland was enormous. One never knew whether it was one Sunderland or 3+ 'Hostiles'. We sat at the top of the steps and scanned the skies with binoculars. A visual was very reassuring! …

We probably took over the Final CH in November 1941. It was built on the left of the road and there had to be considerable levelling by digging into the hillside. The operations room was exceptionally large. The RF7 stood alone in the middle like something left over from Stonehenge, but it was a pleasure to be operating the then latest equipment. Because of the room's size it was often quite cold, with I believe only two flat wall heaters. On night watch we each smuggled in one blanket and, putting all together, made a sort of communal 'bed'. A brand new block had, of course, brand new lino – and a great deal of it. Traditional methods, such as bumpering, do not work with the very first polishing and so the polish was put on, yard by yard, on hands and knees.

The station was unusual in that it had two lines of shoot … and was therefore a little trickier to operate. There was quite a bit of traffic and we were busy most of the time, but seldom on anything exciting, but one did learn to be very accurate. We seemed to have more than our fair share of interference, mostly from natural sources like sun spots and the Aurora Borealis, and our old friend 'scatter'. The worst came from a female radio ham … in New York. She always seemed to be 'calling' and apart from messing up our trace, came through on the loud-speaker, very loud and clear. America was not in the war at this time, so I do not know what we could have done about her and kept our secret …

Slack night watches were often spent by the crews in talking, confiding and discussing. These periods were often the most enlightening and enjoyable … I remember these talks with great affection. We even sang together quietly and certainly on Christmas Day we entered the ops room singing carols. (Doris Pearce, pers comm)

The 72 Wing Defence School was transferred to North Cairn from Kilkenneth on 24 May 1943. A GCI school, for the conversion of experienced CHL mechanics, was set up at North Cairn during June, using GCI convoys 872 and 876 from Dunragit and King Garth. The first course, consisting of 19 mechanics, began on 1 July and was successfully completed on the 14th (TNA, AIR 26/103).

Al Tunis, who was posted to North Cairn in 1943, remembers one of the airmen who was destined for greater things:

One day, not long after I arrived, while shaving in the men's washroom facilities … I heard a splashing and shuffling in one of the stalls behind me, followed by the gush of a flushing toilet. Through the mirror I could see the figure of an airman emerge, carrying a bucket, only to disappear into the next stall. The airman was clad in fatigues – working clothes – with a wedge cap on his head at a careless angle. When he came out in view again, I inspected a thin, stoop-shouldered, shuffling figure, topped off by a sallow, sad face with heavy-lidded eyes. He grunted a greeting and carried on with his work.

This was my introduction to Aircraftman

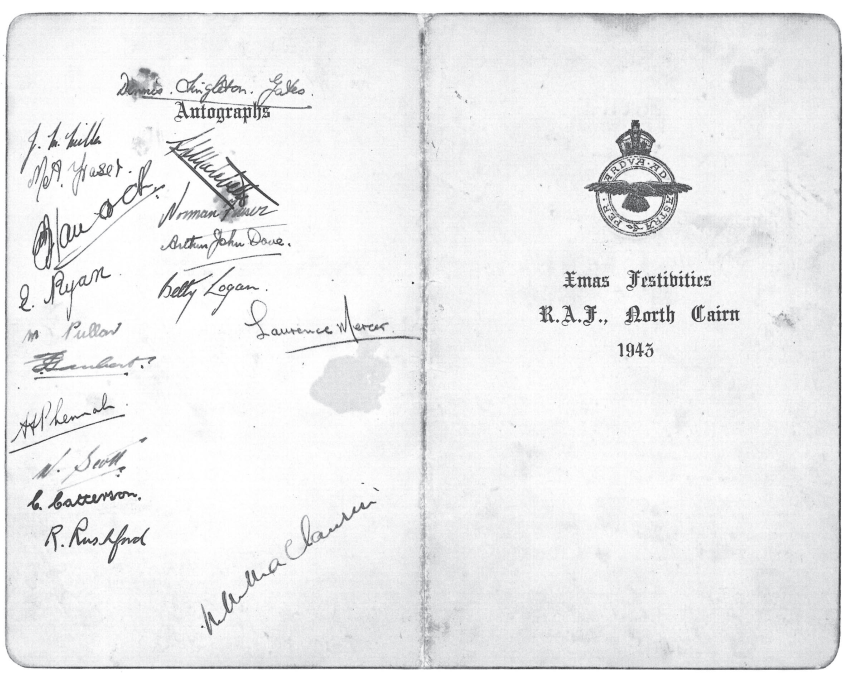
Second Class (General Duties) Anthony (Tony) Hancock.

As the days passed, I managed to learn more about this sad, reserved young man. If memory serves, his deceased father had been a part-time entertainer and hotel-keeper in Bournemouth. His remarried mother was still living in the south of England. Through his father, the impressionable young Tony had been exposed to a passing parade of entertainers and it was probably from this experience that he had developed a burning ambition to be a comedian, in the style of some of the great London music-hall stars of his youth. Having myself participated in theatre work as a youth in Montreal in the late 1930s, I bent a sympathetic ear to Tony's aspirations.

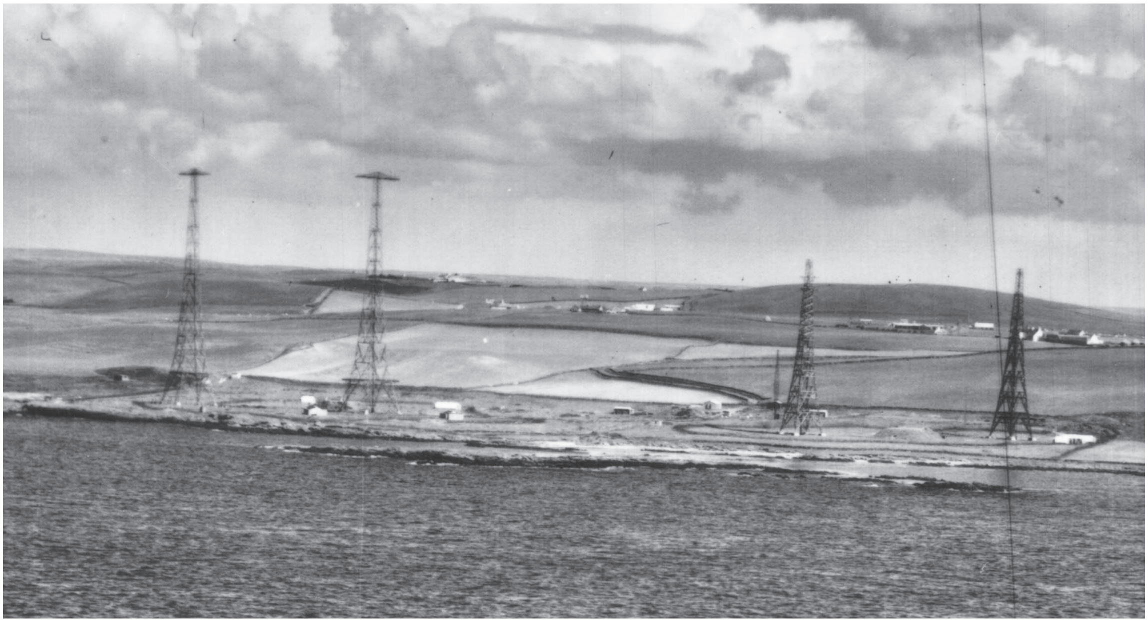
It was during one of our long conversations that the idea emerged to put together a North Cairn concert party. Being isolated, our station was only infrequently visited by entertainers – and these, sad to say, were usually of a third-rate variety. With youthful exuberance, Tony and I decided that with our own talent, we could organise a variety show equal, if not superior, to the depressing entertainment that was occasionally sent our way … We set about our showbusiness project energetically and enthusiastically. Each of us was to get his acts organised and we would then bring it all together at a dress rehearsal. The entire personnel on the station fell behind us to round up props, costumes and make-up – it became a real community effort.

As for Tony, he kept largely to himself in the weeks leading up to the performance. He never, to my knowledge, rehearsed in the airmen's recreation hall, where the event was to take place … On the day of the dress rehearsal, I had to nurse Tony along: he was depressed and nervous, uncertain how he would be received. That evening was a revelation. The rehearsal went well, but the spotlight was clearly intended for a slight, stooped young man with sad eyes who stepped on stage to assume the identity and the manner of the born comedian.

Tony did several turns, with the deadpan expression of a Chaplin or a Keaton. What he



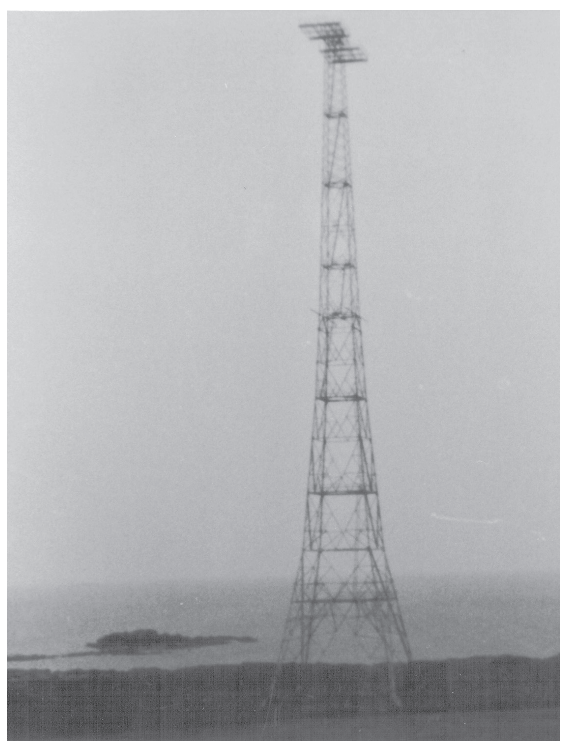
114 North Cairn Christmas menu 1943, signed upper left by Tony Hancock.
(© Al Tunis)



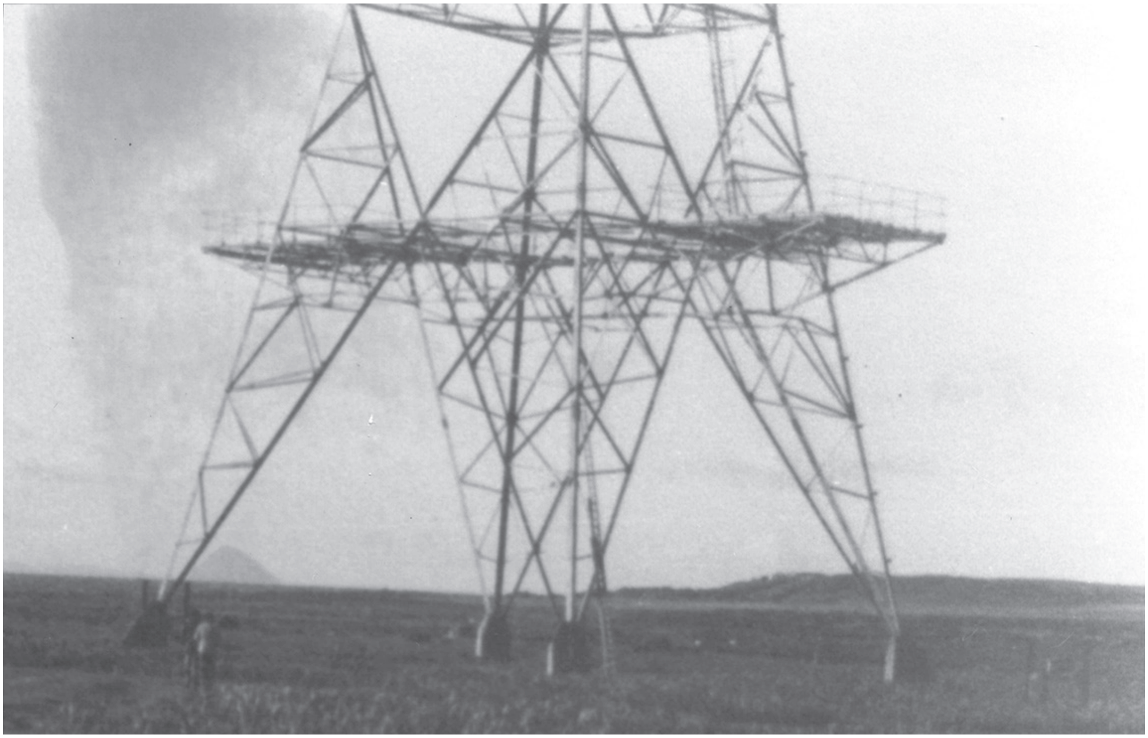
115 North Cairn from the air on 25 May 1948, showing the two 350 foot transmitter towers on the left and the two 240 foot receiver towers on the right, with the IFF mast just visible to the left of the receiver towers.
(© Historic Environment Scotland)

did, of course, was derivative and, in retrospect, none of us present at the performance appreciated the talent that was yet to be exposed. But the performance was a great success for all concerned. In particular, it took Tony out of the washrooms and that, in the final analysis, was what it was all about. (Al Tunis, pers comm)

On 5 October 1943 North Cairn became operational on Final CH equipment. This was a great improvement and operational efficiency of the station increased considerably. The station continued to track transatlantic civil aircraft and was congratulated by the filter



116 The last remaining transmitter tower at North Cairn about to be demolished.
(© Mr Porter, via Tom Murchie)



117 The last remaining transmitter tower at North Cairn about to be demolished. (© Mr Porter, via Tom Murchie)

room several times that month for its work in this respect (TNA, AIR 26/103).

North Cairn CH station ceased reporting at 12 pm on 7 March 1945 and was placed on Care and Maintenance Stage I, meaning it could return to operations at 14 days' notice (TNA, AIR 26/92).

North Sutor

Type	Radar station
Subtype	CA No 1 Mk II
Region	Ross and Cromarty (Highland)
NGR	NH 8288 6980
NMRS	NH86NW 9.01
In use	dates unknown

On 11 November 1941 it was decided to erect a CA Mk I set for Invergordon at North Sutor Battery, the site being equally suitable for 1½ metre or 10 cm radars (TNA, AVIA 7/3407). It is known that a CA No 1 Mk II centimetric fire control radar was installed here, designated B15, but little additional information has been found (TNA, WO 199/1133).

Northtown

Type	Radar station
Subtype	Ground Control of Interception (AMES Type 8)
Region	Orkney
NGR	HY 283 224
NMRS	HY22SE 113
In use	August 1941 – April 1942

Air Ministry Experimental Station No 17G, Northtown was a mobile GCI station comprising the vehicles and radar aerials of GCI convoy No 837 (TNA, AVIA 7/262). The station was being set up in August 1941 (TNA, WO 199/62), although it is not certain that it ever became fully operational. In April 1942 the mobile GCI was moved from Northtown to Russland (TNA, AIR 26/92).

Noss Hill

Type	Radar station
Subtype	Chain Home (AMES Type 1)
Region	Shetland
NGR	HU 3646 1570
NMRS	HU31NE 52
In use	26 December 1940 – 4 August 1945

Air Ministry Experimental Station No 54, Noss Hill became operational as an Advance CH station on 26 December 1940 (HRA, RDF in Northern Scotland and the Islands).

Construction of the Final CH station was under way by early 1941, with both 350 foot steel transmitter towers completed by the first week in April (Air Ministry, 1950 (1): 553). By 5 July the Transmitter Block was ready for the installation of the transmitters, and instructions were issued the following day for their delivery. On 14 July the 200 foot cantilevered platforms were removed from the two 350 foot steel towers (TNA, AVIA 7/372).

Whilst this work was going on, the station was performing well with the Advance CH equipment. On 11 June 1941 several plots were passed on a calibration aircraft 130 miles south of the station. This was the record range for Noss Hill so far, all the more remarkable because this was the blind area for the station. Exactly a month later, on 11 July, a hostile aircraft identified as a Junkers Ju 88 was plotted from 59 miles west to 44 miles east of Noss Hill. Two Hawker Hurricanes intercepted and shot it down (TNA, AIR 26/100).

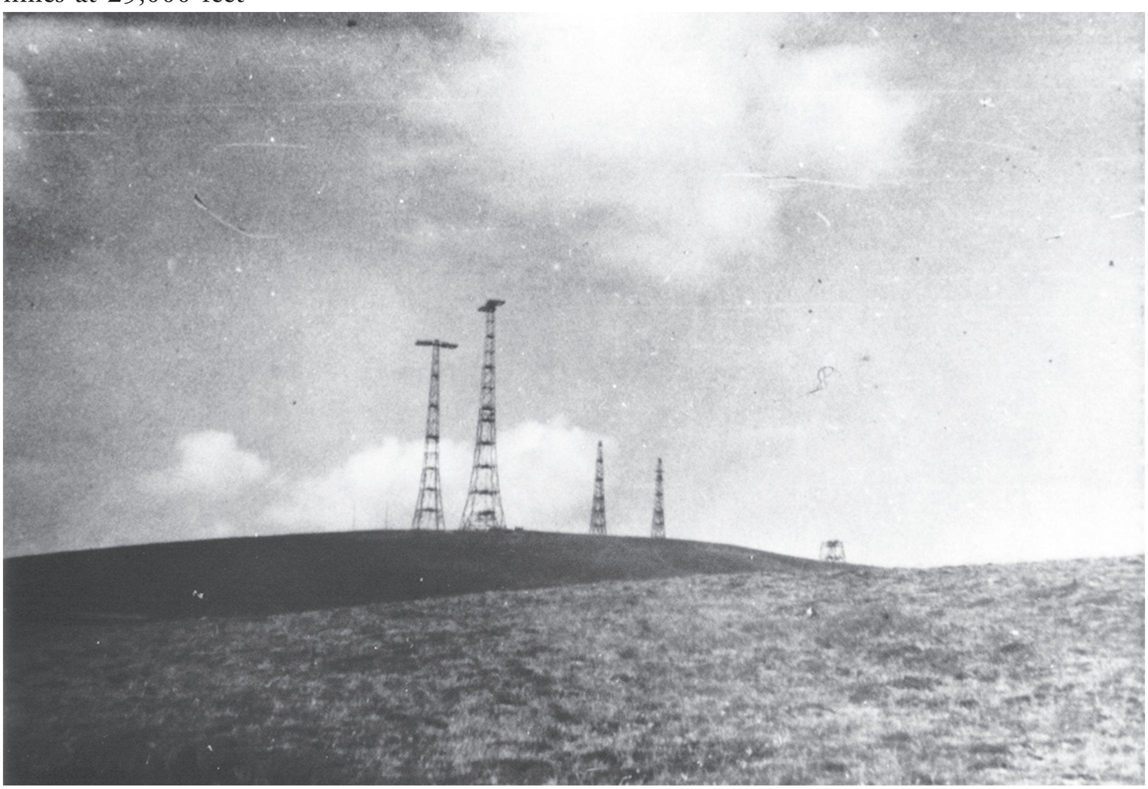
The Aurora Borealis was visible on 11, 22, 24 and 31 October 1941, causing interference on a bearing of 280° or its reciprocal. At 12.55 am on 2 October, an echo picked up to the west and plotted for 200 miles over an erratic course was identified as an electrical storm (TNA, AIR 26/100).

At 6 pm on 17 April 1942 the Final CH

station became operational and, although there were some teething troubles, the performance of the equipment exceeded expectations. Nineteen hostile and three unidentified raids were plotted during April, the greatest range during the month being 179 miles (TNA, AIR 26/100). The new equipment was operating on four lines of shoot: 10°, 100°, 190° and 280°, and the station was thus all-round looking.

On 8 June 1942 a fighter was plotted out to 51 miles at 1,000 feet. It was later learned that this Bristol Beaufighter had intercepted and shot down a Blohm and Voss flying boat, the hostile being plotted by Saxavord. The best track for June that year was on an aircraft picked up at 113 miles at 25,000 feet and plotted out to 195 miles (TNA, AIR 26/100).

Heavy gales raged throughout February 1943 and on the evening of the 19th the main receiver tower was blown down, narrowly missing the Receiver Block and leaving about 65 feet standing. The following day mechanics were able to rig up the secondary aerial system on which the station was operational. For a while the Advance CH was used in conjunction with the Final CH equipment, but the results did not justify keeping it on the air and the Advance CH closed down on 26 February. Despite these problems the station performed well, with ranges of 30 to 60 miles being obtained on aircraft at known heights



118 Noss Hill, showing the two 350 foot transmitter towers on the left, the two 240 foot receiver towers in the middle and on the right the stump of the 240 foot tower which snapped in a storm on 19 February 1943.
(© Ken Peacock)

from 1,000 to 3,000 feet. On 18 March a single dipole aerial looking east and west was erected at about 180 feet on the VEB tower (Variable Elevation Beam – a height-finding system). This gave provision for range-finding east and west, but did not prove effective. The single dipole was replaced later in March with a pair of crossed dipoles making range-finding possible in all directions. Results were, however, poor compared with the secondary receiving system and it was not considered worthwhile using them (TNA, AIR 26/100).

At 12.16 pm on 20 February 1944 Noss Hill was the first station to detect Hostile 556, although it was plotted by numerous other stations as well. The hostile, a photo-reconnaissance Messerschmitt Bf 109G flying at about 35,000 feet, was shot down 50 miles east of Orkney by a Supermarine Spitfire from No 602 Squadron based at Skeabrae (TNA, AIR 26/92).

During the period of 1–16 July 1945, observations on the amount of ionospheric scatter were made from Noss Hill, covering the solar eclipse of 9 July. Readings were taken on the range, amplitude and duration of representative samples of backscatter and analysis of the results showed no noticeable decrease of scatter during the eclipse, but that it did decrease towards sunset each day. This was one of the last events to take place at Noss Hill, with the station ceasing operations on 4 August 1945 (TNA, AIR 26/92).

Perth

Type	Research establishment
Subtype	Special Duty Flight
Region	Perthshire (Perth and Kinross)
NGR	NO 155 279
NMRS	NO12NE 61
In use	September – November 1939

When arrangements were made for the Bawdsey Research Station to be evacuated to Dundee on the outbreak of war in September 1939, plans were also drawn up for the airborne radar group to move to the civil aerodrome at Perth. E G Bowen was head of the Airborne Group and he remembered that, as at Dundee, the arrangements were not as definite as had been thought:

The Station Manager was a sensible and friendly character but he made his position very clear. He was a civilian under contract to Training Command of the RAF to provide ab initio flight training to young pilots … His programme had grown to the point where it required the full facilities of the station and there was nothing to spare …

After a few telephone calls to the Air Ministry by both of us, the Station Manager offered a friendly compromise. Until the matter could be resolved, he would share equally the office and hangar space which was available. There were two small hangars and associated office and work space and this was an arrangement to which I readily agreed. He took one hangar and I took the other, and for the moment I was grateful. It meant that we had a tiny space for laboratory *work and equipment, and hangar space for one or two of the aircraft actually being worked on. The remainder were parked in the open, partially fitted with delicate electronic equipment exposed to the weather. We talked to our respective masters at the Air Ministry and the message came through loud and clear. Perth was considered an ideal place for ab initio pilot training and totally unsuitable for airborne radar research … It became obvious that the Station Manager would shortly get his station back and that another place would be found for us.*

Conditions at Perth were rudimentary compared with those we had left behind … The few rooms available to us were never intended as laboratory space and, in many cases, were simply areas which had been partitioned off for some other purpose in the corner of the hangar. Things were terribly congested, but we were told there was a war on and that this was the kind of thing one put up with … Perth was still rated a civil airfield, so there was virtually no security. In my office, we regularly marked everything 'Secret' or 'Top Secret', as the case may be. We religiously kept the filing cabinets locked when not in use and locked the doors when we left, usually very late at night. There were plenty of Air Force personnel around in daylight but only a perfunctory watch was kept at night. There was no guard of any kind around the airport perimeter. There was top secret radar gear in the aircraft scattered all over the field and in the rooms used as laboratories. Almost anyone with the initiative could have walked in and got away with a complete set of the country's most secret radar equipment …

Meanwhile, at Perth there was an immense amount of work to be done. Our first priority was the installation of AI radar in the remaining Blenheims and, thanks to superhuman efforts from the staff, this was completed in October. At the same time Coastal Command had come into the picture and asked for the installation of ASV radar in Lockheed Hudsons, to be followed by flying boats. In addition, the Fleet Air Arm asked for an experimental fitting of forward-looking ASV radar in a Swordfish and a Walrus, both of which shortly arrived in Perth. (Bowen, 1987: 87–9)

Towards the middle of October 1939 the Airborne Group were told that they would be moving to RAF St Athan (Bowen, 1987: 91–2), and the move took place the following month (Lovell, 1991: xii).

Point of Stoer

Type	Radar station
Subtype	Chain Home Low (AMES Type 2)
Region	Sutherland (Highland)
NGR	NC 0080 3294
NMRS	NC03SW 21
In use	October 1941 – 4 February 1944

Air Ministry Experimental Station No 95A, Point of Stoer was a CHL station. Installation of the technical equipment began in July 1941 and this was completed, with the station becoming operational, in October. Initially, however, the station was of no operational use, being unable to plot by R/T to Stornoway SFR because of interference from the CHL transmitter which had not been prepared for. R/T apparatus was installed in December and, once reception facilities were provided at Stornoway, plots were passed on from February 1942 onwards. The station then produced good performances, with a maximum range that month of 129 miles and then in March of 131 miles on aircraft and 48 miles on surface vessels. This was further improved upon in May with a maximum range of 152 miles and in October, 183 miles (TNA, AIR 26/92).

John Glen was posted to Point of Stoer in October 1941:

Before the domestic site was built, we were billeted in The Lodge Hotel, Lochinvar (no longer exists, was burned down after the war years), 10 miles from the Technical Site, which was above the lighthouse at Point of Stoer. When the Domestic Site was completed at Raffin (Nissen huts) and we moved, we had a 1–1½ mile walk across the peat bogs to go on duty …

Our main task there was the protection of shipping lanes through The Minch, where U-boat activities were intense around the Butt of Lewis and Cape Wrath and the Pentland Firth. Information was plotted by radio link to Stornoway – a TR9 transmitter/receiver was used. Signal strength tests were carried between the CHL station on Isle of Skye, Stornoway and Point of Stoer.

Village dances were held in Lochinvar Hall. About ten o'clock a pianist would arrive, then someone with an accordion and a fiddler. The dance went on and on until everyone was exhausted about 4 o'clock in the morning! …

Another incident during that period at Point of Stoer was the search by radar stations for the plane carrying the Duke of Kent. Later his body was recovered from the hills and taken to Dunrobin Castle on the east coast. (John Glen, pers comm)

In November 1943 it was decided that Point of Stoer was to close (Air Ministry, 1950 (1): 516), and at 12 pm on 4 February 1944 the station ceased operations (TNA, AIR 26/92).

Port Errol

Type	Radio Navigational Aid station
Subtype	Loran, SS Loran (AMES Type 700)
Region	Aberdeenshire
NGR	NK 097 356
NMRS	NK03NE 66
In use	December 1943 – February 1946

Around 21 November 1943 the first personnel arrived at Port Errol to set up a Type 700 Loran station, with equipment following about three days later. This was installed in December. The first transmitter was being tested on 12 December, and the second was operational on 19 February 1944. At 3.30 pm on 20 January 1944 the station was linked to the mains electricity supply, power prior to this having come from diesel generators (TNA, AIR 29/167).

Trials were carried out between 3 and 16 May 1944 with SS Loran (Skywave-Synchronized Loran) in conjunction with a mobile unit at

Bizerta in Tunisia (TNA, AIR 29/167). SS Loran was a version of Loran which relied on the pulses being bounced across the ionosphere at night (the skywave), making it invaluable as a very long range navigational aid for distances between 250 and 1,600 nautical miles (Air Ministry, 1956: 202).

May 1944 was the first time that the European SS Loran system had been tried and it proved a great success, even though it was not yet operational. It was not until 6.30 pm on 7 September that the SS Loran became operational, with Grade 'A' operations being carried out until 4.30 the following morning (TNA, AIR 29/167).

During September and October 1944 the little use that was made of SS Loran was mostly operational trials by Pathfinder Force de Havilland Mosquitoes en route to Berlin and a Pathfinder Force Avro Lancaster en route to Frankfurt. Only three SS Loran operations were carried out in the following month, on 11/12 November against Harburg, on 21/22 November against the Dortmund–Ems Canal and on 26/27 November to Munich. By the end of 1944 it became clear that there was little operational need for SS Loran, with Gee stations on the Continent providing adequate cover. Furthermore, in February jamming of SS Loran started, which seriously reduced its effective use over northern Germany (Air Ministry, 1956: 206). Nonetheless, Port Errol remained operational as an SS Loran station until February 1946 (TNA, AIR 26/93).

Port Mor

Type	Erection of an Advance CH station on Tiree
Subtype	Advance Chain Home (AMES Type 1)
Region	Tiree (Argyll and Bute)
NGR	NL 944 427
NMRS	NL94SW 24
In use	28 May 1941 – 8 October 1942

Erection of an Advance CH station on Tree with 105 foot masts and a line of shoot of 270° (due west) began on 22 January 1941 (TNA, AVIA 7/260). Delays in construction were experienced due to the limited transport facilities on the island (Air Ministry, 1950 (1): 555), and it was not until 23 April that installation of the technical equipment began. Air Ministry Experimental Station No 82R, Port Mor became operational on 28 May (TNA, AIR 26/103).

Port Mor was plotting to the North Western Filter Room at Preston via W/T, and by July 1941 enough data had been accumulated for the filter room to conclude that Port Mor's coverage was good, although interruptions in radio contact between the station and the filter room were causing problems. From September 1941 Port Mor plotted to Dundonald Filter Room (TNA, AIR 29/141).

The station personnel were accommodated in bell tents, a situation which was far from ideal. Kenneth Lampard was posted to Port Mor in February 1942 and he recalls the conditions: 'It was shocking. The wind blew, the rain rained.' He also remembers that they had to wash in seawater and the cook had to use an open range. Nissen huts were eventually built to house the crew, but these were constructed at the bottom of a hill and water ran off the hill into the huts (Kenneth Lampard, pers comm).

Wylie Barrett, a Sergeant Radar Mechanic at Port Mor from 7 May to 29 October 1942, recalls:

The ACH radar station, Port Mor, was located about a mile from the base of Ben Hough and probably half a mile from the ocean … Kilkenneth was the name of the domestic site. During my six months on Tiree, our ACH radar was closed out and the equipment moved into the new concrete transmitter and receiver blocks …

While we were still operating the ACH radar, the method of refuelling the diesels required filling five gallon cans from 45 gallon drums and pouring it into the fuel tanks of the diesels. A destroyer had been run aground and wrecked about a mile from our radar and the salvage people had cut the destroyer off at the water level of the low tides at the time. I discovered even lower tides, and with tools salvaged a considerable quantity of copper pipes, valves and shut-offs. These I installed in the diesel house so that the diesels could be refuelled by merely opening the right valves and wobbling the rotary pump. I remember when Group Captain Fennessy visited our station how the polished copper plumbing caught his eye and prompted a question on where it came from. (Wylie Barrett, pers comm)

Port Mor Advance CH closed down on 8 October 1942 as the Final CH at Kilkenneth came on the air. In under 10 hours the Advance CH transmitter was immediately disconnected and moved to Kilkenneth, where it was used for the stand-by channel (TNA, AIR 26/103).

Wylie Barrett recalls an unusual event which

took place shortly after we had moved to the West Coast type station [Kilkenneth]. It seems that an ACH tower had come down at Saligo and smashed. A request came for us to dismantle one of the unused ACH towers at Port Mor, take it apart and get it ready to ship by air to Islay. Lacking antenna riggers I dismantled the antenna piece by piece and let them down by rope and pulley. Lowering the mast presented a problem as the winches that had been used to

119 Port Mor Domestic Site bell tents, taken in the summer of 1941.
(© Wylie Barrett)

raise [it] had been taken away. So I had a large Bedford flat bed truck loaded heavily with sand, attached cables between tower and truck and, with some bods on either side of the tower with ropes attached to prevent side movement, had the driver slowly back the truck until the tower was down. Then we took it apart putting all the hardware – bolts, gussets, etc. – into burlap sacks and binding the wooden parts in bundles … All of the tower parts went into the aircraft except the long wooden corner pieces. So the front window on the starboard side was opened and the ends of the wooden pieces pushed through. The aircraft took off with that window open and the ends of the tower sticking out possibly about five feet. (Wylie Barrett, pers comm)

As Wylie Barrett relates, in October 1942 one of the 105 foot masts from Port Mor was transported by air from Tiree to Islay by the Communications Flight, Glasgow, to replace a damaged mast at Saligo (TNA, AIR 26/103).

Rerwick Head

Type	Radar station
Subtype	CA No 2 Mk I
Region	Orkney
NGR	HY 5419 1160
NMRS	HY51SW 10
In use	14 April 1944 – date unknown

On 14 April 1944 the CA No 2 Mk I Fire Control radar installed at Rerwick Head, designated F29, became operational in the Fire Command Post. The set covered an arc of 350°–0°–100° (TNA, WO 199/1133).

Rodel Park

Type	Radar station
Subtype	Chain Home Low (AMES Type 2)
Region	Harris (Western Isles)
NGR	NG 0528 8388
NMRS	NG08SE 4
In use	24 November 1941 – 26 January 1944

Installation work began at Rodel Park during August 1941. On 24 November, Air Ministry Experimental Station No 93A, Rodel Park CHL, went on the air and began plotting to Inverness via the teleprinter service from Stornoway. The maximum range achieved by Rodel during December was 125 miles and this was increased to 143 miles during January 1942. During March the station achieved a range of 40½ miles on a ship. In April a maximum range of an aircraft of 180 miles was recorded (TNA, AIR 26/92).

George Ross was a Radar Operator at Rodel Park during 1942:

Work on path-laying was still being carried out at the domestic site when I arrived there. I recall that several calibration flights took place during my early days there …

The work was extremely interesting and operators soon learned to differentiate between the permanent echoes (PEs) and the moving signals, and many interesting tracks were recorded. Two German reconnaissance aircraft, christened 'Weather Willie' and 'Atlantic Special' were plotted regularly in the early morning hours flying in the Orkneys-Shetlands area. They were supposedly at too great a height for interception. The Inverness-Stornoway mail plane, a twin-engined DH Rapide, was plotted daily flying in all weathers and, in addition to other traffic, there was a steady stream of Lease-Lend aircraft flying in from America via Iceland – Liberators, Mitchells, Hudsons, etc. … In addition to aircraft, half-hourly plots were taken on shipping – convoys which had assembled in Loch Ewe passed down the Minch. Weather reports were passed regularly to the Filter Room in Stornoway …

The longest range I can recall was 164 miles due east and off the Aberdeenshire coast. This was a very small echo and was only visible for a short time. I think it could have been an enemy reconnaissance aircraft to be picked up at such a height. It had no IFF anyway … Few long range plots were recorded east of the station due to the deflection of the beam by the mountains. While most of the activity was with aircraft, which were more readily picked up, experience taught us at which positions in the Minch signals from shipping would appear and disappear. These plots were taken half-hourly and visuals were easily obtained …

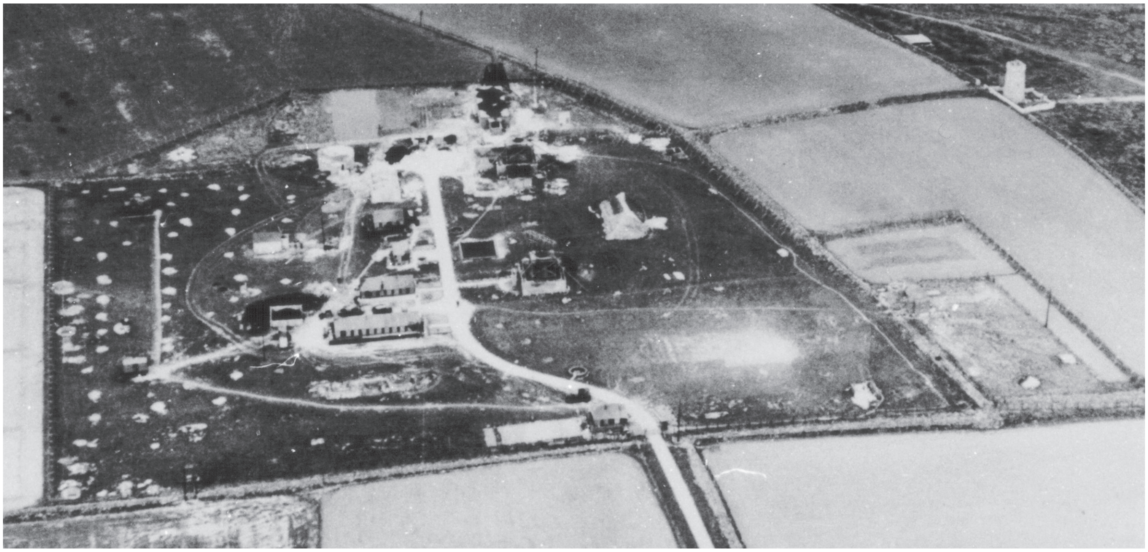
During gales, which sometimes lasted for days, the aerial had to be lashed. This rendered the station non-operational apart from picking up a signal on one bearing … Occasionally a request would come from the filter room: 'Can you see anything in such and such a position?' To do this the aerial was stopped and manually controlled for the search to be carried out, often with nothing to report, but occasionally with a signal detected in the clutter of PEs. (George Ross, pers comm)

In the November 1943 issue of HQ No 13 Group Bulletin, Rodel Park was commended 'for successfully plotting a/c [aircraft] of Scottish Airways through their mass of PEs' (HRA, HQ No 13 Group Bulletin).

Rodel Park CHL ceased operating on 26 January 1944, and dismantling of the equipment began immediately. The station was thanked by the Filter Officer 'for the grand job of work they have done whilst operational'. The searchlight, which had been installed in 1943, was dismantled on 2 February 1944 (TNA, AIR 26/92).

Rosehearty

Type	Radar station
Subtype	Chain Home Low (AMES Type 2), AMES Types 34, 37, 54
Region	Aberdeenshire
NGR	NJ 9319 6676
NMRS	NJ96NW 29
In use	February 1940 – 15 March 1946



120 Rosehearty from the air, taken on 4 May 1942. The 1941 Type CHL can just be seen at the far end of the site, with the combined T & R Block roof camouflaged.
(© J A Macdonald)

Air Ministry Experimental Station No 47A, Rosehearty was set up as part of the second 'crash' programme of rushed CHL installation. The programme was started in January 1940 and Rosehearty was operational by February (Air Ministry, 1950 (1): 85).

An aircraft was plotted at a range of 117 miles on 18 August 1941. This constituted a new record for Rosehearty, although it was quickly improved upon. The following month the VT58 transmitter valves were replaced with higher-power VT98s, and on 4 October a new record range of 137 miles was achieved (TNA, AIR 26/100).

Naval ratings were attached to Rosehearty on 16 October 1941, having been sent there from Aberdeen Naval Base. Their role was to man the telephone line to the naval base and pass on plots on surface vessels (TNA, AIR 26/100).

Continued improvements were made to the equipment and on 22 December 1941 a common transmitter and receiver aerial was commissioned, which improved both the performance of the station and also its efficiency (TNA, AIR 26/100).

At 6.25 pm on 29 January 1942 the Station Warning was sounded, indicating an unidentified aircraft was within 15 miles of the station. The aircraft was quickly established as hostile and at 6.30 pm an Air Raid Warning Red was issued by Fraserburgh Civil Defence Control Centre. The hostile attacked Rosehearty village, causing damage and casualties, although not the radar station itself. At 6.36 pm Rosehearty personnel opened fire with a Lewis gun in the North Block House on the radar site. A total of 44 rounds were fired, but because there were no tracer rounds it was not possible to determine whether hits had been achieved (TNA, AIR 26/100).

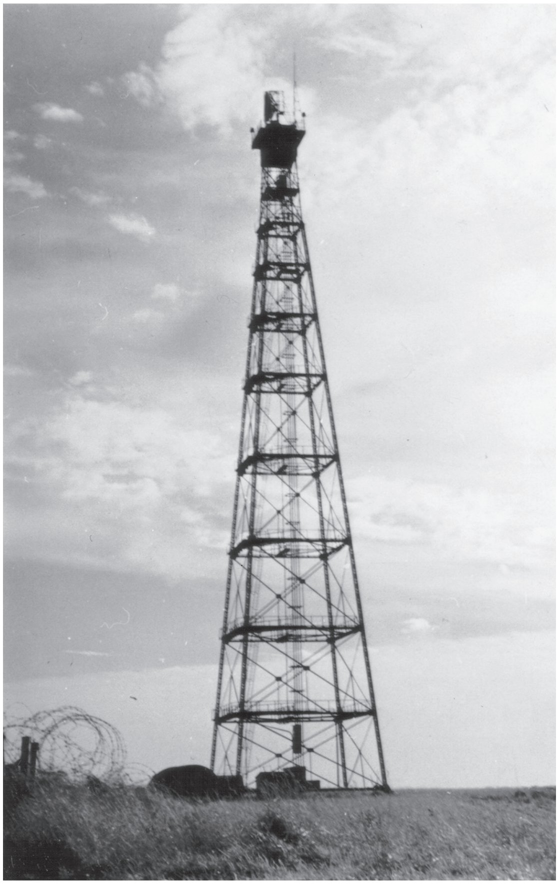
Progress was made with the new 1941 Type CHL when the new transmitter arrived on 11 March 1942. The turning gear arrived on the 31st. The receiver arrived during May but it was not until 13 August that the new station

121 Rosehearty 1941 Type CHL in 1943.
(© Alan Aitken)

finally went on the air. Further developments were made, with contractors starting work at the end of August on the erection of a 200 foot tower for a CD No 1 Mk VI (Tower) or AMES Type 34 radar. In the meantime, a CD No 1 Mk IV or AMES Type 37 mobile centimetric radar was installed in September and became operational on 3 October. This new equipment was operated by Royal Artillery personnel, with shipping plots passed to Aberdeen Naval Base. However, the Army staff were replaced by RAF personnel on 8 February 1943. The equipment performed consistently well and surface vessels were plotted up to 37 miles and aircraft to 40 miles. The Type 37 radar was removed in April 1944 (TNA, AIR 26/100).

The homing searchlight, for directing lost aircraft to the nearest aerodrome, was commissioned on 21 July 1943. It was first used operationally on 8 September, when it helped guide an aircraft in distress to a safe landing (TNA, AIR 26/92).

The tower-mounted Type 34 radar went into operation at 9.30 am on 12 October 1943 (TNA, AIR 26/92). The technical equipment was in a cabin at the top of the tower, with the paraboloid aerial above. This was the Army-style tower which had a lift to provide ready access for mechanics to the equipment (Air Ministry, 1950 (1): 635). Although the Type 34 resulted in improved ranges on surface vessels and low-flying aircraft, it had a short life and was soon replaced by a higher powered version, the Type 54, which came into use at



122 Rosehearty Type 54, 1943.
(© Alan Aitken)

10 am on 15 December. Surprisingly, it was not until 5 July 1944 that a PPI tube was installed in the Type 54. A second PPI was installed on 9 September (TNA, AIR 26/92).

On 21 April 1945 Rosehearty plotted outgoing anti-shipping strike aircraft of 43 de Havilland Mosquitoes escorted by 19 North American Mustangs heading for the Kattegat. At 4.34 pm, 29+ aircraft appeared east of Peterhead heading south-east. They faded from the CHL at a range of 43 miles but were followed out to 68 miles by the Type 54. At 9.04 pm, 3+ aircraft were picked up at 55 miles south-east as the aircraft returned. Very quickly, many other tracks appeared at roughly the same range. Rosehearty was congratulated for its work plotting these tracks (TNA, AIR 26/92). These tracks were, in fact, 42 Mosquitoes from Nos 143, 235, 248 and 333 Squadrons of the Banff Strike Wing and their escort of 24 Mustangs. Heavy rain and mist in the Kattegat frustrated their search for enemy shipping and the formation turned for home. On the return flight, the Mustangs having pulled ahead because of a planned party in the mess at RAF Peterhead, the Mosquitoes encountered 18 Junkers Ju 88s and Ju 188s returning from an armed reconnaissance of the east coast of Scotland. The German crews were overwhelmed and their force decimated, with only two German aircraft returning to make a crash landing at base. The Mosquitoes suffered no losses and returned safely (Bird, 2003: 154–6).

The beginning of the end for Rosehearty came at 12 pm on 26 May 1945 when the Type 54 ceased plotting surface vessels, although it continued watching aircraft. The lift was out of service for a period during June until the drive motor was replaced. The opinions of the mechanics can only be imagined! Further decline came at 12.30 pm on 7 November, when the CHL ceased reporting and was placed on care and maintenance the following day. The end finally came on 15 March 1946 when, with the closure of No 13 Group Filter Room, Rosehearty finally went off the air and was placed on care and maintenance (TNA, AIR 26/92).

Russland

Type	Radar station
Subtype	Ground Control of Interception (AMES Type 8)
Region	Orkney
NGR	HY 3013 1816
NMRS	HY31NW 62
In use	April 1942 – 6 November 1945

Air Ministry Experimental Station No 17G, Russland became operational during April 1942, the first GCI in No 70 (Signals) Wing area covering northern Scotland. Its performance was satisfactory, and it was hoped that more success with interceptions over the Orkney Islands would result. This happened almost immediately when, on 31 May, Russland 'co-operated successfully' in the interception of a Junkers Ju 88 which was severely damaged, but was believed to have limped back to base (TNA, AIR 26/92).

It was noted during June 1942 that Russland was a source of worry since it was not giving the high-flying coverage over Scapa Flow that was hoped for. A thorough overhaul was to be carried out, and it was hoped that an improvement would result (TNA, AIR 26/92).

Russland's performance during September 1942 was almost fadeless (ie the plot did not fade from the screen) on Supermarine Spitfires up to 30,000 feet to a range of about 50 miles, and heights were read on most plots. Some trouble had been experienced with differential height responses, but this was cured during the month (TNA, AIR 26/92).

Fire having destroyed the transmitter vehicle and transmitter at Russland, a stand-by transmitter was temporarily installed in a tent. A new vehicle arrived during January 1944 and was fitted with the new transmitter, which became operational on the 31st. Some delay had been experienced in getting the vehicle to Russland as shipping space was not available (TNA, AIR 26/92).

On 9 August 1945, HQ No 60 Group requested HQ No 70 Wing to investigate the possibility of siting the Russland convoy at Grimsetter aerodrome, as RAF Skeabrae was closing shortly. On 10 August an indifferent site for the convoy was found about 2 miles from Grimsetter. This information was communicated to HQ No 60 Group, who later the same day notified HQ No 70 Wing that Fighter Command did not wish any action in this matter to be taken at that time (TNA, AIR 26/92).

Authority was given for Russland GCI station to be transferred from Fighter Command with its existing care and maintenance establishment to HQ No 70 Wing with effect from 29 May 1946 (TNA, AIR 26/93). Russland GCI went off the air permanently at 6pm on 6 November 1945 (TNA, AIR 28/917).

St Cyrus

Type	Radar station
Subtype	Chain Home Low (AMES Type 2), CD No 1 Mk V (AMES Type 31)
Region	Kincardineshire (Aberdeenshire)
NGR	NO 7419 6407
NMRS	NO76SW 74
In use	February 1940 – 15 March 1946

Air Ministry Experimental Station No 45A, St Cyrus was built as part of the second 'crash' programme of rushed CHL station installation and became operational in February 1940 (Air Ministry, 1950 (1): 85).

Lauriston Castle, located 2 miles from the station, was requisitioned in April 1941 due to the acute shortage of billets in the village. Although the castle was somewhat dilapidated, by the end of the month all station personnel were accommodated and a canteen was being organised (TNA, AIR 26/100).

Tests of overland permanent echoes showed that the range of St Cyrus to the west was very limited as a result of these large PEs, although the station was giving good ranges otherwise. On 9 June 1941 a range of 121 miles was achieved on a civil aircraft, with ranges of 102, 104 and 110 miles on aircraft on 13 June. Despite the problem with permanent echoes, an overland aircraft was plotted at a range of 120 miles on 17 June (TNA, AIR 26/100).

Just before midnight on 15 May 1941, a hostile was picked up heading south-west. At the same time, a second plot appeared 2 miles behind the first one, the response being about 60% of the original track. The echoes merged and the second echo did not reappear. The echo was then identified as an aircraft. It was considered that the second echo was a mine, and the aircraft a minelayer. Pitreavie NPR was informed. Other hostile tracks were keeping the station busy at this time. On 25 June 1941 a Junkers Ju 88 was plotted by St Cyrus at a bearing of 45°. An unidentified aircraft, later identified as a fighter, was plotted following the bomber and the hostile track subsequently disappeared, the hostile having been destroyed. The station was complimented by the Filter Officer for its plotting of this track. On 11 July an unidentified track X8 was picked up and soon changed to H561. This aircraft bombed a convoy 15 miles east of the station, heading north. An aircraft was plotted emerging from the convoy echoes and was identified as F31, which turned out to be a Hawker Hurricane which shot down H561, a Heinkel He 111 (TNA, AIR 26/100).

A closer encounter with a hostile took place on 14 July 1941 when a Junkers Ju 88A-1 of Küstenfliegergruppe 506 crashed at Lauriston railway station at 4 pm (Ramsey, 1990: 55). Off-duty personnel from St Cyrus at Lauriston Castle took charge and carried the dead German aircrew from the aircraft, which was on fire. They remained guarding the wreck until relieved by Polish troops (TNA, AIR 26/100).

Hostile activity in the area continued, and on 16 August 1941 H57 was followed from a range of 35 miles south-east of St Cyrus in to the minimum range of the station, and then out again to 43 miles east. The aircraft bombed Montrose and damaged the main railway bridge. At 9.13 pm on 4 September 1941 H574 was picked up at a range of 22 miles to the north-east and was followed out to 30 miles south-south-west. A total of 40 plots were passed on, with the aircraft following the coast, 4 to 6 miles offshore. South of the Firth of Tay the aircraft circled and passed over land, before being picked up again 11 miles south of St Cyrus and plotted in to the ground ray. The hostile dropped three bombs in a field below the station, probably aimed at a dummy flare path there. The aircraft was followed out to 52 miles east-north-east, the last plot being taken at 10.16 pm (TNA, AIR 26/100).

The 1941 Type CHL with common aerial working and power turning became operational on 23 June 1942 and produced a satisfactory performance, although a slight discrepancy in the aerial alignment had to be corrected. July 1942 saw ranges up to 165 miles being achieved on aircraft, with ships carrying barrage balloons being seen up to 50 miles away. During December four hostiles were seen between heights of 3,000–4,000 and 7,000–8,000 feet, all plotted at ranges over 120 miles. A new long-range record of the station was set that month with a plot of 187 miles being achieved (TNA, AIR 26/100).

Installation of a CD No 1 Mk V (AMES Type 31) centimetric set was carried out at the same time as quarterly maintenance from 15 to 19 January 1943. It required some creative thinking to get the 2 ton wooden cabin on to its concrete bed without the assistance of a crane, but this was achieved with the use of volunteers. Communications between the CHL, Type 31 and Aberdeen Naval Base were installed on 22 January and, following instruction on the operation of the equipment from a Royal Artillery Sergeant, the 10 cm Type 31 became operational on 1 February (TNA, AIR 26/100).

On 15 February 1943 a severe gale hit the east coast of Scotland and the aerials at St Cyrus were lashed for 3½ hours. This was apparently the first time in the station's life that the aerials had been lashed. The station continued to perform well and in March there

123 St Cyrus 1941 Type CHL, with the combined T & R Block and 20 foot aerial gantry visible at centre right, taken on 16 February 1942.
(© Historic Environment Scotland)

was substantial hostile activity. Two raids on Newcastle were plotted accurately on 11 and 14 March, with hostiles seen on 23 and 24 March to the north and south of the station respectively (TNA, AIR 26/100).

Margaret Quinn was posted to St Cyrus from a very busy south coast station, a month or two after the Normandy landings in June 1944:

At first the peace and quiet was very relaxing – then, of course, it became boring. There was an admin WAAF officer there when I arrived but she left soon after and I did both admin and ops. I had a very good male sergeant in the Ops Room. There was little activity so all went smoothly. The men were billeted in the village; the girls were all in an old, cheerless and spooky castle – Lauriston Castle … We had no buses to Montrose, few liberty runs and morale was low. I did my best as I had been warned about the situation and I think I helped a little by arranging dances and inviting nearby service personnel to the castle. Also we played badminton in Montrose and had more transport provided. (Margaret Quinn, pers comm)

On 30 August 1944 the Type 31 radar went off the air. Although this was a result of the high-power Type 55 radar becoming operational at Douglas Wood on 14 July, the Type 55 did not quite cover the gap left by the closure of the St Cyrus Type 31, and surface cover in the area suffered as a result. During September 1945 a site was selected on the station for a Type 13 Mk II centimetric height finder, and the equipment arrived in November (TNA, AIR 26/92). Installation began soon after but it is not clear that it was ever completed. Certainly, at 2.20 pm on 15 March 1946, with the closure of No 13 Group Filter Room, St Cyrus ceased operating. Dismantling began almost immediately and by 15 May the technical equipment had been removed to Schoolhill for storage (TNA, AIR 26/93).

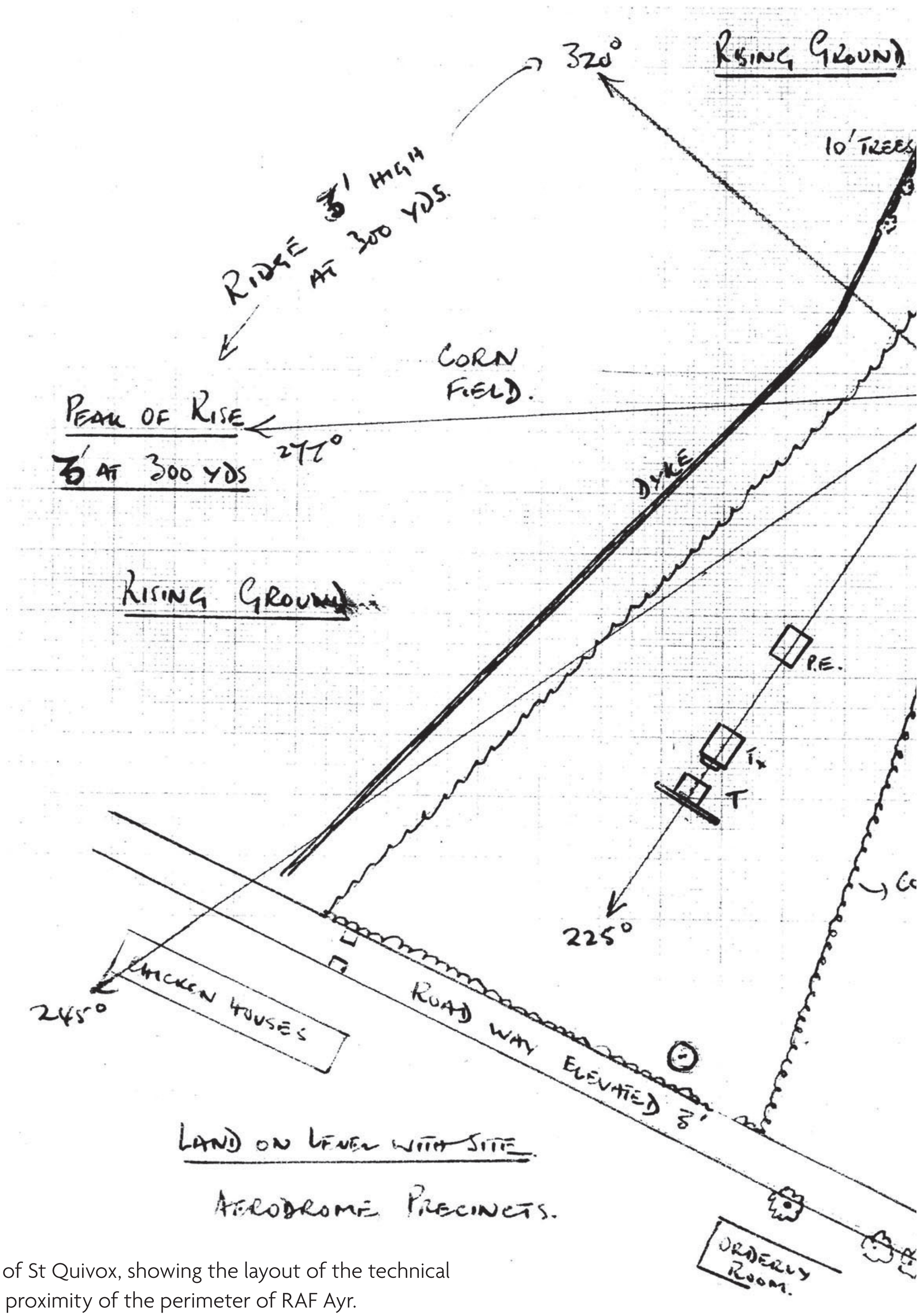
It has been claimed locally that there was a tower with a lift on the station, in which someone was killed. It would appear that the equipment referred to is a Type 54 which was mounted on a 200 foot tower, with which St Cyrus was never equipped. Thus, it is quite certain that the reference to St Cyrus is erroneous.

St Quivox

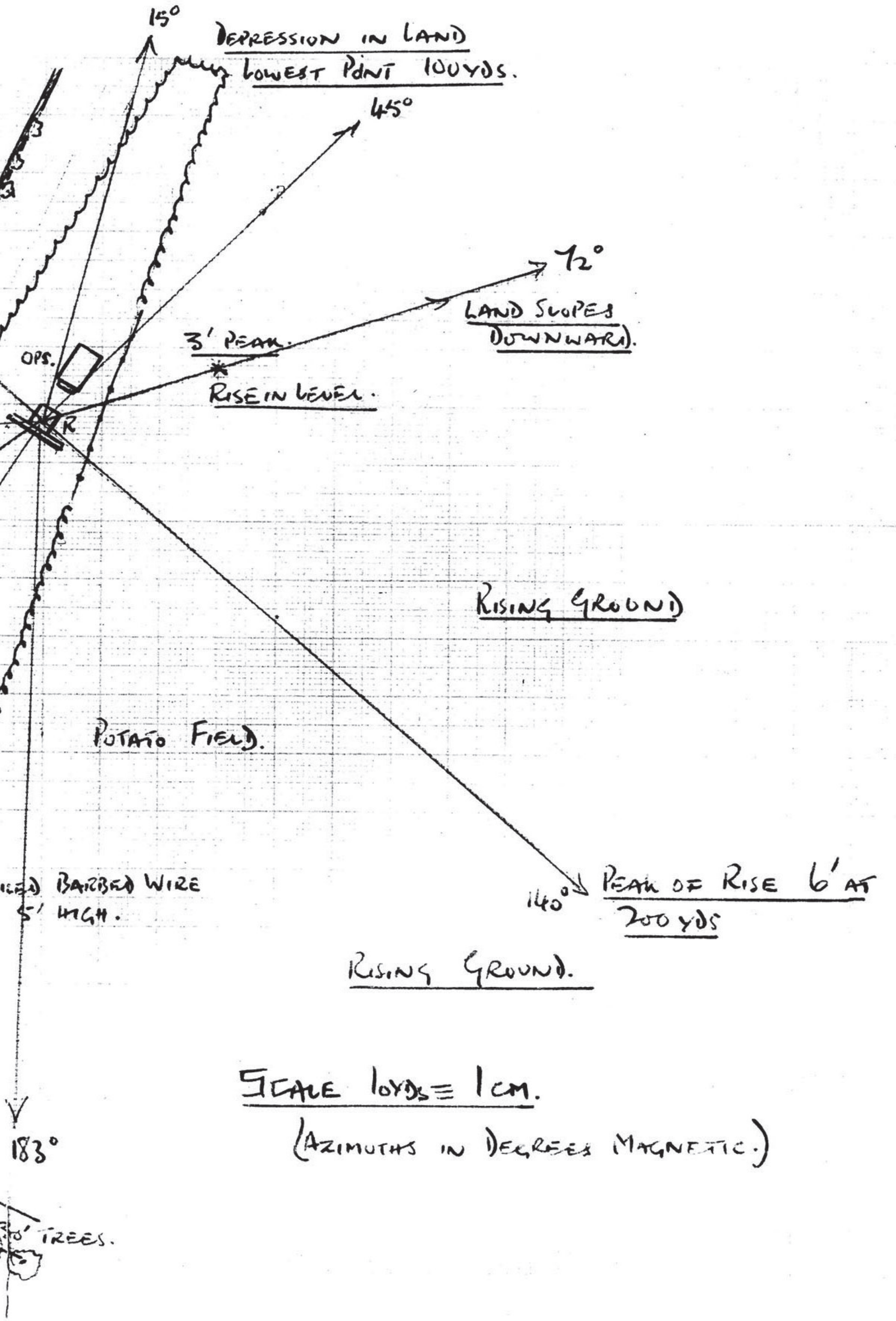
Type	Radar station
Subtype	Ground Control of Interception (AMES Type 8)
Region	Ayrshire (South Ayrshire)
NGR	NS 3626 2505
NMRS	NS32NE 142
In use	12 April 1941 – 13 January 1942

On 4 April 1941 the installation of a mobile GCI radar at St Quivox commenced, with the station, designated Air Ministry Experimental Station No 15G, becoming operational on 12 April (TNA, AIR 26/103).

The Sector Controller at RAF Ayr was



124 Sketch plan of St Quivox, showing the layout of the technical vehicles and the proximity of the perimeter of RAF Ayr.
(© The National Archives AVIA 7/1309)


15°
DEPRESSION IN LAND
LOWEST POINT 100YDS.
45°
72°
LAND SLOPES
DOWNWARD.
3' PEAK.
OPS.
RISE IN LEVEL.
R
RISING GROUND
POTATO FIELD.
BARBED WIRE
5' HIGH.
140°
PEAK OF RISE 6' AT
200 YDS
RISING GROUND.
SCALE 10YDS ≡ 1CM.
(AZIMUTHS IN DEGREES MAGNETIC.)
183°
TREES.

Squadron Leader Sir Archibald Hope, and he recalled the siting and operation of the GCI station:

a party … arrived to find a suitable site. They wanted a flat area measuring not less than half-a-mile in each direction. It was impossible to find such a site anywhere near Ayr and the whole siting project was about to be abandoned when I suggested to them that if they put the station right on the edge of the aerodrome they would have the site they wanted. Oddly enough, this simple solution had not occurred to anyone in the survey party! However, the station was established almost in line with one of the main runways. The permanent 'clutter' extended to no more than 4 to 5 miles from the station. Had it been less than this we might well have invented for ourselves the prototype Ground Control Approach system which was not perfected until many years later!

At Ayr we had two night fighter squadrons to control from the station … The Blenheim's AI was pretty ineffective and the Defiants were too slow to catch anything. However, it was a Defiant which one night [10 May 1941] was sent up to pursue a raider which we had detected on our GCI as flying across … Scotland. This plot was followed until it went beyond our range over Arran. Shortly after, it reappeared flying back along the same course, until it suddenly faded off the radar about 25 miles north-east of us. Not until next morning did we learn that this was the Me 110 flown across Britain by Rudolf Hess. (Bushby, 1973: 144–5)

At the end of August 1941 it was noted in the Operations Record Book of No 72 Wing that the score of St Quivox GCI 'remains at two Swastikas' owing to a lack of enemy activity in the area (TNA, AIR 26/103). It has not been possible to positively identify the two 'kills' achieved by fighters under St Quivox control. However, it is extremely likely that the bombers were shot down by Boulton Paul Defiants of No 141 Squadron during the raids on Clydeside in early May 1941, and may have been the Heinkel 111H-5 5J+IH shot down by Sergeant Laurence and Sergeant Hithersay on 5/6 May and the Junkers Ju 88A-5 M2+CK shot down by Squadron Leader Wolfe and Sergeant Ashcroft on 6/7 May (TNA, AIR 50/61; Ramsey, 1988: 590, 592).

Eric Folkson was posted to St Quivox from Kent around September 1941:

St Quivox was unusual in that it was not on a remote site but virtually part of RAF Heathfield, Ayr, a wartime fighter station to cover Glasgow.

The station CO was W/C Guinness and the local sector ops room was a large country house called Rosemount. Controllers included a number of ex-Battle of Britain pilots: S/Ldrs Riddle, Gemmel, Hope & Bazin.

There were no WAAFs at St Quivox. The crews were all male & accommodated & fed by RAF Heathfield. The exception was myself, a Sergeant Radar Mech at the time. Possibly because the Sergeants' Mess was full, I found myself in a very comfortable civilian billet with a delightful Scottish family in Prestwick, only a couple of miles away & easily traversable on my motorbike. Returning to the billet in the small hours after a 'panic' at the station, I would switch-off the engine of my noisy old Norton and coast the last few hundred yards to avoid waking the neighbours.

As there was no technical officer, I enjoyed the title of NCO i/c St Quivox which appeared on all station paperwork … There was not a great deal of hostile activity; Practice Interceptions comprised most of our work. Prestwick was, of course, a main staging post for aircraft ferried across the Atlantic. On odd occasions Heathfield would be used as a take-off point for government *missions to Canada & USA. Usually Liberator or similar aircraft would be used. There was a horrific incident once when the aircraft failed to lift off and exploded in a ball of fire.*

It became evident that the coverage from St Quivox was much inferior to other GCIs. After some operational research … which proved the blind areas, a decision was made to move the station to a new site … at Fullarton. (Eric Folkson, pers comm)

On 13 January 1942 the mobile GCI convoy from St Quivox was established at Fullarton, approximately 8 miles away (TNA, AIR 26/103).

Saligo

Type	Radar station
Subtype	Chain Home (AMES Type 1)
Region	Islay (Argyll and Bute)
NGR	NR 2149 7227
NMRS	NR26NW 54
In use	21 December 1940 – 7 March 1945

Air Ministry Experimental Station No 58, Saligo (sometimes known as Saligo Bay), was a West Coast type CH station. The Advance CH station at Saligo became operational at 10 am on 21 December 1940, but was not in communication with North Western Filter Room at that time. In fact, it was 11 January 1941 before Saligo plots began to be passed to the filter room, being sent by W/T to North Cairn in code using a fictitious grid which was changed at frequent intervals. North Cairn decoded the messages and passed the grid references to the filter room. This complex procedure, accompanied by frequent W/T failures, was a considerable handicap to the usefulness of Saligo (TNA, AIR 29/141).

Leading Aircraftman Wylie Barrett was posted to Saligo on 13 August 1941:

On arrival at Port Charlotte we found that our home was an old distillery warehouse. The kitchen and dining area was on the lower concrete floor and sleeping dormitory on the second floor. There was no heat except for the cook's stove. There was only a trickle of fresh water from up in the hills behind the village. Washing our fine things was either done in brown peat water heated on the stove or in the stream that flowed near the radar site. The toilet was a few Elsans which the ACH/GD [Aircrafthand/General Duties] bloke was supposed to empty on a daily basis. For baths once a week we were scheduled at the bath in the distillery at Bruichladdich about two miles distant.

We cycled to Bruichladdich for that nice warm bath in the brown peat water which is about the colour of McEwans ale but is as soft as milk. At Port Charlotte we lacked some of the comforts such as sheets to cover the three hard biscuits [solid, square mattresses] on each cot. Pillows were also missing, yet no-one complained.

The radar site was located at Saligo Bay, about ten miles overland by quite a rough road. The worst part of that journey were the fumes from the exhaust which seemed to swirl up into the canvas *covered back of the Commer vehicle. The Flight Sergeant rode in front with the driver.*

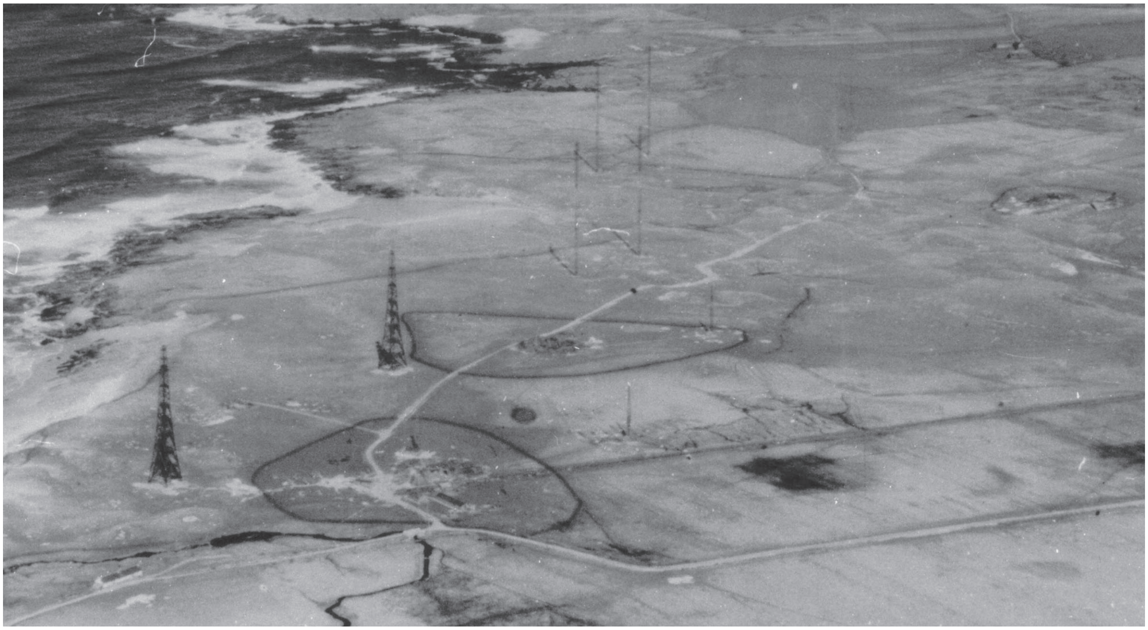
At Saligo Bay the radar then was of the ACH type. Transmitter and receiver buildings were wood frame surrounded by sandbags. In the diesel house were two three-cylinder Lister diesels. There being no local hydro power, the diesels ran continually. Technical equipment for the station included a T3018 radar transmitter, R3020 radar receiver, T1087 transmitter and SX-25 Hallicrafters receiver for passing plot information by CW (Morse) to Dundonald in Northern Ireland. The transmitter and receiver towers were of the transportable type, 105 feet in height. At the time … all personnel at Saligo Bay were RAF or, in my case, RCAF on attachment. The construction of a West Coast CH type station was in progress as was living accommodation at Coille, about three miles distant … The coming of WAAF ops was scheduled for 1942 …

During my first tour at Saligo, in addition to normal 23 hours per day [with one hour routine maintenance each day], seven days per week operations, there were a few incidents … The first I shall mention was the wrecking of a cargo ship on the rocky coast nearby during a bad storm. I do not remember the name of the ship[6] *but it was bound for the Middle East with a mixed cargo ranging from railway locomotives, bolts of cloth, whisky, cigarettes to such articles as boxes of pocket combs. As the ship piled up on the rocks the crew were able to shoot a line ashore. Personnel from our station received the crew and took them to our old distillery building, giving them a meal and a bed. During the night the ship broke in two and the articles that would float washed ashore along with oil and tar, and lodged among the rocks. The coastguard soon put a watch detail on the land approaches to the wreck. However, that left access by way of the beach. About half-a-dozen of our ranks, me included, planned a mission to investigate what might be available in the way of salvage. A very dark night with light rain falling, we blackened our faces and made our way quietly along the beach to the scene of the wreck. There we started feeling among the debris where it seemed that the round tins containing fifty cigarettes were the chief item that could be had. Each of us had a sandbag which in short time we had full of the round cans. Back at the radar site we stashed the sacks until morning. In the morning we washed the tar off the cans with turpentine from a 45-gallon drum we had previously salvaged. It turned out that we each had about fifty cans of the best cigarettes such as State Express 555, Philip Morris, etc. One of our fellows was not so lucky. In the darkness he had misjudged the weight of a can of cigarettes. When he washed his booty he had nearly 50 cans of Andrews Liver Salts but no cigarettes. The value of cigarettes took a nosedive for a while. In barter, a can of cigarettes would be fair exchange for a box of Swan Vesta matches.*

The workmen who were then constructing the buildings for the West Coast CH type station also visited the wreck and came away with quantities of whisky. The workmen were accommodated in a camp for workers at Ballinaby, near our radar site. Apparently they indulged too heavily on the whisky and became unmanageable to the point of setting fire to their canteen. The camp boss appealed to our CO for help to restore order. So a company of about fifteen or twenty of our fellows marched into the camp with Lee Enfields, fixed bayonets and empty clips. There wasn't a workman to be seen and the camp was quiet.

Early in May 1942 I received notice of a

6 SS *Floristan*, wrecked on 19 January 1942 (Moir and Crawford, 1994: 79).



125 Saligo from the air, with the two 240 foot receiver towers visible at lower left and the four 325 foot transmitter masts in the upper centre of the photograph.
(© J A Macdonald)

126 Saligo, 1945.
(© Imperial War Museum London CH16469)

posting to Port Mor on the island of Tiree. (Wylie Barrett, pers comm)

In October 1942, to replace a damaged mast at Saligo, one of the 105 foot masts from Port Mor Advance CH was transported by air from Tiree to Islay (TNA, AIR 26/103).

Saligo established liaison for the interest of Radar Operators, with No 246 Squadron operating Short Sunderland flying boats from Bowmore. On 24 January 1943 Saligo assisted a Sunderland to reach Bowmore, but it crashed on landing (TNA, AIR 26/103). In fact, the aircraft clipped the roof of a cottage coming in to land and crashed on the edge of Loch Indaal. The crew got free only to discover the rear gunner was trapped in the aircraft. They returned to the Sunderland just as the depth charges on board exploded. Nine of the crew of twelve were killed (Hughes, 1998: 89–90). Also as part of the co-operation with local flying boats, an ASV beacon was erected at Saligo on 16 June 1943 (TNA, AIR 26/103).

The Final CH station was calibrated during August and September 1943. At the end of January 1944 the Advance CH equipment and masts were dismantled. The Advance CH receiver was finally disposed of in March 1944 to HQ No 72 Wing (TNA, AIR 26/103).

At 12 pm on 7 March 1945 Saligo CH ceased reporting and was placed on Care and Maintenance Stage I, meaning that it should be kept ready to return to operations at 14 days' notice (TNA, AIR 26/92).

127 Leading Aircraftman L K Williams cleaning the feeder insulators on one of the 240 foot receiver towers at Saligo.
(© Imperial War Museum London CH16470)

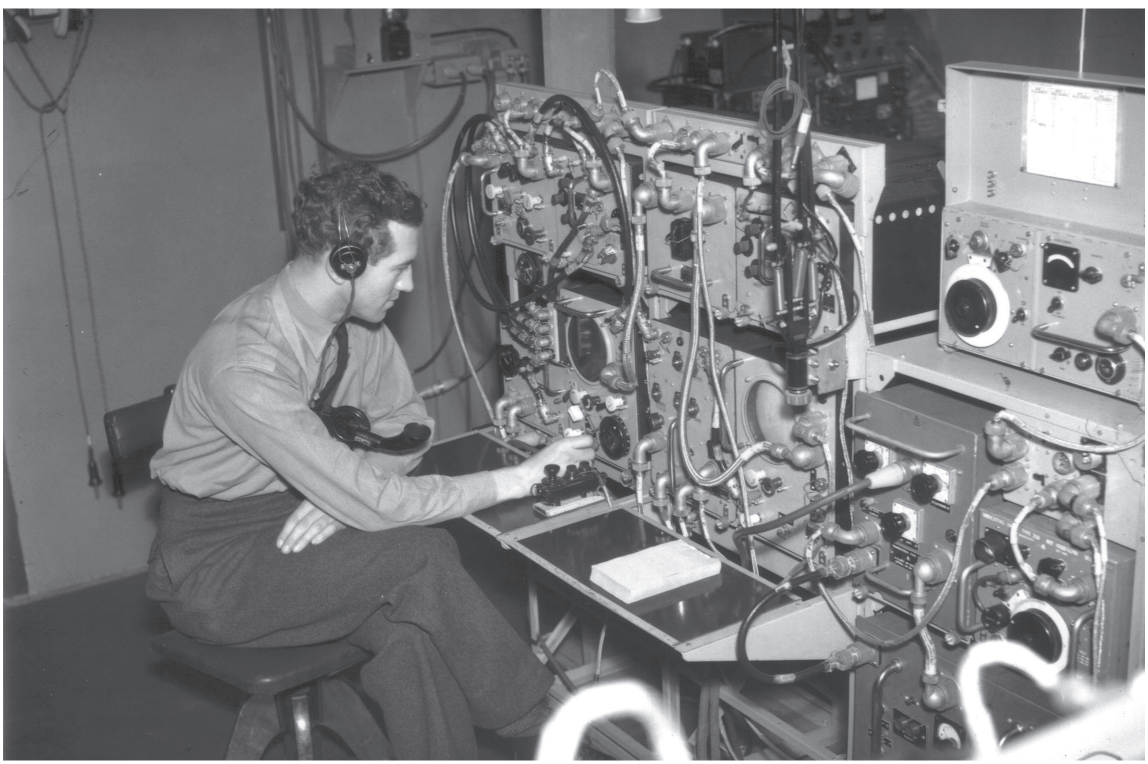
Saligo

Type	Radio Navigational Aid station
Subtype	Gee Slave (AMES Type 100)
Region	Islay (Argyll and Bute)
NGR	NR 2149 7227
NMRS	NR26NW 54
In use	23 March – 1 November 1945

RAF Saligo was an operational CH radar station when it was chosen for the site of the Master station in the North Western Type 7000 Chain. This was the ground component of the Gee radio navigational aid system.

The Type 7000 station was designated Air Ministry Experimental Station No 7411, and installation of the equipment was completed on 9 March 1945. At 4 pm the following day prolonged tests began and were completed on 22 March. The station finally became fully operational at 6 pm on 23 March 1945 (TNA, AIR 29/167).

The station was established as a mobile unit,



128 Leading Aircraftman L K Williams tuning and setting up impulses on an indicator unit of the Type 100 equipment.

operating with Light Transportable Type 100 sets, but was re-established as a section of the CH station, with the change taking place on 26 March 1945 (TNA, AIR 26/92).

After only 7½ months on the air, the North Western Type 7000 Chain closed down at 6 pm on 1 November 1945. Dismantling of the equipment began later that month (TNA, AIR 26/92).

Sango

Type	Radar station
Subtype	Chain Home (AMES Type 1)
Region	Sutherland (Highland)
NGR	NC 4108 6738 (Sango)
NMRS	NC46NW 22
In use	30 December 1940 – 7 November 1945

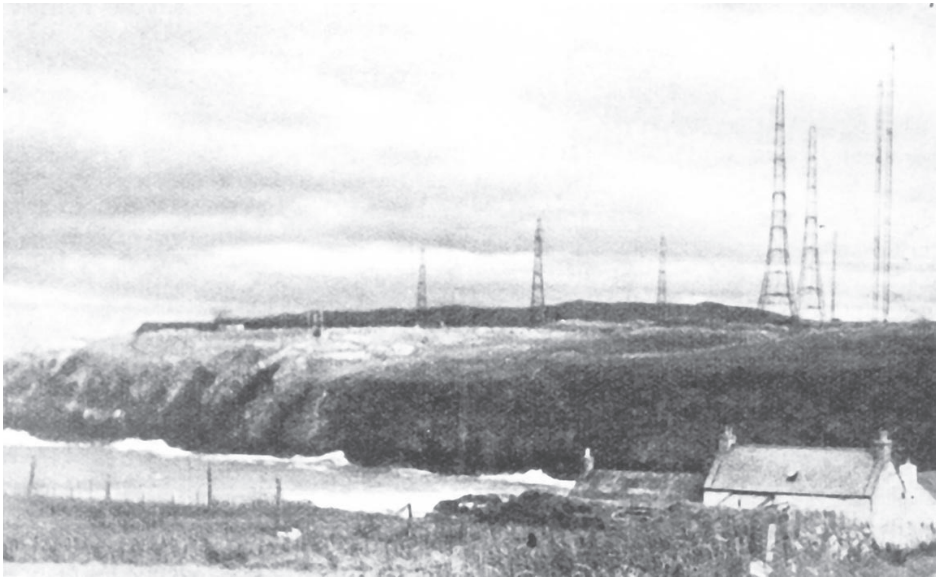
Type	Radar station
Subtype	Chain Home Low (AMES Type 2)
Region	Sutherland (Highland)
NGR	NC 4150 6780 (Sango (Smoo))
NMRS	NC46NW 22
In use	31 August 1941 – 7 November 1945

A survey team visited the Cape Wrath area in 1940 to select a site for a CH and a CHL station. The cape itself was not visited due to insurmountable transport problems, and a site was instead selected on a headland 1 mile east of Durness village. To avoid confusion with the CHL station at Deerness on Orkney, the station was to be named Sango (Bragg, 2002: 229).

A party of 12 men from No 2 Installation Unit left for Sango on 28 September 1940 to begin erection of the Advance CH station. The masts and equipment were shipped on 3 November and erection of the masts began on 18 November, and was completed three days later. The transmitter and receiver were in position and wired by the end of November and the station reported as operational, apart from problems with W/T communications on 13 December. The Advance CH, Air Ministry Experimental Station No 57, became fully operational on 30 December (TNA, AVIA 7/372).

Eric Brittin was posted to Sango on 29 November 1940:

It is a very lengthy journey to the north of Scotland and I travelled in a train which was known as the Jellicoe, as most of its passengers were sailors. It steamed out of Euston at 7.30 pm in the evening and did not arrive at Thurso until noon the next day. But I did not travel all the way, leaving the train at Inverness to report to the headquarters of 70 Wing at Bunchrew House, a few miles out of the town. From there I went to Sango with Sgt Stonier and Corporal Rooney catching the train at



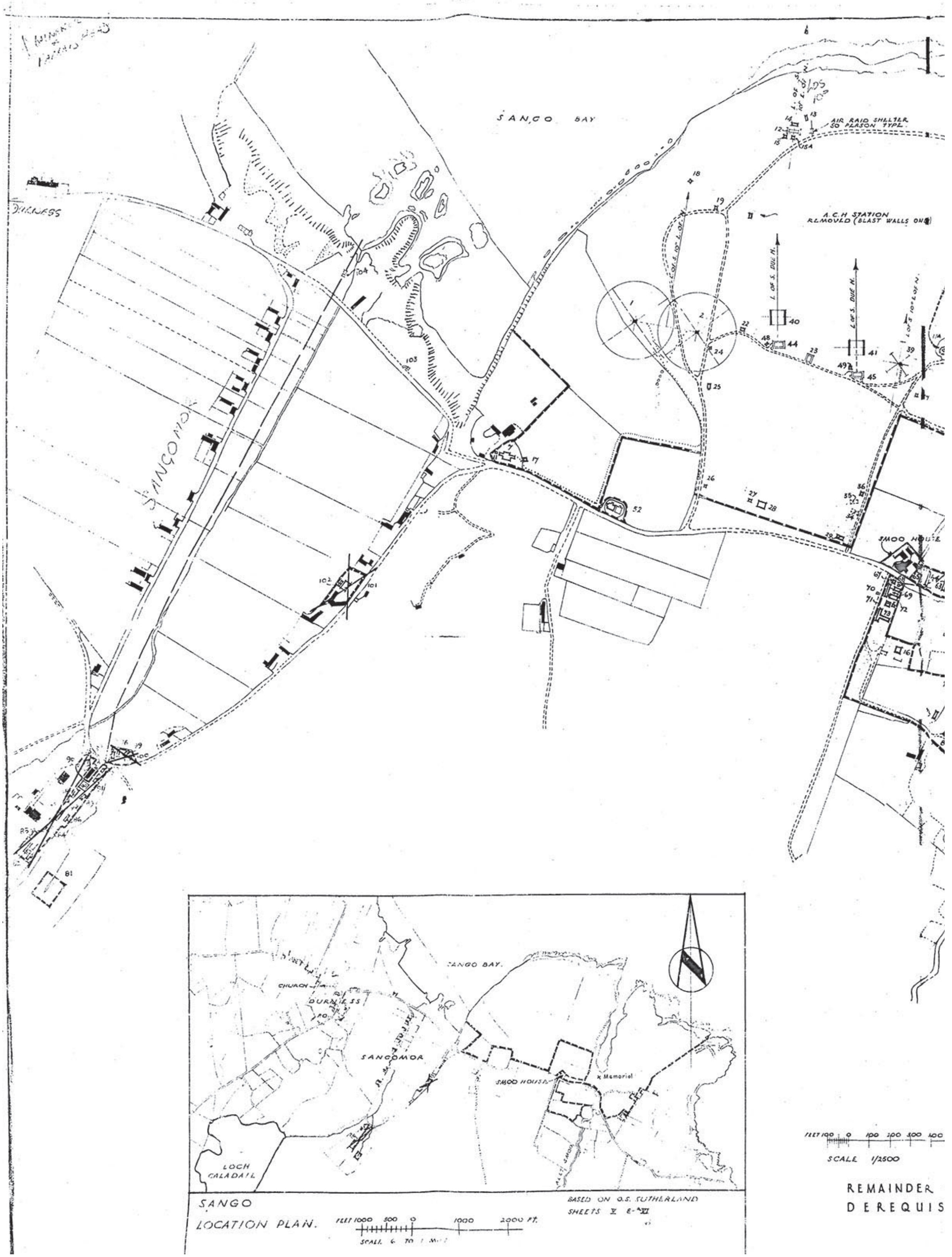
129 Sango, with the 325 foot transmitter masts and 240 foot receiver towers of the CH station on the right and the CHL station on the left. The three towers in the centre were part of the Type 7000 Radio Navigational Aid station.
(© Freddie Smith Collection)

Inverness. We left it at Lairg where the line veers off to the east and runs up the coast, and caught the post bus. There were eight passengers and it was loaded with luggage, including a quantity of dried fish. During the journey the driver stopped and refreshed himself with a wee dram – it was a fantastic experience!

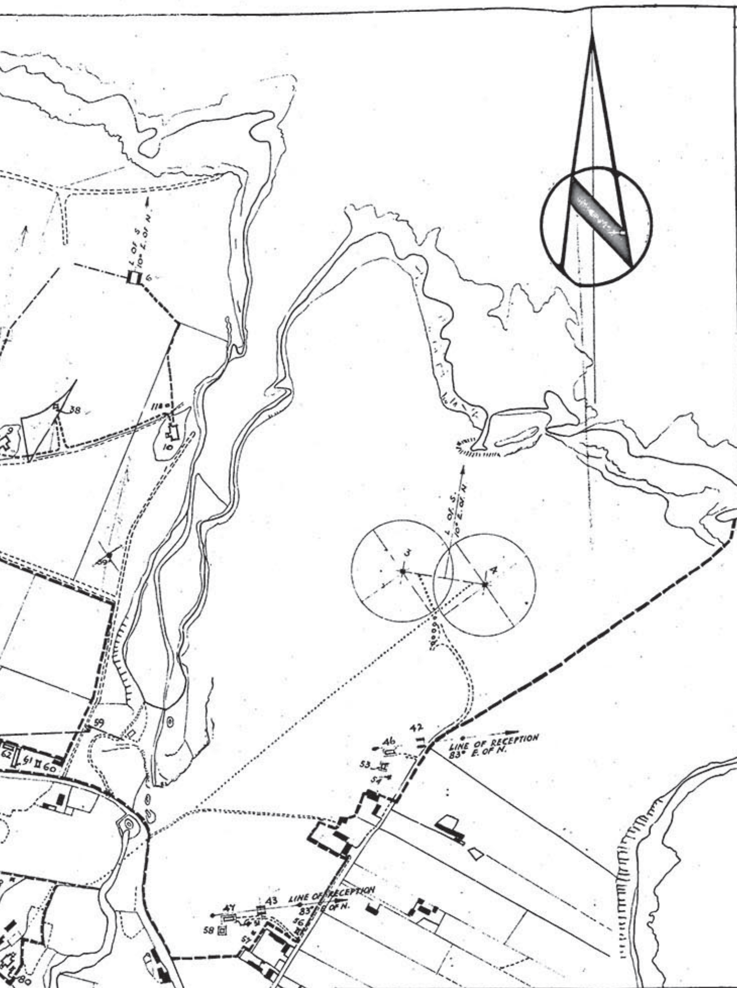
When we arrived at Durness we discovered that the CH station was not yet ready and neither was the domestic accommodation, so we were billeted in the Parkhill Hotel with the MacKay family. They were wonderful people and Mrs MacKay was a superb cook, particularly of the local salmon. They also kept the local shop and I would help there and was sometimes entrusted with the takings which I would bank for them at Lairg.

You can imagine how sorry I was when the time came for us to move out. Our new home was Smoo Lodge, next to the famous Smoo Caves. It was owned by the brewers Buxton, Truman and Hanbury whose top brass stayed there on fishing trips in peacetime. The CH station which had been built was under the command of Fl/Lt Bennett – a very good officer. It was a diesel powered station which worked on shifts and we used to work to the Filter Room at Kirkwall by wireless telegraphy for passing messages. It was generally a very quiet posting and we had few positive responses …

In summer the midnight sun was the big attraction and we would often lie on the high wall which surrounded the station reading newspapers, but things were different in winter. The winds were so strong that a rope was stretched from the house to the station so that we could hang on and not be blown away when the gusts were at their worst. And it snowed very hard; once it was up to ten foot deep and, with the roads blocked, our stocks of diesel ran low. Supplies were sent by boat which we had to haul up to the station. The food situation became acute and Lancaster



130 Sango site plan. (© Historical Radar Archive)



BLDG Nº	BUILDING	CONSTRN	TYPE	DWG. Nº
24	TRANSFORMER PLINTH.			18560/40
25	ARMOURY	T.B.		600P/14A/41
26	WATCH HUT			
27	FILTER			
28	RESERVOIR 20,000 GLS.			
29	BARRACK HUT 38' X 17'4"	C.A.		
30		C.A.		
31		C.A.		
32		C.A.		
33		C.A.		
34	D° FLOOR ONLY 38' X 17'4"	C.A.		
35	D° D° D° 38' X 17'4"	C.A.		
36	FIRST AID POST			WA15/35/43
37	TRANSFORMER PLINTH.			18560/40
38	V.E.B. BUILDING	P.C.M.		6804/41
~~38A~~	~~V.E.B. 240' TIMBER TOWER. MK II~~ — BLOWN DOWN			
39	COMBINED 'T' & 'R' CUBICLE & 105' MAST MK II	P.B.		8872/41 15046/41
~~39A~~	~~COMBINED 'T' & 'R' CUBICLE~~ - (MAST REMOVED)	P.B.		8872/41 15046/41
40	'T' 350' STEEL TOWER			
41	'T' D° D° D°			3735A/36
42	'R' 70' TIMBER TOWER			3735A/36
43	'R' D° D° D°			3434/42
44	TRANSMITTING HUT	N.T.		3434/42
45	D° D° A.M.E.S. 7000	"		3335/42
46	RECEIVING HUT	"		3335/42
47	D° D°	"		15014/41
48	LATRINE BLOCK.	T.B.	'B'	15014/41
49	D° D°	"	'B'	15014/41
50		"	'A'	15014/41
51	D° D°	"	'A'	8328/42
52	POWER HOUSE	N		3573/42
53	STAND BY SET HOUSE AMES 7000	N.T.	1 SET.	18560/40
54	TRANSFORMER PLINTH.			WA15/72/44
55	WATCH HUT 16' X 18'	N		WA15/74/44
56	GUARD HUT 16' X 18'	N		18560/40
57	TRANSFORMER PLINTH			3573/42
58	STAND BY SET HOUSE AMES 7000	N.T.	1 SET.	
59	SEPTIC TANKS. 2Nº 10'X4' DIA. CONC. PIPES			
60	ORDERLY ROOM.			
61	BARRACK HUT 70' 0"	T		1575/41.
62	BATH & ABLUTIONS.			
63	BARRACK HUT 70' 0"	T		1575/41
64	D° D° 80' 0"	"		1575/41.
65	FUEL COMPOUND			
66				
67	STATIC WATER SUPPLY 5000 GAL.			
68	TRANSFORMER PLINTH			18560/40
69	OFFICERS' MESS & QTRS : STATION H.Q.	T	-	1576/41 600/20/45
70	INCINERATOR 4'X4'X4'	B		
71	COAL COMPOUND.	CHAIN LINK		6869/36.
72	TRANSFORMER PLINTH.			18560/40.
73.	DINING ROOM & SGTS. MESS.	T		1576/41.
74				
75				
76				
77				
78	TRANSFORMER PLINTH.			18560/40
79	GUARD HUT 38' X 17'4"	C.A.		WA15/87/42
80	LATRINE.			
81	RESERVOIR - 12,500 GAL. & FILTER			
~~82~~	~~RAF DINING RM. & INSTITUTE.~~			WA15/453A/42
83	RATION STORE			WA15/421/42
84	SICK QUARTERS.			
85	BARRACK HUT R.A.F. 60' 0"			
86	SLEEPING SHELTER	P.B.		15476/40
87	BARRACK HUT R.A.F. 60' 0"			
88	D° D° D° 60' 0"			
89	D° D° D° 60' 0"			
90	COAL COMPOUND			
91	BATH & ABLUTION			WA15/453A/42
92	SGTS. ABLUTIONS & LATS & OFRS DRY RM.			WA15/453A/42
93	FIRE TRAILER PUMP HOUSE (ORIGINALLY PETROL STORE)	T		1575/41
94	TRANSFORMER PLINTH.			18560/40
95	M.T BUILDING	T		1575/41.
96	WORKS SERVICES OFFICES.			
97	BARRACK HUT	N		WA15/453A/42
98	D° D°	"		WA15/453A/42
99	D° D°	"		WA15/453A/42
100	EQUIPMENT STORE			600P/72/42
~~101~~	~~EQUIPMENT STORE (ORIGINALLY BUILT AS POWER HOUSE)~~	~~P.B.~~		~~3298/41.~~
~~102~~	~~LATRINE~~			
103	G.P.O. CARRIER TERMINAL BUILDING	P.B.		10360/41
104	SEPTIC TANKS. 2Nº 10'X4' DIA. CONC. PIPES.			

DEREQUISITIONED

SCHEDULE OF BUILDINGS

BLDG Nº	BUILDING	CONSTRN	TYPE	DWG. Nº
1	'T' 325' STEEL GUYED MAST.			6839/40
2	'T' D° D° D° D°			6839/40
3	'T' D° D° D° D°			6839/40
4	'T' D° D° D° D°			6839/40
~~5~~	~~'R' 240' TIMBER TOWER~~ — BLOWN DOWN			~~3889/40~~
~~6~~	~~'R' D° D° D°~~ — 90' STUB (EX 240' TOWER BLOWN DOWN)			~~3889/40~~
7	'T' BLOCK.	P.C.M.		16091/40
?— 8	'T' BLOCK	"		16091/40
9	'R' BLOCK	"		16087/40
10	'R' BLOCK	"		16087/40
11	LATRINE BLOCK	.		WA15/87/42
11A	D° D°			D°
11B	D° D°			D°
12	COMBINED 'T' & 'R' BLOCK	T		4275/41
13	LATRINE			WA15/87/42
14	20'0" TIMBER GANTRY. A.M.E.S. 2			432/41
15	TRANSFORMER PLINTH.			18560/40
15A.	STAND BY SET HOUSE	T.B.		16444/40
16	STAND BY SET HOUSE.	P.C.M.		1235/41
17	GUARD HUT 16' X 18'	N		
18	RESPONDER BEACON 12' X 10'	T		
19	NISSEN GENERATING HOUSE 18 X 18'	T.B.		
20	GUARD HUT 16' X 18'			
21				
22	GUARD HUT 16' X 18'	N		
23	STAND BY SET HOUSE AMES 7000	N.T.	2 SETS.	3573/42.

A M E N D M E N T S

CONSTRUCTION ABBREVIATIONS

B.	—	BRICK.
T.B.	—	TEMPORARY BRICK BUILDING.
P.B.	—	PERMANENT D° D°
P.C.M.	—	D° CONCRETE D° MOUNDED
T	—	TIMBER HUTTING
N	—	NISSEN D°
N.T.	—	D° D° TRAVERSED.
C.A.	—	CURVED ASBESTOS HUTTING.

BASED ON WORKS AREA DRG. WA15/397/42

SANGO (A.M.E.S.)

RECORD SITE PLAN

SCALE : 1/2500 & 6" TO 1 MILE.

500 1000

N O T E

THIS IS A SECRET DRAWING. UNDER NO CIRCUMSTANCES MUST IT BE REPRODUCED. IT IS NOT TO BE SEEN BY UNAUTHORISED PERSONS, MUST BE KEPT UNDER LOCK & KEY WHEN NOT IN USE AND ITS SAFE CUSTODY IS THE RESPONSIBILITY OF THE PERSON TO WHOM IT IS ISSUED.

S.E.	SECRET No.	D. G. OF W.
No. 15 WORKS AREA.		W.A15/8/45.
H.H. JAN. 1945.		AIR MINISTRY.

OF STATION
ITIONED 27·12·57.

bombers came over and supplied us by parachute. Many of the 'chutes hit the rocks and split open but we got our food and did not starve. (Eric Brittin, pers comm)

The station had a difficult start, as Eric Brittin relates, and when in January 1941 Sango was cut off by heavy snow, the rations were dropped to it on home-made parachutes from a Hawker Hurricane fighter based at RAF Castletown (Smith, 1983: 64).

Work on the installation of a CHL within the CH compound began on 10 July 1941. By the following day the technical buildings were nearing completion. The CHL turning gear was delivered on 16 July, and on the 20th the gantry erection was completed and turning gear was being installed. The CHL station, Air Ministry Experimental Station No 57A, became operational on 31 August, with an angle of sweep of 300°–0°–110°. Although officially part of RAF Sango, the CHL was also often known as Smoo (TNA, AVIA 7/372). The maximum range for the two Sango stations during October was noted as 117 miles for the Advance CH and 80 for the CHL (TNA, AIR 26/92).

The Power House at Sango was extensively damaged during July 1942 when a flywheel on one of the engines disintegrated at speed. The station went over to stand-by power supply and remained operational. Further misfortune visited Sango when a gale blew down an IFF mast during December 1942. Despite these setbacks, the Final CH station at Sango became operational on 12 January 1943, with transmitting curtain arrays suspended between 325 foot steel guyed masts and receiving aerials mounted on 240 foot wooden towers (TNA, AIR 26/92).

During August 1943 a searchlight became operational at Sango for directing aircraft in distress to a suitable aerodrome. On 11 September Sango plotted track B583 for two hours and the aircraft was observed to be off course. The station searchlight was exposed and was the means of putting the aircraft safely on the track for RAF Wick (TNA, AIR 26/92).

Trouble was experienced during January 1944 with insulators breaking on the Marconi curtain transmitting array. New insulators were installed by No 70 Wing Aerial Party, and the array was given special attention during the quarterly overhaul the following month. Dismantling of the Advance CH station was completed on 24 February (TNA, AIR 26/92).

Sango CHL lost its surface vessel plotting function on 30 August 1944 and thereafter plotted aircraft only. However, Sango was to play a part in another operation. During the solar eclipse on 9 July 1945 Sango was one of the CH stations which made observations of ionospheric backscatter in conjunction with the National Physical Laboratory. The observations took place from 1 to 16 July (TNA, AIR 26/92).

Operations at both the CH and CHL stations ceased with effect from 12.30 pm on 7 November 1945 and the stations were placed on care and maintenance (TNA, AIR 26/92).

Sango

Type	Radio Navigational Aid station
Subtype	Gee Slave (AMES Type 7000)
Region	Sutherland (Highland)
NGR	NC 4148 6752
NMRS	NC46NW 23
In use	14 November 1942 – 31 March 1946

Construction of the Northern Type 7000 Chain began during June 1942. The chain comprised four stations: Burifa Hill (Master and Monitor), Scousburgh (Slave), Windyhead Hill (Slave) and Sango (Slave) (TNA, AIR 29/147).

The Northern Type 7000 Chain became operational at 2 pm on 14 November 1942, 24 hours ahead of schedule. On 1 March 1943 operational trials of the Northern Chain began and a number of operations were carried out using Northern Chain signals that month, including a heavy bomber raid on St Nazaire. The operational programme included a heavy bomber raid on Stettin on 20/21 April. Interestingly, the Northern Type 7000 Chain was used on the night of 17/18 August for the large attack on the rocket research facility at Peenemünde. Various other raids used Gee coverage from the Northern Chain, including attacks on Berlin, Hanover, Le Mans and Frankfurt, as well as USAAF 8th Air Force attacks on Bremen, Kiel and Hamburg. The coverage was also used for minelayers in the North Sea and Baltic and for Coastal Command strike aircraft attacking shipping off the Norwegian coast. There is not space here to list every operation in which the chain was involved, but this gives some idea of the extensive use to which the Northern Chain coverage was put (TNA, AIR 29/147).

Doug Lee, a Corporal Radar Mechanic on Gee, was posted to Sango in early November 1943:

RAF Sango was, it seems, initially a CH station, with Gee added later. Hence our accommodation was on the other side of the road … There was no security whatsoever at the living site. Also, no WAAFs were allowed on the camp as it was considered to be too isolated!

The Txs for CH and Gee were about a mile up the road to the east. This was fenced in; the CO's accommodation and orderly room was also on this site. CO was Flight Lieutenant Welch …

The Gee Tx was, if I remember correctly, a modified MB2. We had two of these in a Nissen hut connected to the station diesel generator, and in an emergency we also had our own smaller diesel generator which was housed separately (this was a real 'b…' to start in cold weather – hurt my back turning it).

I don't remember much about the Gee Rx except that all operators were male and often to break the monotony, we mechanics would do a spell of operating simply to have a female voice to talk to. The Master Station was at Dunnet Head [Burifa Hill] and the other slave at Scousburgh.

Living conditions were not too bad, for it was not a 'strict discipline' unit, being a bit isolated. We did a three watch system … one day 1 pm to 6 pm, next day 8 am to 1 pm then *on again at 6 pm until 8 next day. Then a day and a half off. Not much to do in off duty time. Went occasionally to the Hotel 'Cape Wrath' just outside Durness. We used to have tea and scones there – quite posh. Often went beach-combing, especially on Balnakeil Bay … We had film shows several nights in the mess-room and there was a kind of NAAFI shop there. If I remember it was run by station staff, not the usual NAAFI types …*

We did occasionally have a big party and invited some of the WAAFs over from Dunnet Head. (Doug Lee, pers comm)

The Northern Type 7000 Chain closed down at 11 pm on 31 March 1946 and Sango was placed on care and maintenance (TNA, AIR 26/93).

Saxavord

Type	Radar station
Subtype	Coast Defence U-Boat/Chain Home Low (AMES Type 2), Naval Type 273 (AMES Type 30)
Region	Shetland
NGR	HP 6315 1666
NMRS	HP61NW 6
In use	24 September 1940 – September 1945

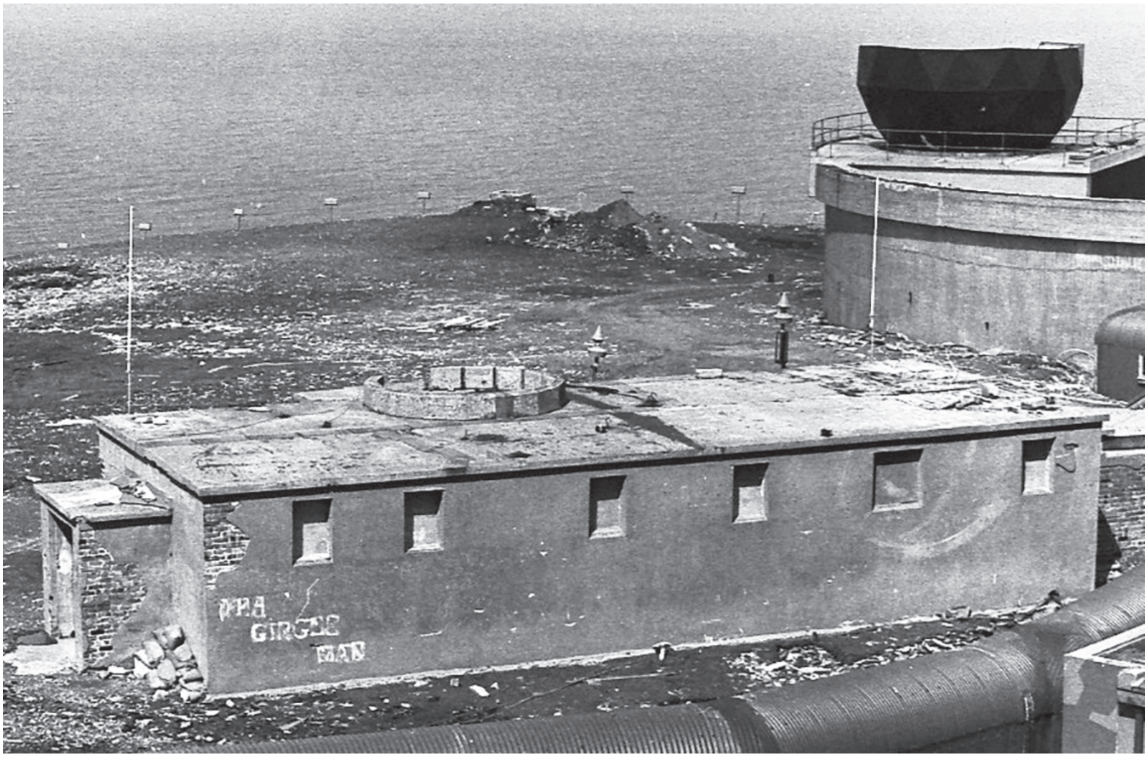
In February 1940 Vice-Admiral Sir James Somerville issued instructions for construction of Admiralty Experimental Station No 4 to begin. This station would be the fourth station in what became known as the Somerville Scheme, whereby a chain of CDU (the Naval version of CHL) stations would be set up in the northern isles to detect U-boats attempting to leave the North Sea on the surface north of the Scottish mainland. The station at Saxavord was tasked with providing early warning to the east and north of the Shetland Islands and keeping watch over the waters around Muckle Flugga Lighthouse, the most northerly part of Britain. The site chosen was somewhat remote and inaccessible but was the best operationally. At a height of 950 feet above sea level, it gave a clean sweep of 237°–0°–187° (HRA, Naval Shore Radar).

Work began on the site early in March 1940. The top of the hill at Saxavord was very steep and as a result the road to the site ended 200 feet from the top; a winched railway was built, which saved several weeks in the time taken to build the station. The two reinforced concrete huts for the transmitter and receiver, 16 feet square, were started in April and completed in July. The transmitter and receiver themselves were delivered in July, the aerials in August, and the aerials were erected on Friday, 13 September (HRA, Naval Shore Radar). The station became operational on 24 September (TNA, AVIA 7/441).

As a result of the German occupation of Norway in April 1940, Saxavord found itself in an isolated position, with the enemy in closer proximity than the Admiralty Signals Department in London. The defence of Saxavord was for the first few weeks carried out solely by the station personnel armed with rifles

131 Saxavord combined T & R Block with the stand-by CHL Block (one of the original CDU huts) in the background, taken in 1948.
(© Jim Dimond)

132 Looking west from the technical buildings at Saxavord with the 203 steps down to the road, taken in 1948. The building on the right was the Operators' mess hut where they ate.
(© Jim Dimond)



133 The combined T & R Block, taken in 1983, showing the location of the circular lantern for the Naval Type 273 paraboloids. This required a slight extension to the side of the building which is just visible behind.
(© Gordon Carle Collection)

and bayonets. Only in September did a platoon of the Shetland Defence Battalion arrive, and the Army guarded Saxavord for the remainder of the war (HRA, Naval Shore Radar).

As a result of its location, the station plotted numerous hostile aircraft, principally the long-range maritime and weather reconnaissance aircraft. Long tracks were obtained each day and, in fact, Saxavord was kept busy with hostiles right up to the end of the war in Europe in May 1945. Towards the end of 1941, steps were taken to try to use Saxavord to control interceptions directly. This was problematic, not least because the CHL equipment had no height-finding capability, and also due to the poor performance of fighter aircraft then available in Shetland. An R/T set was installed at Saxavord but found to be restricted in its coverage. However, in October 1942 attempts were made to control interceptions from Saxavord, but this proved unsuccessful. Instead, two or three fighters were used together, with the aircraft passing information between them. This, combined with airborne radar, turned out to be more useful and a number of interceptions took place, although not always resulting in a successful 'kill' (HRA, Naval Shore Radar).

In March 1942 a common aerial system was installed using the aerial array above the Receiver Hut. The transmitter was moved from its hut into an annexe to the Receiver Hut.

This resulted in considerable improvements to the station performance, including greater range, quicker plotting, less maintenance, less operator fatigue and sharper echoes. During 1942 construction began on the 1941 Type CHL, but various delays meant that it was not until 23 February 1943 that the new station became operational with CHL, the Type 273 radar in the same building having gone on the air in January 1943 (HRA, Naval Shore Radar).

On 12 June 1945 the CHL closed down and, with the closure of Lerwick NPR, the Type 273 radar plotted aircraft movements only (TNA, AIR 26/92). Saxavord remained in Naval hands and operated by Naval personnel until it was closed down by its last Station Commanding Officer, Lieutenant B G Wilkinson, in September 1945 (HRA, Naval Shore Radar).

Schoolhill

Type	Radar station
Subtype	Chain Home (AMES Type 1)
Region	Kincardineshire (Aberdeenshire)
NGR	NO 9085 9830
NMRS	NO99NW 41
In use	November 1939 – 15 March 1946

Following the decision in January 1939 to set up a CH radar station near Stonehaven (Air Ministry, 1950 (1): 60), work was carried out throughout much of 1939 on the construction of the station at Schoolhill. The equipment consisted of a modified gun-laying GL Mk II transmitter and receiver, known as GM, and the station did not become operational until November 1939 (TNA, AVIA 7/499).

On 19 December 1939 Air Marshal Joubert, Assistant Chief of the Air Staff (Radio), wrote to Robert Watson Watt, the Director of Communications Development:

Understand results from Schoolhill CH Stn very bad. Suggest diverting next production MB1 temporarily to this station until necessary alterations in existing equipment are carried out. Inform me urgently as to possibility of this suggestion and date of installation. (TNA, AVIA 7/303)

The MB1 transmitter and RM3 receiver were installed at Schoolhill early in 1940 (TNA, AVIA 7/257). The MB1 was replaced with a CH type transmitter in August, but the RM3 continued in use in the Receiver Hut, although an RF6 receiver was being installed during October (TNA, AVIA 7/499; Air Ministry, 1950 (1): 124).

At the end of April 1941 an MB2 transmitter and RF7 receiver arrived at Schoolhill without warning, and it was not until 31 May that they were lowered into the Buried Reserve buildings. It took until January 1942 before work on the Buried Reserve was completed, but another year before calibration was completed and the Buried Reserve became operational (TNA, AIR 26/100).

In the meantime, the station was performing well, with a new record range of 196 miles on a civil aircraft on 19 June 1941. A total of 27

134 Schoolhill site plan. (© Historical Radar Archive)

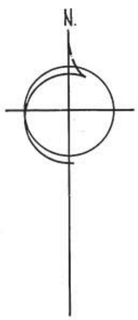
RICTED

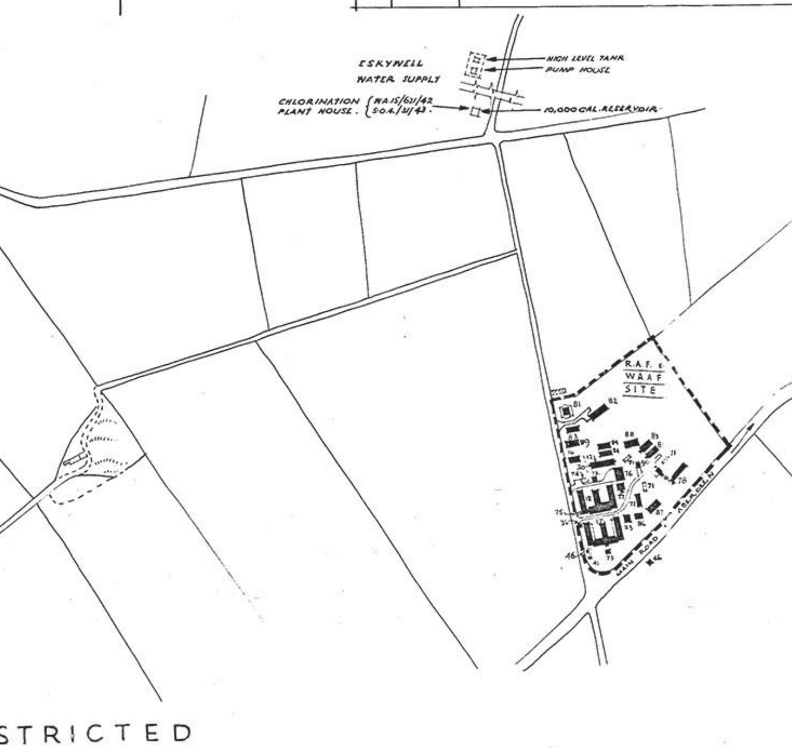
REFERENCE.

		R.A.F. & W.A.A.F. SITE.
12	WA15/234/41	BARRACK HUT (R.A.F.)
16		A.M.W.D OFFICE & STORE.
17	AM. 25/232'00	WAAF QUARTERS.
18	WA15/234/41	RAF QUARTERS.
19		
20		
21		
22		
23	WA15/234/41	W.A.A.F. SICK QUARTERS.
30		A.M.W.D YARD.
36		WATCH HUT.
41		L.T. KIOSK.
43		
46	4837/37	SEPTIC. TANK.
71		AIR RAID SHELTER (3NO) STANTON TYPE.
72	WA15/249/41	SLEEPING SHELTER (DECONTAM. CENTRE.)
73		FIRE FIGHTING WATER TANKS (2 NO.)
74		COAL COMPOUND
75		STORE PROOFED CLOTHING.
76	WA15/413	M.T. SHED & CYCLES
77		SICK QUARTERS R.A.F.
78	WA15/230/41	W.A.A.F. OFFICERS. MESS. & QUARTERS (5 No)
81	WA15/500/41	A.A. HEADQUARTERS OFFICE
82	WA15/500/41.	BARRACK RM. DINING. RM & KITCHEN FOR. H.Q. PERSONEL
83	WA15/500/41.	A.A. OFFICERS & MESS.
84	9024/41	BARRACK HUTS FOR R.A.F. (2 NISSEN).
85	9024/41	BARRACK HUTS FOR W.A.A.F. (2 NISSEN.)
86	WA15/807/41.	W.A.A.F. ADMINISTRATION OFFICE
87	WA15/269/42.	R.A.F. OFFICERS QUARTERS.
88		R.A.F. & WAAF RECREATION HUT. (42'-0" x 24'-0" NISSEN)
89		EQUIPMENT STORE
90		FIRE TENDER SHELTER
		UNDERGROUND BUILDING. SITE.
34	2422/40	R. BLOCK. (UNDERGROUND)
35	2422/40.	T. BLOCK. (UNDERGROUND)
69	13889/40	R TOWER. 120'-0" HIGH.
70	16435/40	T. TOWER. 120'-0" HIGH.
61		POLICE POST 10' x 10'
		AMMUNITION. SITE.
66	9895/39.	2 POUNDER A.A. AMMUNITION STORE
67		

REFERENCE

		T. SITE.
3.	8550/38	WATCH HOUSE
4.	1603/37	WARDENS QUARTERS.
5.	4234/38	PERMANENT. T. BLOCK.
6.	5744/38	STANDBY SET HOUSE.
7.	12983/39	BARRACK HUTS (2 NO) ARMY. GUARD.
8.	do.	do.
9.	do.	do.
10.	DDK25/245	INSTITUTE.
11.		
13.	25/2594	OFFICERS & SERGS MESS. SERGS QRS. DINING & RECREATION RM
14.	WA15/269/42	
15.		A.A. STORE.
24.	C.C. 25/36	PUMP HOUSE.
25.		
26.		INCINERATOR.
27.		COAL COMPOUND.
28.		COAL COMPOUND.
29.		COAL COMPOUND.
38.		ARMY GUARD HUT.
39.		WATER TOWER.
40		
42.	9047/40	PETROL STORE.
44	4837/37	SEPTIC TANK.
48.		AIR RAID SHELTER (SUMMER'S TYPE)
57.	12973/38 – 13006/38	T TOWERS 350'-0" (STEEL) .... ORIG. A.M. No 1.
58.	" "	T TOWERS 350'-0" (STEEL) .... ORIG. A.M. No 2.
59.		
60.		
61.		FIRE FIGHTING TANKS 2NO.
62.		RESERVOIR (6000 GALS.)
63.	F.C.W. 4034	KITCHEN (OFFICERS MESS)
64.		FIRE EQUIPMENT HOUSE.
65.		
68.	9047/40	GARAGE & CYCLE SHED.
79.		ARMY PILL BOXES (4 NO)
91 & 92		BLAST WALLS
		R. SITE.
1.	4238/38.	PERMANENT R. BLOCK.
2.	8550/38	WATCH OFFICE.
31.	~~25/240.~~	~~TEMPORARY R. HUT~~ DEMOLISHED. TRANSFERED TO DYCE
32.	25/242.	TEMPORARY T. HUT
33.		FIRE FIGHTING TANKS 2NO.
37.		ARMY GUARD HUT.
45.	4837/37	SEPTIC TANK
46.		
47.		AIR RAID SHELTER (SUMMER'S TYPE)
49.		O.C. ADMINISTRATIVE BLOCK.
50.		WAAF REST ROOM.
52		
53.	5467/37	R TOWER 240' TIMBER .....ORIG. A.M. No 5.
54.	5467/37	R TOWER. " " ....." " " 6.
55.	5467/37	R TOWER. " " ....." " " 7.
56	5467/37	R TOWER. " " ....." " " 8.
80.		ARMY PILL BOXES. (2 No.)
59	8972/41	T&R CUBICLES





DOWN GRADED 13/1/58

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BASED ON WORKS AREA DRAW. NO. WA.15/87/44 (RECEIVED IN W.B. 30.3.44)

SCHOOLHILL

AMES TYPE. .

RECORD LAYOUT PLAN. & LOCATION PLAN

SCALES 1/2500. & 6" INCHES = ONE MILE

D. of W.

A.R.I.B.A FOR W.B

FOR D.G.W

A.J.M. R.J.T. G.D. HUNT.

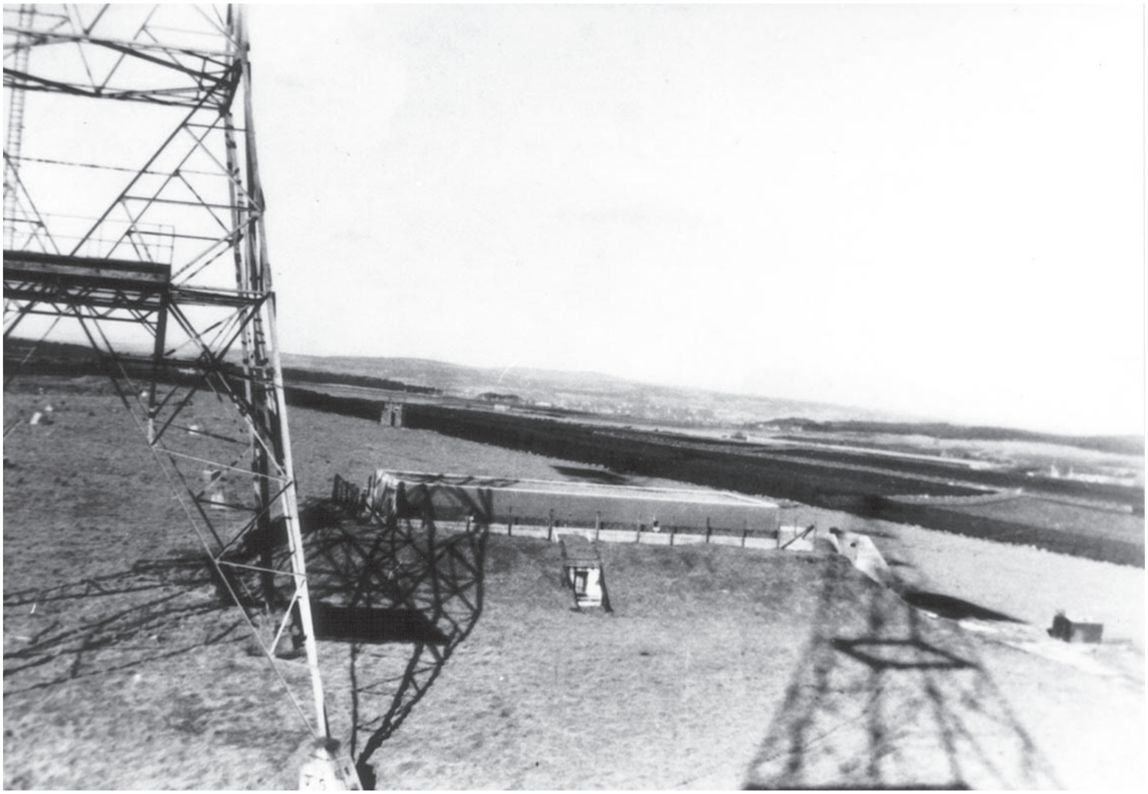
APRIL 1944.

1838/44

AIR MINISTRY.

39" x 24"

STRICTED

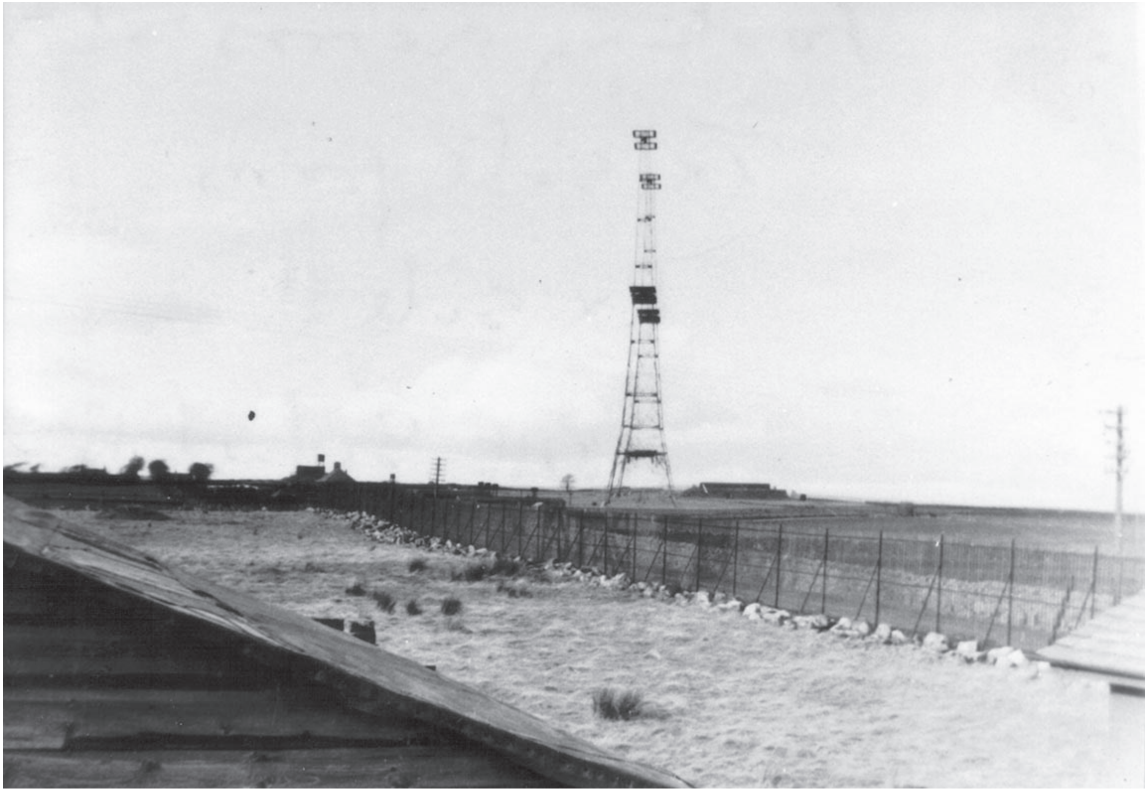


135 Schoolhill Transmitter Block and base of tower, taken from the 50 foot platform of the adjacent tower in 1951.
(© Robert Newstead)

hostiles were plotted during August 1941, mostly at night. On 24 September a Junkers Ju 88 came in undetected and machine-gunned the Receiver Site. The aircraft dropped two bombs which failed to explode. The station's anti-aircraft defences opened fire on the Ju 88, but it was able to escape safely. A new record range was achieved on 28 March 1942 when another civil was tracked out to 226 miles (TNA, AIR 26/100).

June 1942 saw a major change in the appearance of the station, with the complete dismantling of two of the 350 foot steel transmitter towers. Having never been used, it was felt that they could be better employed elsewhere, and they were removed for use at a Type 7000 Gee station. The second CH transmitter arrived during February 1943. The MB2 transmitter (which had been in use since 28 January 1942) moved into the Intermediate CH Hut and employed the aerial array which had been in use with the MB1 almost three years earlier. The new CH transmitter was commissioned during March 1943 and was generally satisfactory, although there were some teething troubles. Further progress came the following month with the erection of the curtain array, slung between the two 350 foot towers; this aerial system was commissioned during May 1943 (TNA, AIR 26/100).

On the evening of 21 April 1943 Aberdeen was attacked by about 15 hostile aircraft. The



136 Schoolhill Transmitter Site, taken from the Receiver Site in 1951.
(© Robert Newstead)

raid was picked up by Schoolhill at 9.17 pm at a range of 55 miles and the number given as 8 aircraft. The hostiles were plotted in until making landfall at Aberdeen. Four of the bombers approached Schoolhill at 10.30 pm, all at between 300 and 400 feet high. One hostile flew at the height of the tops of the 350 foot towers, directly over both the Transmitter and Receiver Sites, towards the sea. No bombs were dropped on the station by these aircraft, which had presumably already released their loads over Aberdeen, but they did machine-gun the towers. Browning and Lewis machine-guns on the Transmitter Site fired about 1,500 rounds without success. Fortunately, the station suffered neither casualties nor damage. At 11.05 pm all hostiles on the Buried Reserve plotting table were going out to sea (TNA, AIR 26/100).

On 29 May 1943 the Buried Reserve picked up a reconnaissance aircraft at 103 miles on a bearing of 100° at a height of 20,000 feet, fading at 145 miles at 111° and reappearing at 168 miles, increasing in range until it turned at 195 miles and came back in again. This was a remarkable range for a Buried Reserve (TNA, AIR 26/100). The Buried Reserve was used between 13 August and 7 October 1943 and was performing well, with some long ranges being plotted (TNA, AIR 26/92). Sadly, the No 13 Group Bulletin recorded in October that the Buried Reserve was unserviceable because of flooding (HRA, No 13 Group Bulletin), and the dismantling of the equipment and aerial systems from the Buried Reserve was completed on 9 February 1944 (TNA, AIR 26/92).

The RF6 receiver became operational on 2 July 1943, although installation had been in progress back in October 1940. The electro-mechanical calculator, used to convert radar information into map plots, was almost wired and was hoped to become fully operational soon after. Another development was the first test of the searchlight on 9 September 1943. This equipment was to be used to direct lost aircraft towards the nearest suitable airfield and the test was carried out at 12.20 am, the searchlight being successfully aimed towards RAF Peterhead. Over the succeeding months, numerous aircraft were safely homed to Peterhead (TNA, AIR 26/92).

On 10 April 1945 an enemy aircraft approached the east coast of Scotland but was identified as a friendly reconnaissance aircraft expected on that route. It was only when the aircraft was on its way out that it was properly identified as a hostile. Schoolhill achieved a range of 210 miles on this track. The station was busy after the German surrender on 8 May 1945, plotting large formations of Douglas Dakotas and Boeing B-17 Flying Fortresses carrying troops and supplies between Scotland and Norway. The busiest day of May was the 11th, when Schoolhill reported 160 tracks on the tube, including 9 simultaneously (TNA, AIR 26/92).

The VT114 power amplifier was moved from Douglas Wood to Schoolhill on 27 September 1945 in order to increase the output power at Schoolhill for ionospheric observations. An Oswald paper recorder unit and an RF8 receiver were also installed during October for these observations. The RF8 became operational at 9.45 am on 12 November, and on 17 November the ionospheric observations began for a total of 24 hours per week (TNA, AIR 26/92). Between 8 and 11 February 1946 the effects of sunspots were recorded, it being noted that sunspot activity slightly affected operations, but that increasing cloud cover reduced this interference. On 24 February the ionospheric research at Schoolhill was completed. Schoolhill CH station ceased operating at 4.30 pm on 15 March and was placed on care and maintenance on the 19th (TNA, AIR 26/93).

Scousburgh

Type	Radio Navigational Aid station
Subtype	Gee Slave (AMES Type 7000), Loran (AMES Type 700)
Region	Shetland
NGR	HU 3890 1902
NMRS	HU31NE 50
In use	14 November 1942 – 31 March 1946

Construction of the Northern Type 7000 Chain began during June 1942. The chain comprised four stations: Burifa Hill (Master and Monitor), Sango (Slave), Windyhead Hill (Slave) and Scousburgh (‘B’ Slave). The Type 7000 Slave at Scousburgh was designated Air Ministry Experimental Station No 7321 (TNA, AIR 29/147).

The Northern Type 7000 Chain became operational at 2 pm on 14 November 1942, 24 hours ahead of schedule. On 1 March 1943 operational trials of the Northern Chain began. Northern Type 7000 Chain signals provided navigational assistance for numerous operations for the rest of the war in Europe, including heavy bomber raids on Nuremberg, Berlin, Hanover, Leipzig and Milan, as well as the large attack on the rocket research facility at Peenemünde on the night of 17/18 August 1943. Various other raids used Gee coverage from the Northern Chain, including USAAF 8th Air Force attacks on Regensburg, Bremen, Kiel and Stuttgart. The coverage was also used for minelayers in the North Sea and Baltic and for Coastal Command strike aircraft attacking shipping off the Norwegian coast (TNA, AIR 29/147).

The Northern Type 7000 Chain closed down at 11 pm on 31 March 1946 and Scousburgh was placed on care and maintenance (TNA, AIR 26/93).

As well as its role as the 'B' Slave in the Northern Type 7000 Chain, Scousburgh was also the location of a Type 700 Monitor Station. This was the Monitor of the North East Atlantic Loran Chain from 22 December 1944 until this function was taken over by Burifa Hill at 6 pm on 21 June 1945, when the Type 700 station at Scousburgh closed down (TNA, AIR 29/167).

Skaw

Type	Radar station
Subtype	Chain Home (AMES Type 1)
Region	Shetland
NGR	HP 6692 1561
NMRS	HP61NE 6
In use	12 January 1941 – 4 August 1945

Bill Badcock, a Leading Aircraftman Radar Mechanic, recalls:

I was one of the party that left Aberdeen that cold and foggy afternoon in the late autumn of 1940. The vessel was the Ben McCree, a ferryboat that normally plied between Liverpool and the Isle of Man in holiday times. It was quite unsuitable for a North Sea journey in a storm. It rolled like a barrel and made about 5–7 knots I should think, at the best.

I believe there were about 200 servicemen on board and there was no accommodation except the decks. As the storm got worse water poured on deck and we were washed to the lower decks. I finished up as near the engine room as I could get, for warmth and dryness. It was the most horrific journey I have ever made and many times during the long and frightening night I thought if we sank and drowned we would all be better off …

I don't recall much of the landfall off Lerwick except that we had to stand off most of the day before the weather cleared, enabling us to proceed to Balta Sound. The unloading of the essential equipment was No. 1 priority, i.e. cooking equipment, beds & bedding, 2 or 3 vehicles and all the spares. I can remember 'borrowing' a farm gate to use as an improvised sledge to move crates and boxes. It was all man-handled.

The domestic campsite had Nissen huts but *little else and [they] were just as the riggers and builders had left them. I noted that they were anchored with several cables over the top which were most definitely needed, as we found later when gales reached 100–120 mph for hours on end. It was quite impossible to walk upright out in the open when wearing a sheepskin coat!*

Towards Christmas (I don't think there was one that year) we had very short days. It was dark from 4 pm to 10 am – high winds and snow – the locals said they never had much snow and we must have brought it!

We radar chaps were glad to have much to do in getting the station on the air. The non-tech chaps nearly died of boredom – in fact, one went berserk and had to be sent back. Others tried it without success! (Bill Badcock, pers comm)

RAF Skaw became operational on 12 January 1941 as an Advance CH station (HRA, RDF in Northern Scotland and the Islands).

Bill Badcock continues:

With the station on the air and the watch system going smoothly we settled down; then the first enemy action noted. Daily at first light a German Condor … came over us on a photographic flight, looked around and left. Up till then our CO, a regular, had treated us civilian type airmen gently – no bull but get on with the job – which we did. Then he did what turned out to be a mistake – he insisted on a flag-raising parade first thing every day. The next time the Condor came over he must have seen the flag because he shot up both sites – some damage done but no casualties. The most serious damage was to the Tech Site ablutions, made out of driftwood for our convenience and comfort. Quite illegal, of course, but a real boon. The Domestic Site ablutions were, in the early morning, cold, inadequate and over-crowded. The most you could hope for was some privacy behind a rock that had not been used before! The Condor machine-gunner must have thought our little hut on the edge of the cliff had sinister significance for he shot it many times. The seat, lovingly hand shaped with primitive tools, was cut in two. I shudder what would have happened had an occupant been there at the time …

The spring of 1941 was quiet and pleasant by comparison. I passed my spare time fishing in the burns – small trout were plentiful and easy to catch on a hand line – and trapping rabbits on the cliff to add to our menu. We also tried Eider duck but these were definitely for the bedding and not for the pot!

I … remember the reports of German submarines lying up at night in the shelter of the lighthouse at Muckle Flugga, charging batteries, because they were safe from attack there, under International Law. (Bill Badcock, pers comm)

RAF Skaw was attacked at 5 pm on 26 March 1941 by an enemy aircraft which approached from the east at a height of 200 feet. The aircraft's starboard wing hit the top of a 240 foot wooden tower, breaking a corner member. Four bombs were dropped, apparently jettisoned when the pilot realised he was going to hit the tower. All four bombs landed in the sea about 60 yards from the Transmitter Hut. The following day another attack was made at 8.15 am by a Junkers Ju 88 which dropped two 250 lb bombs. These missed the Transmitter Block by about 100 yards (TNA, AIR 26/92).

More strikes were to come. On 5 October 1941 a Junkers Ju 88 attacked Skaw without warning. The hostile gave a short burst of machine-gun fire and dropped four bombs, one of which failed to explode. Fortunately, there were no casualties and the only damage was a temporary cutting off of internal communications. A 'hit and run' attack was made on the station at 1.20 pm on 15 December.

The Junkers Ju 88 gave several bursts of machine-gun fire and dropped one 500 kg bomb which fell north-west of the station, bounced completely over the huts, bounced again and then exploded harmlessly in a field. Another attack was made on 4 January 1942 by a Ju 88 during a severe snowstorm. Two bombs were dropped, but they fell in the sea, causing no damage. A short burst of machine-gun fire also caused no damage (TNA, AIR 26/100).

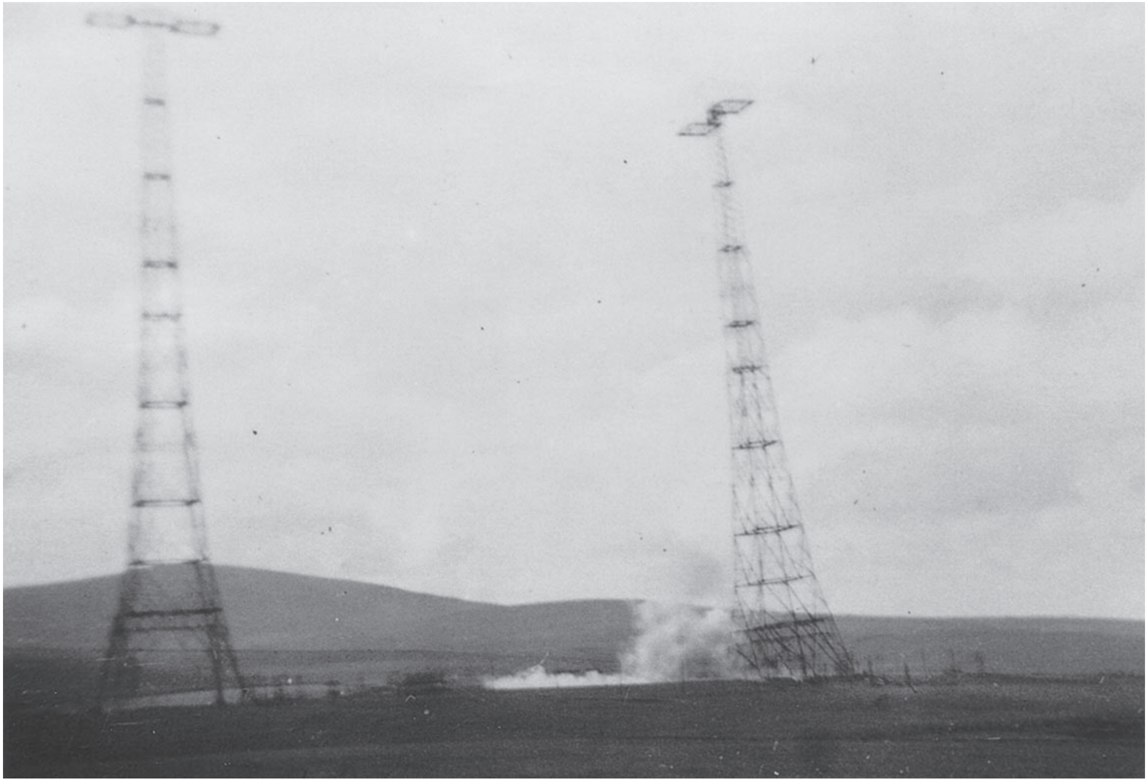
The Final CH station became operational on 17 May 1942. By the end of June the station had reported many good ranges, with plots at 185 miles south-east, 151 miles north-east, 150 miles east, 138 miles south-west and 70 miles west all passed on. Practice in W/T plotting began during June using dummy grids and coded plots. July saw continued good performances, with ranges of 157 miles south-east, 150 miles east and 65 miles north-west, and Photo Freddie 9 plotted on 16 July out to 182 miles north-east, practically on the Norwegian coast (TNA, AIR 26/100).

Further hostile activity kept Skaw busy during October 1942. On the 7th, Hostile 297 was intercepted by Fighter 172, which claimed the bomber as damaged. Four days later H298 was intercepted by F166, which claimed a probable. On the 13th, H294 was another probable, to F169. On the 17th, H299 was claimed as a probable, having been severely damaged by F173. H204 on the 27th was claimed as damaged by F169. A check with the filter room afterwards showed that Skaw's plotting and ranges on H204 were extremely accurate (TNA, AIR 26/100).

At 10 am on 7 July 1943 dismantling of the top section of the north 350 foot transmitter tower was begun in order to re-orientate the cantilevered platforms. The dismantling was completed on 23 July and re-orientation work on the cantilevers began on the 31st. As a result of this work, on 15 September the transmitter array was changed to all-round looking, with four lines of shoot of 10°, 100°, 190° and 280° (TNA, AIR 26/92).

Fighter 505, a de Havilland Mosquito of No 307 Squadron, was picked up by Skaw at 12.10 pm on 22 November 1943, 24 miles west of the station. The aircraft was patrolling the area and finally faded at 80 miles to the north-east. The fighter was able to shoot down a Heinkel He 177 which it found at 8,000 feet, fired on intermittently for five minutes and saw diving steeply into cloud with both engines belching black smoke (TNA, AIR 26/92).

137 Andrew Laurenson at the top of one of the 350 foot steel transmitter towers at Skaw in 1947. (© Andrew Laurenson, via Leslie Smith)



138 One of the transmitter towers being demolished at Skaw in 1947.
(© Andrew Laurenson, via Leslie Smith)

The station was equipped with a searchlight for the purpose of directing lost aircraft to the nearest suitable airfield for a safe landing. The searchlight was exposed for the first time on 20 January 1944, pointing a Consolidated Catalina flying boat towards Sullom Voe (TNA, AIR 26/92).

Although new equipment was coming online, other equipment was being removed, and dismantling of the Advance CH station was completed on 10 February 1944. Dismantling of the Remote Reserve equipment was completed on the 25th. The towers for the two channels took longer, and it was May 1944 before these had been removed and the Advance CH and Remote Reserve were both completely dismantled (TNA, AIR 26/92).

Between 1 and 16 July 1945, covering the solar eclipse of 9 July, observations were carried out at Skaw on the amount of ionospheric scatter received by the station, with readings being taken of the range, amplitude and duration of representative examples of scatter. The results showed no decrease of scatter during the eclipse, but that it did decrease towards sunset each day. These observations proved to be something of a swansong for Skaw CH radar station, which ceased operations at 5 pm on Saturday, 4 August 1945 (Radio Maintenance Form 1497, via RAF Saxa Vord).

139 Skaw Stand-by Set House, the back-up power station for the site, taken in 1947. (© Andrew Laurenson, via Leslie Smith)

Skaw

Type	Radio Navigational Aid station
Subtype	Loran (AMES Type 700)
Region	Shetland
NGR	HP 6639 1679
NMRS	HP61NE 8
In use	7 November 1944 – 20 February 1946

During July and August 1944 a Type 700 station was built on the disused Remote Reserve site of Skaw CH station. The RR Transmitter Block was demolished, the concrete floor extended, and a Nissen hut erected to house the Type 700 transmitter and receiver. Construction of the combined T & R Hut was completed on 31 August, erection of a 120 foot tower was completed on 11 September and a 65 foot receiving aerial pole was set up on 25 September. The equipment was installed during October and the station was operational for 24 hours for test transmissions from 7 November. Air Ministry Experimental

Station No 713 at Skaw became operational for Grade 'B' operations on 13 November 1944 (TNA, AIR 29/167).

AMES No 713 was an extension to the North East Atlantic Loran Chain which had become operational on 6 March 1944. The expansion was required because the Chain did not stretch far enough to the north-east and its usefulness to Coastal Command was therefore limited. The decision was taken to build the station at Skaw, which became of great value not only to Coastal Command aircraft, but also for operations over Norway and for surface vessels escorting Arctic convoys to Murmansk (Air Ministry, 1956: 207).

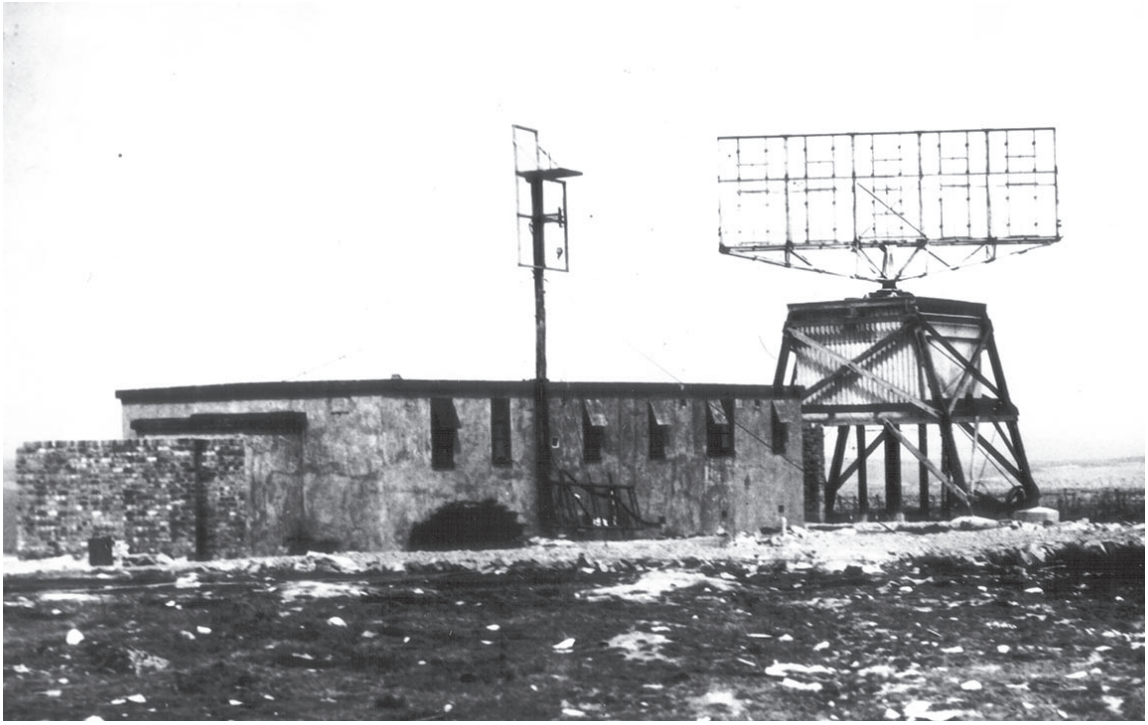
The Type 700 station at Skaw ceased transmitting at 8 am on 20 February 1946 and the station went onto care and maintenance (TNA, AIR 26/93).

South Ronaldsay

Type	Radar station
Subtype	Coast Defence U-Boat/Chain Home Low (AMES Type 2), AMES Type 13 Mk I, Naval Type 273 (AMES Type 30), Naval Type 277S (AMES Type 50)
Region	Orkney
NGR	ND 4564 8871
NMRS	ND48NE 22
In use	21 October 1940 – 15 March 1946

South Ronaldsay was the fifth station built as part of the Somerville Scheme, devised by Vice-Admiral Sir James Somerville to provide a chain of CDU (the Naval version of CHL) stations in the northern isles to detect U-boats attempting to leave the North Sea on the surface north of the Scottish mainland (HRA, Naval Shore Radar).

Work on the station started in the spring of 1940 and by August the Transmitter and Receiver Huts had been built. However, their parapets had to be reduced in height by 1 foot, holes drilled in the roofs for turntable bolts had to be filled in and a hole knocked in the blast wall of the diesel hut to enable the engines to be put in also had to be filled in. August that year was very wet and the unsealing of the tops of the T Hut and R Hut walls allowed water into the walls. As a result, the huts became so wet that the equipment could not be unpacked for four weeks. A sodium silicate wash, followed by distemper, was applied internally, but it did little good and cracked off once the huts began to dry, making a great mess. A solution was only achieved by applying an external waterproof cement rendering to the walls and then running electric heaters inside. The transmitter was installed on 27 August but, due to its packing not being waterproof, water had penetrated the transmitter casing and the equipment had to be dried gently before starting. The receiver was installed on 28 August and had also been affected by dampness. The aerial arrays were mounted on their turntables on 5 and 6 October and the first echo was observed on 13 October. Experimental watches of 9 hours per day were carried out on 16 and 17 October, and then 12 hours per day on 18, 19 and 20 October, in order to familiarise operators with the numerous fixed echoes whilst adjustments



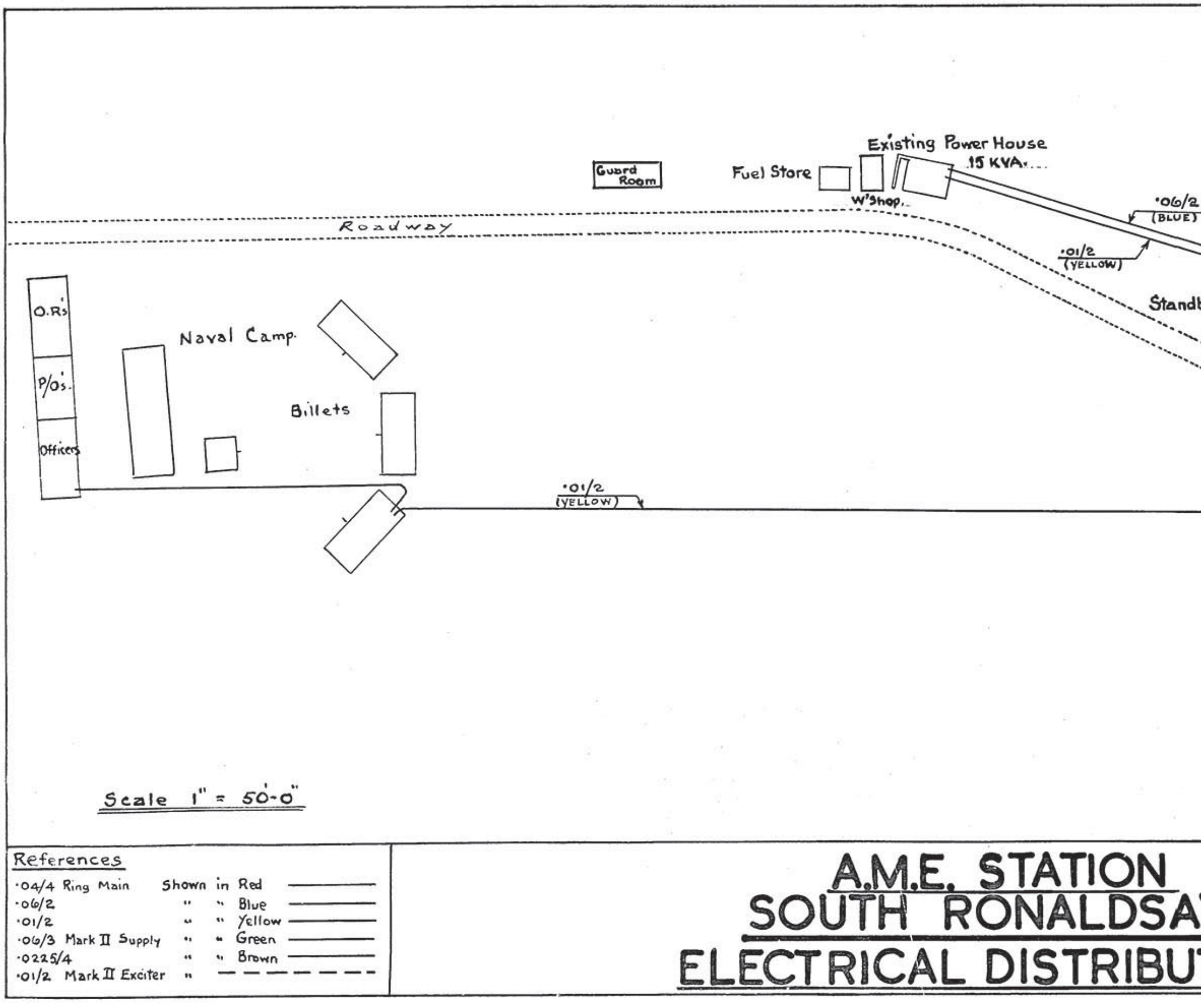
140 South Ronaldsay 1941 Type CHL.
(© The National Archives ADM 116/5790)

were made. AES No 5, South Ronaldsay, became operational at 2 pm on 21 October 1940, plotting to Kirkwall Filter Room by W/T (HRA, Naval Shore Radar).

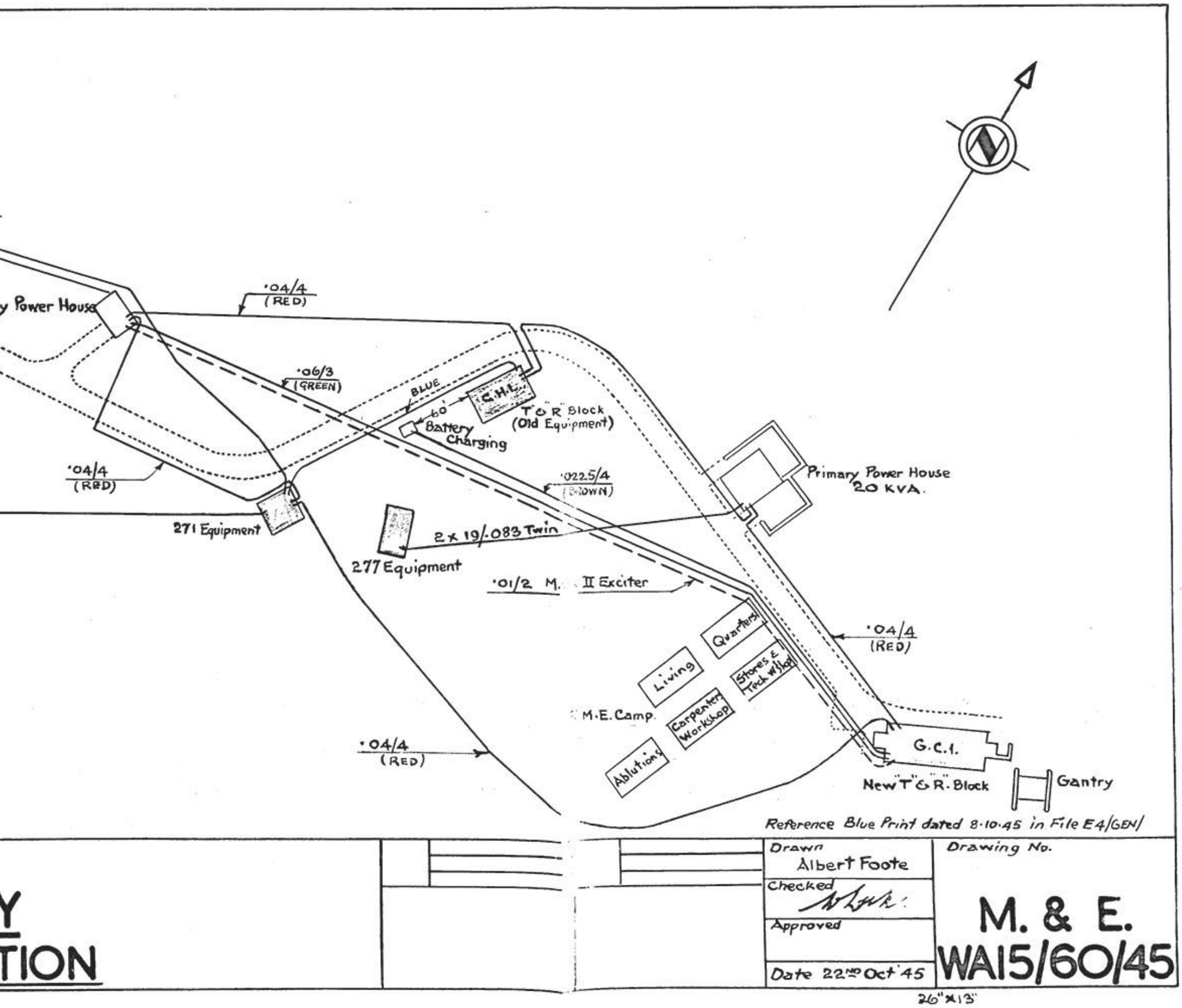
The two aerial arrays were turned by hand, the transmitter following the receiver whilst trying to keep the galvanometer reading at zero, which would indicate the aerials were facing in the same direction. ARL (Admiralty Research Laboratory) turning motors were later installed but these were found to be unsuitable for the task. However, one was able to turn the transmitter aerial. As a result, the receiver aerial continued to be turned by hand and it controlled the transmitter remotely. This proved successful and was used until a common transmitter and receiver aerial was fitted in October 1941, with feeder lines then being run from the Transmitter Hut. A PPI display was installed in May 1942 and, in order to dispense with outside feeder lines, an annexe to the Receiver Hut was built and the transmitter was moved on 12 July. After the move of the transmitter, the Transmitter Hut was used for a Type 273S 10 cm radar, with a Perspex lantern put on the roof to protect the paraboloid from the weather. This set became operational on 9 August (HRA, Naval Shore Radar).

Work had already started on the 1941 Type CHL and this went on the air in January 1943. In order to improve low-flying cover, a mobile AMES Type 13 centimetric height-finder radar was set up. It was delivered to St Margaret's Hope in a Landing Craft Tank on 25 May and was operational the following month (HRA, Naval Shore Radar; TNA, AIR 26/92).

Unusual weather conditions during



141 South Ronaldsay site plan.
(© Historical Radar Archive)


y Power House
·04/4 (RED)
·06/3 (GREEN)
BLUE
60'
G.H.E.
"T" "R" Block (Old Equipment)
Battery Charging
·04/4 (RED)
·022.5/4 (BROWN)
Primary Power House 20 KVA.
271 Equipment
2 x 19/.083 Twin
277 Equipment
·01/2 M. II Exciter
·04/4 (RED)
Quarters
Living
Stores & Tech W/Shop
M.E. Camp.
Carpenters Workshop
Ablutions
·04/4 (RED)
G.C.I.
New "T" "R" Block
Gantry
Reference Blue Print dated 8.10.45 in File E4/GEN/
Y
TION
Drawn Albert Foote
Checked
Approved
Date 22nd Oct '45
Drawing No.
M. & E.
WA15/60/45
26"x13"

142 South Ronaldsay Naval Type 277S radar (AMES Type 50).
(© The National Archives ADM 116/5790)

September 1943 enabled the CHL to achieve a maximum range that month of 237 miles on an aircraft, and range and bearing was passed on the IFF response of Recce 517 at a range of 276 miles (TNA, AIR 26/92). However, although the CHL was performing well, the Type 13 suffered from a lot of problems and a Type 277S (AMES Type 50) was installed and became operational on 10 July 1944. The Type 13 Mk I was removed in September and sent to RAF Crustan, which left the 1941 Type CHL and the Type 277S as main sets at South Ronaldsay, with the old CHL and the Type 273S as stand-by sets. On 12 June 1945 the CHL closed down and, with the closure of Lerwick NPR, the Type 273 and Type 277 radars plotted aircraft movements only. In August all but the Type 277S were dismantled and the station transferred to the RAF on the 28th (HRA, Naval Shore Radar; TNA, AIR 26/92). South Ronaldsay remained operational until instructed to cease operations on 15 March 1946 due to the closure of Inverness Filter Room. However, maintenance continued and repairs to the Lister diesel generators were carried out between 22 March and 6 April (TNA, AIR 26/92).

South Sutor

Type	Radar station
Subtype	CA No 2 Mk I
Region	Ross and Cromarty (Highland)
NGR	NH 8086 6706
NMRS	NH86NW 11.01
In use	17 March 1944 – date unknown

On 17 March 1944 the CA No 2 Mk I Fire Control radar installed at South Sutor, designated F11, became operational in its transportable wooden cabin known as a Gibson Box. The set covered an arc of 20°–120° (TNA, WO 199/1133)

Mains supply for the operation of the CA radar was drawn from Cromarty CHL radar station, which had by then closed down. It was noted, however, that the supply would not be sufficient to provide enough power for both the CA and CHL radars, should the RAF decide to reopen Cromarty CHL. Assurance was therefore sought from the Air Ministry that this would not happen, and this was duly given. As a result, it was possible to make permanent use of the power supply from the disused CHL station, with stand-by power being provided by a Lister diesel generator (TNA, WO 199/1133).

The CA No 2 Mk I set was moved from its Gibson Box and into the Fire Command Post, and became operational there on 10 July 1944. It is not clear exactly when the radar ceased operating (TNA, WO 199/1133).

Stanger

Type	Radar station
Subtype	CA No 2 Mk I, CA No 1 Mk 3
Region	Orkney
NGR	ND 3748 9246
NMRS	ND39SE 11.01
In use	7 April 1944 – 19 March 1945

On 7 April 1944 the CA No 2 Mk I Fire Control radar installed at Stanger, designated F26, became operational in its transportable wooden cabin known as a Gibson Box. This set covered an arc from 60° to 260° (TNA, WO 199/1133).

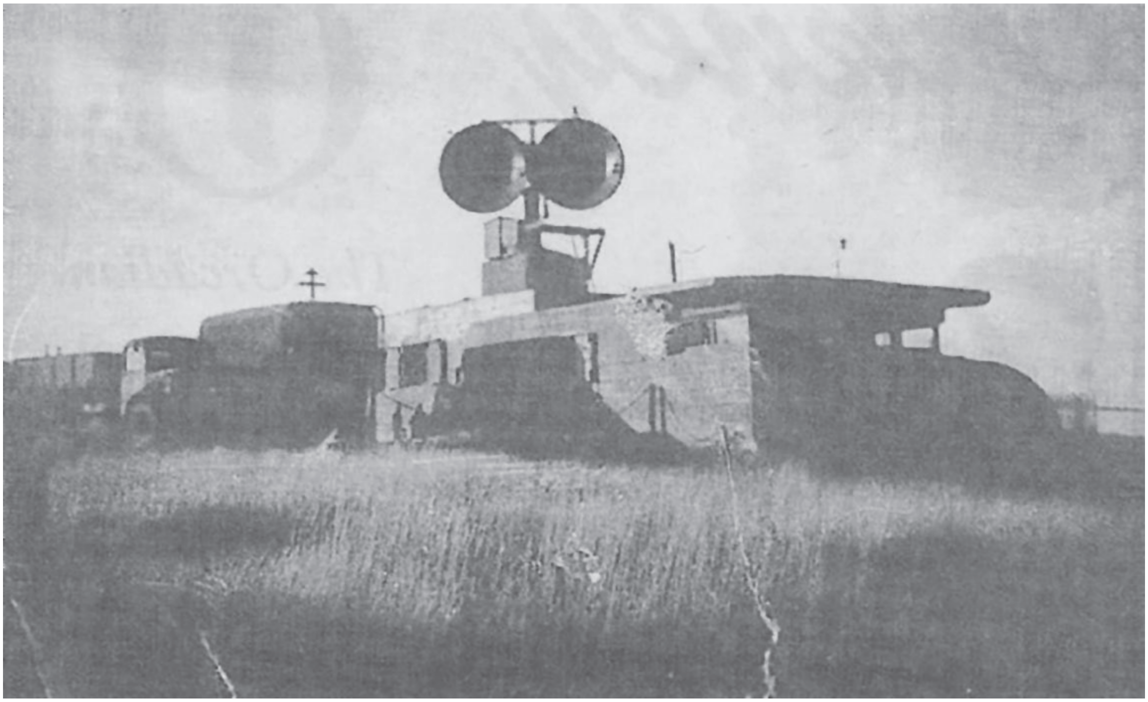
A letter from the Brigadier, RA, Orkney and Shetland Defences, to Headquarters, RA, Scottish Command, dated 3 August 1944, noted:

Recent trials with the Coast Arty No 2 Mk I radar set have convincingly demonstrated the practical value of radar in defence of the entrances to Scapa Flow against small vessels and X craft [midget submarines] on the surface … It is requested that the War Office be asked to increase the complement of radar operators for their sets at Stanger Head to enable a continuous watch to be kept during darkness and thick weather. The GOC-in-C [General Officer Commanding-in-Chief] concurs … The present establishment … is 6. This only provides two watches of 3 (1 NCO and 2 Gnrs [Gunners]) and has at the same time to provide the normal range-finding personnel when radar is not working. In this latitude, when the hours of darkness in winter amount to as much as 18½ hrs out of 24, without counting times of low visibility during the few hours of daylight, it would be impossible to maintain the required cover with less than four watches of 3. It will therefore be necessary to increase the OsFC [Operators Fire Control] by 6. (TNA, WO 199/1133)

A memorandum from the War Officer to CA branch of GHQ Home Forces, dated 26 August 1944, read as follows:

As a result of representations made by Admiralty it has been agreed that this radar installation, while retaining its primary role of a Fire Commanders set, shall forthwith be made available for continuous operation to meet local naval requirements during darkness and thick weather. (TNA, WO 199/1133)

The continuous manning of the CA No 2



143 Stanger CA No 1 Mk 3 Fire Control radar.
(Copyright holder unknown)

Mk I set began at 6 pm on 4 September 1944. However, the absence of enemy activity meant that such defences were being reduced, and a list of radar sets which could be placed on care and maintenance at the discretion of the Home Commands, as of 19 March 1945, included the CA No 1 Mk 3 set, designated B26, at Stanger (TNA, WO 199/1133).

Stromness

Type	Radar station
Subtype	CA No 2 Mk I
Region	Orkney
NGR	HY 2486 0804
NMRS	HY20NW 27
In use	1 May 1944 – date unknown

On 1 May 1944 the CA No 2 Mk I Fire Control radar installed at Stromness, designated F28, became operational in the Fire Command Post. The set covered an arc of 100°–180°–300° (TNA, WO 199/1133).

Sumburgh

Type	Radar station
Subtype	Coast Defence U-Boat/Chain Home Low (AMES Type 2)
Region	Shetland
NGR	HU 4071 0786 (Sumburgh)
NMRS	HU40NW 4
In use	27 December 1939 – 15 April 1944

Type	Radar station
Subtype	Chain Home Low (AMES Type 2), Naval Type 273 (AMES Type 30)
Region	Shetland
NGR	HU 4078 0935 (Grutness)
NMRS	HU40NW 5
In use	1 January 1943 – 4 August 1945

In 1939 Vice-Admiral Sir James Somerville proposed what became known as the Somerville Scheme, whereby a chain of CDU (the Naval version of CHL) stations would be set up in the northern isles to detect U-boats attempting to leave the North Sea on the surface north of the Scottish mainland. The first of these sites was selected at Sumburgh Head, within the lighthouse compound there, and construction began at the end of October. The Receiver Hut was built just outside the southern wall of the inner enclosure of the lighthouse; the Transmitter Hut was 20 yards away, inside the inner enclosure; the Engine Shed was 50 yards away, outside the northern wall of the inner enclosure. All three huts were made of wood with wooden gantries for the two aerial arrays straddling the R and T Huts. The aerial turning gears consisted of inverted searchlight turntables, which meant that all oil and grease apertures were upside down. Despite this, the turntables did not require frequent removal for maintenance. The aerials themselves were hand-turned, using bicycle chain drives and upturned bicycles with the pedals replaced by handles (HRA, Naval Shore Radar).

Construction of the station proceeded quickly and tests with submarines were carried out in early December 1939, with some plots being passed by W/T to HMS *Greenwich* in Scapa Flow. On 18 December aircraft were detected 61 miles to the south and were acknowledged as hostile by Scapa Flow. Permanent watch began at 11 am on 27 December, with the station designated AES No 1 (HRA, Naval Shore Radar).

On 8 and 10 April 1940 AES 1, in co-operation with AES 2 and 3 on Fair Isle, played an important part in the detection of mass raids on the Home Fleet base at Scapa Flow. Good radar warning gave enough time for the defences to be prepared (HRA, Naval Shore Radar), and a total of six German bombers were destroyed during the two attacks (Ramsey, 1987: 77). No further mass attacks were made on Scapa Flow by enemy aircraft for the rest of the war (HRA, Naval Shore Radar).

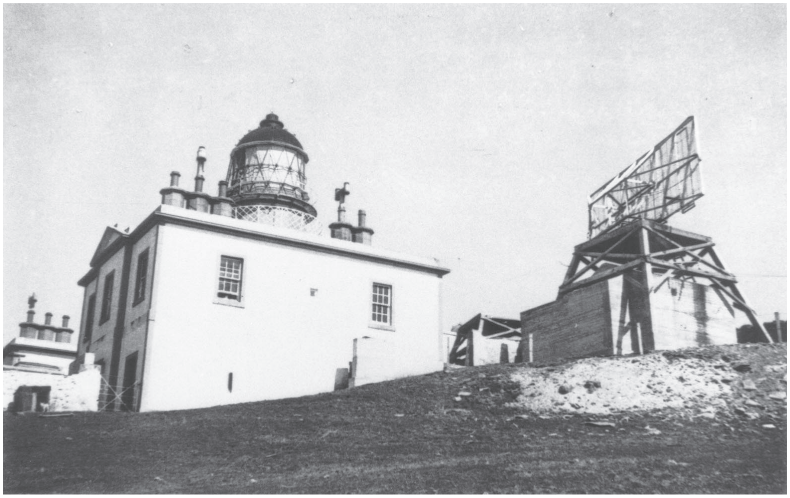
144 Sumburgh, late 1939, showing the twin-gantry CDU with the receiver on the left and the transmitter on the right.
(© Richard Feachem)

From the summer of 1940 a series of standard patrols by German aircraft developed which continued throughout much of the rest of the war. The first regular track was a weather reconnaissance patrol flown from north-east Germany, Denmark or Norway to Fair Isle and then to the Faroe Islands, from where they would turn for home by way of the north of Shetland. Good tracks on these aircraft were given by AES 1, with an initial detection range of about 50 miles. In January 1941 one of these aircraft, and possibly two others, was shot down and the patrols ceased abruptly on 17 January.

The second regular track was a long-range Atlantic patrol aircraft which would be tracked east- or westbound near Fair Isle and picked up at 60 to 80 miles' range. The latter part of June 1941 saw these patrols decline and none were flown after that month. The third regular track was a successor to the original weather reconnaissance patrols and was flown up and down the east coast of the Shetland Islands. By October 1941 this track was an almost daily occurrence and it continued into spring 1942.

The fourth regular patrol was carried out between late January and May 1942 and was flown from Stavanger, directly over Sumburgh at about 20,000 feet and then on to the north-western approaches, usually flying on to Bordeaux, a round trip of some 1,600 miles. The average detection range on this aircraft was 91 miles, the longest being 138 miles (HRA, Naval Shore Radar).

As operations continued at Sumburgh during 1940 and into 1941 it became clear that the performance of the station was hampered by the proximity of the lighthouse buildings, a situation which had been accepted originally because of the ready access the site provided. The proximity of the foghorn which was seven yards from the Transmitter Hut and which blew a seven second blast every 90 seconds, was also an issue. During July 1941 it was in operation for 165 hours and it operated continuously from 05.15 on 25 September 1941 until 20.35 on 27 September 1941. Work began on 1 September 1941 on the 1941 Type CHL station which could replace the original site. The new station was built at Compass Head, 1 mile north of Sumburgh Head, and known



145 Sumburgh, mid-1941, showing the twin-gantry CDU station beside Sumburgh Lighthouse converted to single T/R aerial array.
(© Richard Feachem)

as Grutness. The building of the T & R Block, engine house and officers' quarters was nearly complete by August 1942, and the centimetric Type 273 radar arrived in late November and was operating in the T & R Block on 1 January 1943. The Type 273 almost immediately proved itself: on 24 March a hostile aircraft approached Sumburgh but faded from CHL plots because it was flying at very low level. The Type 273 gave good directional plots and the Messerschmitt Me 210 was shot down a few miles north-west of the station. This was the first occasion on which a Type 273 radar took part in an aircraft interception (HRA, Naval Shore Radar).

The CHL itself did not become operational in the new building until 14 March 1943. The original site at the lighthouse was thereafter used as a stand-by for maintenance periods and breakdowns until it was finally closed on 15 April 1944. By that time a more fundamental change had taken place. On 4 November 1943 Sumburgh was transferred from Admiralty to Air Ministry control, and AES No 1 became AMES No 54A (HRA, Naval Shore Radar). The Type 273 went off the air on 30 August 1944, but the CHL remained operational until 4 August 1945 when it ceased reporting and was placed on care and maintenance (TNA, AIR 26/92).

Tannach

Type	Radar station
Subtype	Chain Home (AMES Type 1)
Region	Caithness (Highland)
NGR	ND 3207 4696 (Thrumster)
NMRS	ND34NW 37
In use	December 1939 – September 1940

Type	Radar station
Subtype	Chain Home (AMES Type 1), Chain Home Low (AMES Type 2), AMES Type 9 Mk V
Region	Caithness (Highland)
NGR	ND 3190 4677 (Tannach)
NMRS	ND34NW 36
In use	July 1940 – 7 November 1945

At a conference held at the Air Ministry in London on 2 October 1939, it was decided that a radar station should be established in the Wick area to provide warning of enemy aircraft approaching Scapa Flow from the south (TNA, AVIA 7/308). As a result of this, mobile equipment was installed at Thrumster in December for Air Ministry Experimental Station No 49, and the station became operational that month with an MB1A transmitter and RM3A receiver (TNA, AVIA 7/257).

Hubert Nettleton recalls:

I arrived at Wick in December 1939. On my first visit to Thrumster I found the site was in the middle of a boggy area of scrub land and wellies were the order of the day. Two wooden huts and two wooden masts, about 125 feet high, had been erected (presumably by contractors) and that was all! No equipment and no power supply …

The RDF receiver arrived at the end of January and was duly installed. The transmitter did not arrive until the end of February and turned up just after a very heavy snow fall. The civilian driver of the low-loader was unable to deliver the transmitter nearer than about fifty yards from the hut that was to house it because of the snow and the soft ground beneath the snow and, as it was late afternoon when he arrived, he was sent off to Wick to find accommodation for the night, leaving the transmitter in its packing case on the low-loader and ourselves to organise a guard over it until next day.

The snow was still there and still as thick next day. At our CO's suggestion, we dismantled the packing case and used the timber to construct a large sledge. The transmitter was about six feet in length, three feet or so wide and nearly six feet high, and very heavy. With a lot of effort, we got the transmitter off the low-loader and on to the sledge. In the meantime, RAF Wick Transport Section had sent up a tractor (though not one with tracks) and we hitched up the sledge to this and eventually got the thing to the hut, only to find that the door to the hut was too small to allow the transmitter through! So it had to stand outside until next day – but this time we were able to round up a platoon of soldiers to stand guard duty.

Next day we set to work and removed one side of the hut and then manhandled the transmitter in and replaced the side of the hut. In the days that followed, the civilian radio mechanics, under the guidance of the CO, did what was necessary to connect up the equipment to the respective aerials. But we still had no power supply. This duly arrived in the shape of a Lister three cylinder diesel generator set similar to those used by searchlight units. Because of the noise it made, it had to be sited some distance from the huts. In the bitter cold it was a brute to start (no self-starter fitted) but at last things could begin to happen.

Then we discovered that there was a fault on *the automatic voltage regulator on the generator. There was an electric heater in the receiver hut but, if this was to be switched on, someone had to go across to the generator to adjust the manual voltage control to compensate for the additional load. It was a couple of months later before we got a second unit and then the first one was only used as a stand-by.*

So, at last we were able to set about learning to use the equipment. Of the transmitter … amongst its motley collection of valves … there were a pair of enormous valves about 15 inches high which operated at such a high temperature that they had to be cooled by an electric fan. The transmitter hut was the warmest place on the site! …

So far as I can recollect, the station had a useable range of about 50 miles in an easterly direction but reducing as one approached 90 degrees north and south of our position. We had no coverage behind us to the west. There was also a 'ground wave' which effectively blotted out the last three or four miles of the trace as the aircraft approached us. We had a pair of binoculars and, in daylight hours, one of the crew would go outside and get a visual which would be passed as such to Wick control.

Since the wireless station was not yet completed, there was little work for us to do and most days we would walk down into Wick and explore the town and the coastline. Our saving grace was the Church of Scotland hut in the town which had been made available to the service personnel. Here it was warm and we could buy pots of tea and cakes. There were a couple of table-tennis tables and we would spend hours in there. There was a piano and, since I could play, I became quite popular. Before long, some of the men from the camp who could play other instruments joined me and we formed a dance band. The camp officers, anxious about the morale of the men, encouraged us in our venture and soon we were playing every Wednesday night for dancing in a cinema in the town (all the seats were moved to make way for the dancers). Soon our band was in big demand and in the months that followed we played at many village dances as far down as Berriedale and also at the John O'Groats Hotel.

We operated a 24 hours system of four watches in a way that, after a long night shift, that shift had a break of almost 24 hours before the next duty. My dance band activities meant that I had to do a bit of shift swapping. Later we had two extra RAF types posted to us which made this a bit easier.

The unit was completely unguarded – we did not even have a security fence and I cannot recall us having any firearms. Plots were passed by us to the control room at RAF Wick but whether they were relayed elsewhere I do not know.

Catering was whatever we chose to do for ourselves. The parent unit at Wick would send up basic rations – tea, sugar, bread, margarine and sometimes some bacon – and each of us would bring something from our 'landladies' for supper on the long night shift, but all our proper meals were provided at our billets. Our officer was accommodated at a hotel in the town …

There were said to be a number of illegal drinking 'joints' in the town where illicit whisky was available but I doubt if any service personnel ever got into them. For myself, being a virtual non-drinker, beer was available but I never did go there. The nearest pubs were the John O'Groats Hotel and a pub down at Lybster, but these were not easily accessible unless you knew someone who had a car … The Station Hotel in Wick had a 'residents only' licence but, as the hotel had become an unofficial Officers' Mess, there was little chance of the 'troops' getting in there.

Most of my spare time was spent in the very welcoming Church of Scotland Hut playing table tennis and drinking tea … However, 269 Squadron used to hold fairly frequent dances at the John O'Groats Hotel and myself and my pals *in the station dance band would be invited to play for them – they had little option since we had no competition – and on these occasions there was plenty of 'oil' about to lubricate the players and dancers …*

In the early months of 1940 there was not a great deal of flying activity at Wick airfield. I think there was a squadron of Skua aircraft belonging to the Fleet Air Arm of the Royal Navy and there was a squadron of Avro Ansons doing reconnaissance flights under Coastal Command. There was also a civilian passenger plane (a Dragon Rapide) which flew in from Kirkwall on its way south to Glasgow. When our wireless station eventually went on the air (early February) most of our work was plotting the movements of these aircraft and reporting them by telephone to the control room at Wick airfield.

We had the occasional hit-and-run raid, often by single aircraft. These mainly came in from the north and we guessed that they had probably intended to drop their load over Scapa Flow but had been scared off by the heavy anti-aircraft fire available over there.

My time at Wick came to an end in November 1940. (Hubert Nettleton, pers comm)

In July 1940 a CHL became operational at Tannach, north of the existing CH station (Air Ministry, 1950 (1): 124). This was a single-gantry, hand-turned CHL, with a Yagi transmitter aerial mounted on top of the receiver array, and equipment housed in a wooden Laing hut 30 feet long and 18 feet wide. The CHL had a sweep of 180°–90°–302°. Average ranges achieved by the CHL during December 1940 were 15 to 18 miles on aircraft at 500 feet, 20 to 22 miles on aircraft at 1,000 feet and 25 to 35 miles on aircraft at 2,000 feet and at 4,000 feet (TNA, AVIA 7/441).

During September 1940 the CH station was moved to Tannach and operated with an MB2 transmitter and RM3A receiver. However, after a few weeks a gale wrecked both transmitter and receiver towers, and the station moved back to the old site and resumed operations with the MB1A and RM3A equipment. On 24 November operations began once more with the MB2 and RM3A at the new site and immediately gave a most useful performance (HRA, RDF in Northern Scotland and the Islands). Perhaps

146 Ron Atkins practising with a Lewis gun next to the Receiver Hut and mast at Tannach in March 1941.
(© Quinton MacMillan)

because of the moves back and forwards, for some time the new station continued to be called Thrumster. On 2 April 1941 the old site was bombed by German aircraft, but no serious damage and no casualties resulted. Two unexploded bombs had to be dealt with, however. Despite such difficulties, the station attained some outstanding performances: in September 1941 a high-flying Spitfire was plotted out to a range of 187 miles, a remarkable achievement for an Advance CH station (TNA, AIR 26/92).

Although performing well, Tannach had no shortage of problems. On 10 November 1941 the 105 foot transmitter mast was blown down. The station was back on the air at 7.30 pm, but later that night the receiver mast was blown down. A temporary receiver array consisting of a single crossed dipole with reflectors was rigged on one of the 240 foot wooden towers, and the station was operating by 14 November. On the plus side, the new MB2 transmitter was commissioned in the Transmitter Block on 10 November, the day the transmitter mast blew down (TNA, AIR 26/92).

Tannach CHL was converted to common aerial working during December 1941, which greatly improved the performance of the equipment. The maximum range achieved during December was 123 miles on the 28th, whereas the maximum the previous month had been 88 miles on 25 November. However, the CHL closed down in May 1942, having been replaced by the 1941 Type CHL at Ulbster (TNA, AIR 26/92).

The Final CH station became operational in early April 1942 and saw the arrival of the first WAAF Operators to the station (TNA, AIR 26/92). However, the new equipment had no sooner been commissioned than disaster struck, when, on 28 May, one of the masts was badly damaged. At 5 am Bristol Beaufort IIA, serial number AW345, coded BX-A of No 86 Squadron, returning from a patrol off the Norwegian coast (TNA, AIR 27/708), crashed into the top of one of the 325 foot transmitter masts, tearing off one wing and removing about 50 feet of mast. Tannach personnel were quickly on the scene but found that all the crew of the aircraft had been killed. Work quickly began on the second transmitter curtain aerial array, which had not been commissioned, and in the creditable time of 1 hour 7 minutes, the CH station was back on the air. In the meantime, a party from Marconi, with assistance from aerial erectors of No 70 Wing, successfully secured the damaged mast, a dangerous task since only the lower set of guy lines was complete (TNA, AIR 26/92).

On 23 June 1945 an AMES Type 9 Mk V MRU was despatched to Tannach for use in observations of backscatter during the solar eclipse of 9 July, with the observations being carried out between 1 and 16 July. The Type 9 filmed the scatter which appeared on the trace and analysed the film, which showed that there was no noticeable decrease in scatter during the eclipse, but that it did reduce towards sunset each day (TNA, AIR 26/92).

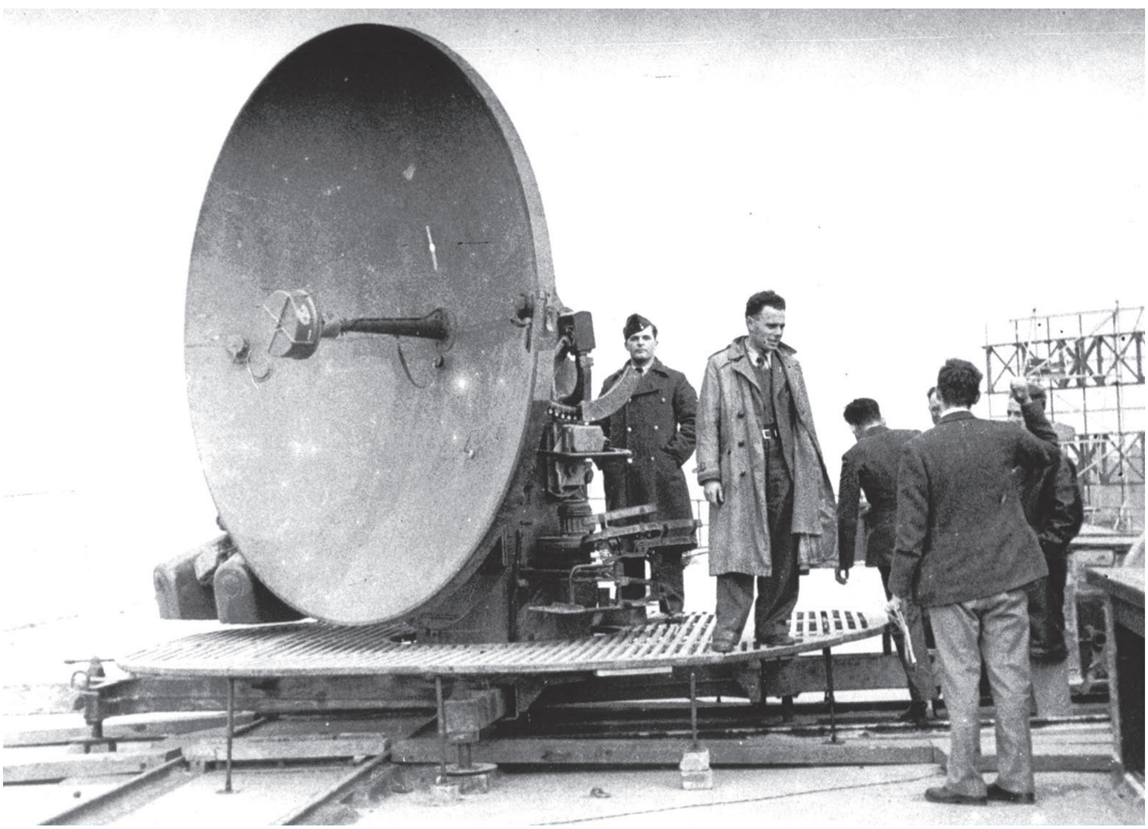
Tannach CH station ceased operating at 12.30 pm on 7 November 1945 and was placed on caretaking the following day (TNA, AIR 26/92).

Tantallon

Type	Research establishment
Subtype	Admiralty Signals Establishment Extension
Region	East Lothian
NGR	NT 5931 8524
NMRS	NT58NE 59
In use	1943–84

During 1943 the Admiralty Signals Establishment, the organisation developing radar equipment primarily for the Royal Navy, set up Admiralty Signals Establishment Extension (ASEE), Tantallon, because its existing facility at Eastney Fort East in Portsmouth had become unsuitable for aircraft trials due to the threat posed by enemy aircraft (Kingsley, 1995: 62; Howse, 1993: 102).

Early in 1944 the decision was taken to carry out a series of trials at ASEE, Tantallon, to test the effectiveness of all the radio



147 *Würzburg* at Tantallon, March/April 1944. Jesse Supper is standing on the platform in the raincoat and John Twinn is standing with his back to the camera and right arm raised.
(© The National Archives ADM 220/1644)

countermeasures equipment which would be used during the Normandy landings in June that year. The trials would also examine whether there was any mutual interference from these sets and the general effect of a diversionary force against existing German radar equipment (TNA, AVIA 7/2455).

The intensive trial programme was carried out from 9 March to 25 April 1944, and included amongst the equipment used were the following sets:

Radars

AMES Type 11, representing the Giant *Würzburg*
AMES Type 12, representing the German *Freya* radar
Freya, composed of an original German equipment but with a reconstructed aerial array
Seetakt, a complete German set, but using British-made transmitter valves
Würzburg Type 39(D)
NZ2, a New Zealand radar representing German radars operating on a frequency of 370 MHz

Radio countermeasures equipment

Carpet I
Carpet II
Carpet 3
Mandrel
Moonshine
Window

Ships

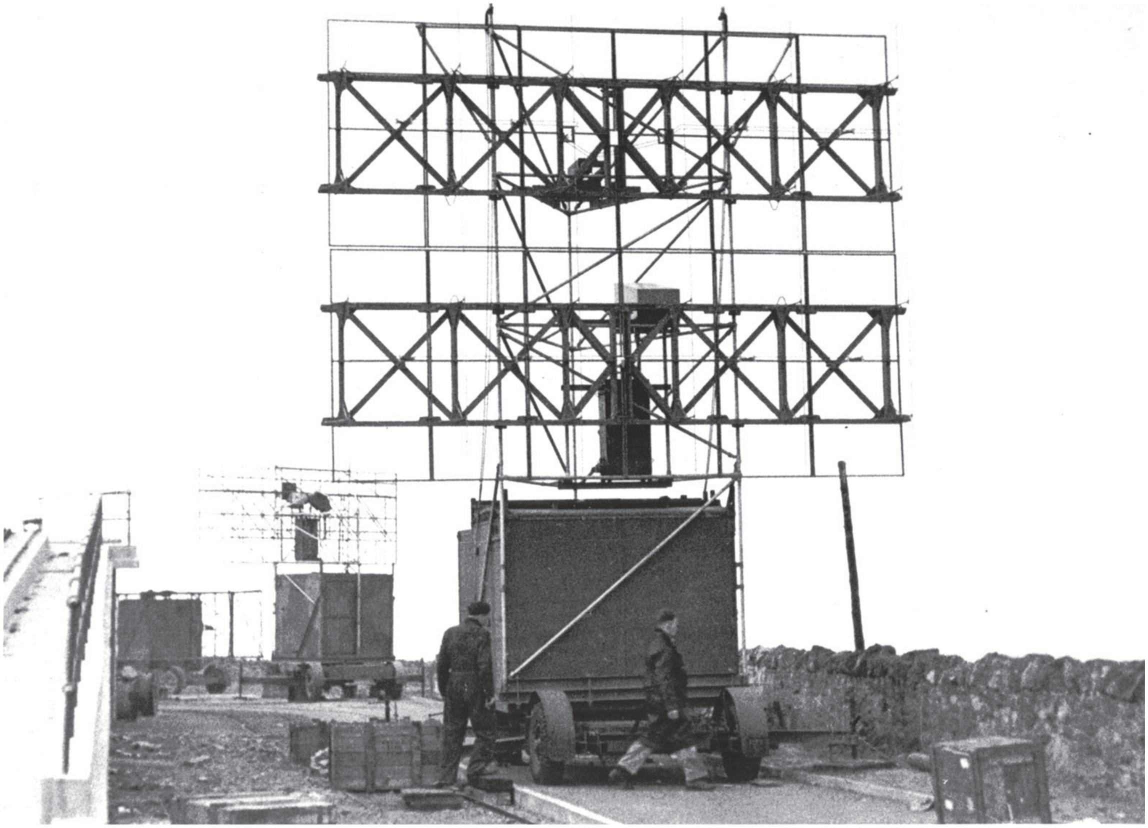
HMS *Largs*, Headquarters Ship
HMS *Gazelle*, American-built British auxiliary minesweeper
HMS *Stormcloud*, Algerine Class fleet minesweeper
HMS *Wallace*, V and W Class destroyer
Fighter Direction Tender 216
Landing Craft Headquarters 187, Landing Craft Tank (4) 675
Harbour Defence Motor Launches 1055, 1056, 1060, 1081, 1085 and 1091

Aircraft

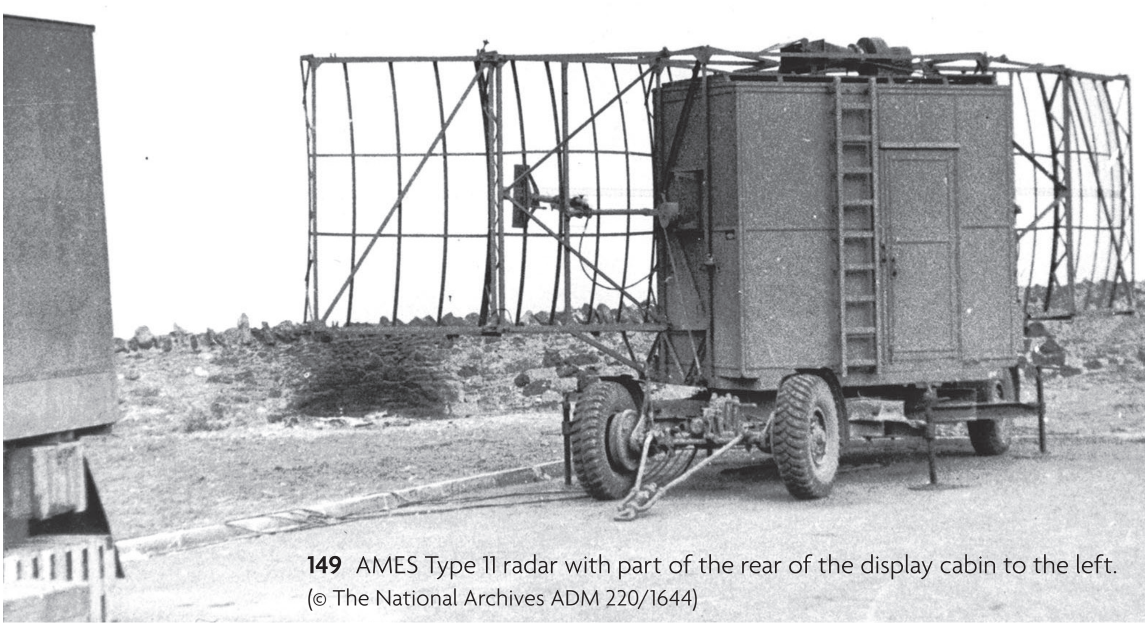
Bristol Beaufighter fitted with ASV
Grumman Avenger fitted with ASB
Two Douglas Mitchells dropping Window (TNA, AVIA 7/2455).

The trials were successfully completed and several conclusions were drawn from them. There was very little interference between different RCM sets, nor any interference to any of the 10 cm wavelength radars. The trials proved that Window cut to interfere with German radars operating on the 50 cm band did indeed cause considerable interference to them, although, as expected, there was no interference on 10 cm.

In addition to jamming, extensive trials were carried out with the RCM sets, including reflective balloons and Window, to determine the method of dropping Window to simulate ships and/or aircraft moving in any desired direction. Investigation was also made of the method of dropping Window, simulating ships or aircraft, at the maximum range of the radars in order that the echoes did not suddenly appear. The results of these trials were good enough to draw up a detailed Window-dropping schedule, and it was also possible to obtain a good representation of a large convoy, arranged in 8 columns, 14 miles long, 2 miles apart and advancing at 7 knots. A further trial of this was subsequently carried out against a Type 11 radar at RAF Bempton in Yorkshire (TNA, ADM 220/1644). The Radar Operators there had not been briefed on what to expect and reported a very large convoy, convincing evidence that the deception operation would be successful on the night of 5/6 June 1944, as indeed it was (Price, 1967: 204).



148 Reconstructed *Freya* radar aerial mounted on a standard RAF trailer at Tantallon.
(© The National Archives ADM 220/1644)



149 AMES Type 11 radar with part of the rear of the display cabin to the left.
(© The National Archives ADM 220/1644)

The overall results of the trials at Tantallon indicated that slight changes were required to avoid interference to radar and communications, but the performance of the RCM equipment was largely as expected. However, the special diversion units required either more equipment or more powerful jammers in order to be effective. Most importantly of all, experience was gained in testing, fitting and operating RCM equipment which would be invaluable to the success of the Normandy landings (TNA, ADM 220/1644).

Jesse Supper recalls:

As the section leader at RAE responsible for the reconstruction and analysis of captured German ground radar I was asked if I could provide functional German radars to support the planned RCM trials. I was glad to be able to comply with this request but … I am now fairly sure that we all agreed that there was little to be gained by transporting Freya and Seetakt to Tantallon since their reaction to the tests could be assessed from the performance of British equipment of similar design and frequency … However, the Würzburg could not be satisfactorily represented by a British radar and in consequence I arranged for the smaller mobile version to be transported to Tantallon together with an experienced setting up and maintenance cum operational team under the direction of GWE Starke who was one of my sub-section leaders … As there was some initial difficulty between this team and the trial organisers I visited the site to sort things out … I stayed for part of the trials as an observer primarily to satisfy myself that the Würzburg was functioning properly and partly out of interest, but I did not take an active part in the trials as such. (Jesse Supper, pers comm)

After the conclusion of the RCM trials, Tantallon returned to its role as a trials station for Naval radar. Later in 1944 a rolling platform, to simulate the rolling motion on board ships, was built (Mike Exeter, pers comm). From mid-1946 this installation was used for trials of Types 960P (aircraft warning), 980 (air and surface warning) and 981 (height-finder) radars, which were set up together on the rolling platform to represent as far as possible a shipborne installation (Howse, 1993: 261). George Oberman was involved in this work:

The Tantallon trials served as a useful period to collect statistical radar performance data against live aircraft trials not possible during the emergencies of war, and not only winkled out design and manufacturing weaknesses, but also enabled fighter director officers to get a preview of things to come before ship fitting commenced. These three radars became the mainstay of carrier-borne Naval radars which would have been used against Japan but in the event were not installed until the 1950s. I was in charge of a team of about 6 scientific officers with a young Sub-Lieutenant … Trials extended from 1946 to 1948. (George Oberman, pers comm)

These tests were just a part of the Naval radar trials work carried out at Tantallon until the Admiralty sold the site to Ferranti in 1984 (Norman Murphy, pers comm).

The Law

Type	Radar station
Subtype	CD/CHL (AMES Type 2), CD No 1 Mk V (AMES Type 31)
Region	Angus
NGR	NO 5132 3735
NMRS	NO53NW 43
In use	24 June 1942 – August 1944

The Law was completed as far as possible by No 71 (Signals) Wing, in conjunction with the Army, during May 1942. However, delay in the installation of telephone lines prevented the CD/CHL station becoming fully operational until 1 pm on 24 June. It was a Triple Service station, with personnel of all three services deployed there, and was equipped with continuous rotation gear, allowing the aerials to be rotated through the full 360°, PPI tube and VT98 transmitting valves. The initial results were not outstanding and average for the equipment, with 173 miles being the best range achieved during June 1942 (TNA, AIR 26/100).

July 1942 saw The Law obtain a range of 49 miles on surface vessels flying barrage balloons. Several hostile tracks were plotted, including one seen at 125 miles' range at 233°. Due to the high level of activity at the station, plots were not passed on this response until 6 sweeps later. One plot was passed before the response faded, which was insufficient for the plot to be identified. Its position was approximately 4 miles off the south-west coast of Arran. Another plot, H652, was picked up at 178 miles, a new record range for The Law. The filtered height of this aircraft was 22,000 feet (TNA, AIR 26/100).

The strength of the station during October 1942 varied between 45 and 55 personnel. At the end of October there were 5 experienced Radar Operators and 11 Operators under training. Four ratings from HMS *Cressy* (a Royal Naval Reserve drill ship, previously named HMS *Unicorn*) were still attached to the station. During December the sweep of the station was extended to cover an arc between 90° and 180°. Long ranges were picked up on almost every bearing that month, convincing the station personnel that no gaps existed in the cover. The long-range record was broken in January 1943 with a plot on a friendly fighter at 16,000 feet at a range of 188 miles. Later that month the record was broken again with a plot at 195 miles, and the station was given permission to increase the range scale on the tube to 210 miles (TNA, AIR 26/100).

Installation of a CD No 1 Mk V (AMES Type 31) centimetric radar was completed and became operational on 21 April 1943, producing excellent results (TNA, AIR 26/100). A further addition to the station equipment came on 18 September with the commissioning of the searchlight for homing lost aircraft (TNA, AIR 26/103).

Ron Dean was a Radar Mechanic at The Law from April to July 1943:

The CHL stations comprised a large concrete building – flat roofed and a large wooden cage on top in which there were dipole aerials stacked vertically and horizontally so as to produce a pencil beam on a higher frequency. The aerial *assembly was rotated through 360° at speed so that the range and bearing of an echo was immediately available …*

At Monikie we also had a small timber hut having an early centimetric naval radar for detecting shipping and convoys off the Tay Estuary. If memory serves me correctly, I think it was possible (even with this early equipment) to detect the bow and stern of a ship. These plots were reported through to Naval Operations Room in Fife. With both equipments, the Bell Rock Lighthouse out to sea gave a very good signal and was most useful for checking bearings and range. On the whole things were fairly uneventful and although there was plenty of activity with our own aircraft, there was little enemy activity … I think that some of the long range aircraft detected were the planes the RAF flew to Sweden to obtain ball bearings.

The electronic equipment gave little trouble and most of the problems were in connection with the motors and equipment required to keep the large and heavy aerial array on the roof turning in all weathers. (Ron Dean, pers comm)

As Ron Dean recalls, The Law became unserviceable due to a badly worn Lucas aerial turning gear which failed on 17 July 1943. Repairs to the turning gear were not completed until October (TNA, AIR 26/103), and HQ No 13 Group recorded: 'The Law, after all their trials and tribulations, are finally back on the air; we only hope that their temporary aerial fault will not develop into another headache'

150 The Law, photographed in late 1945, with the T & R Block just visible in the trees on the left. (© Ron Dean)

(HRA, HQ 13 Group Bulletin). However, the following month the decision was taken to dismantle the CD/CHL equipment (Air Ministry, 1950 (1): 516) and operations ceased on 21 December. Dismantling started immediately (TNA, AIR 26/103).

The Type 31 equipment remained operational and gave good performances. On 17 February 1944 a northbound coaster of 1,336 tons was picked up at 45,000 yards at 127°, the vessel being 3,000 to 4,000 yards off course. The NPR requested plots every 10 minutes and the vessel was able to regain the shipping channel and eventually faded at a range of 36,000 yards on a bearing of 76° (TNA, AIR 26/103).

On 14 July 1944 a Type 55 high-power centimetric radar became operational at Douglas Wood, and as a result the Type 31 at The Law became redundant (TNA, AIR 26/92). Authority was received on 24 August 1944 to dismantle the Type 31, and consequently The Law went off the air (Air Ministry, 1950 (1): 638).

Ulbster

Type	Radar station
Subtype	Chain Home Low (AMES Type 2), CD No 1 Mk V (AMES Type 31)
Region	Caithness (Highland)
NGR	ND 3323 4232
NMRS	ND34SW 290
In use	late May 1942 – 15 March 1946

Construction of the combined T & R Block of the 1941 Type common aerial working, power-turned CHL at Ulbster was completed during February 1942. Building of the Stand-by Set House and gantry was also finished during February and the transmitter, receiver and aerial frames were on site awaiting installation. Air Ministry Experimental Station No 49C, Ulbster became operational a few days before the end of May, replacing the CHL at Tannach. Ulbster was equipped with a PPI tube and it gave much better coverage than Tannach CHL had, especially on low-flying aircraft, achieving ranges of 192 miles on aircraft and 56 miles on shipping during June 1942 (TNA, AIR 26/92).

A second PPI display was installed at Ulbster during September 1942, making the station ready to accept WAAFs and WRNS, at least as far as the technical equipment was concerned. WAAFs took over operations in October and Wrens were using the second PPI for plotting surface vessels (TNA, AIR 26/92).

Early in 1943 a CD No 1 Mk V (AMES Type 31) centimetric radar became operational; after a few teething troubles, by April it had settled down and was giving a satisfactory performance. The CHL was also working well, producing ranges of 196, 203 and 205 miles during April and May (TNA, AIR 26/92)

Peggy Haynes was posted to Ulbster in August 1943:

Tannach (CH) & Ulbster (CHL) were on separate sites, but we all lived in the one admin compound. There was a prototype CD at Ulbster & at one time I think I trained a few new ops there … Can't recall what the equipment was beyond a *small hut which must have had a parabola aerial, but as ops we didn't really know how to mend anything – you just needed to calibrate the PPI & range tube on your permanent echo & get on with it!* (Peggy Haynes, pers comm)

During August 1943 a searchlight became operational, to be used in directing lost aircraft towards an airfield for a safe landing. An example of how useful this equipment could be is given by the events of 10 April 1944. At 12.18 am Ulbster picked up A643 travelling in a westerly direction. The plot faded at 12.42 am and reappeared 12 minutes later. At 1 am the station was instructed to expose the searchlight and point it towards Tain. The aircraft followed the beam and at 1.18 am the light was doused. The aircraft was a Fairey Barracuda which had only 30 minutes' worth of fuel remaining when it landed at Tain (TNA, AIR 26/92).

Ulbster continued to prove its value to Barracuda aircrew when, on 15 May 1944, one such aircraft crashed into the sea and the station was asked to search for it. The Type 31 picked up a weak echo showing very slight movement and an aircraft was directed into position to search. A dinghy containing three survivors was located (TNA, AIR 26/92).

The Type 31 ceased operating at 6 pm on 30 November 1944 (TNA, AIR 26/92). The CHL remained on the air until it too closed down on 15 March 1946, the last WAAF having been posted away on 7 March (TNA, AIR 26/93).

Unst

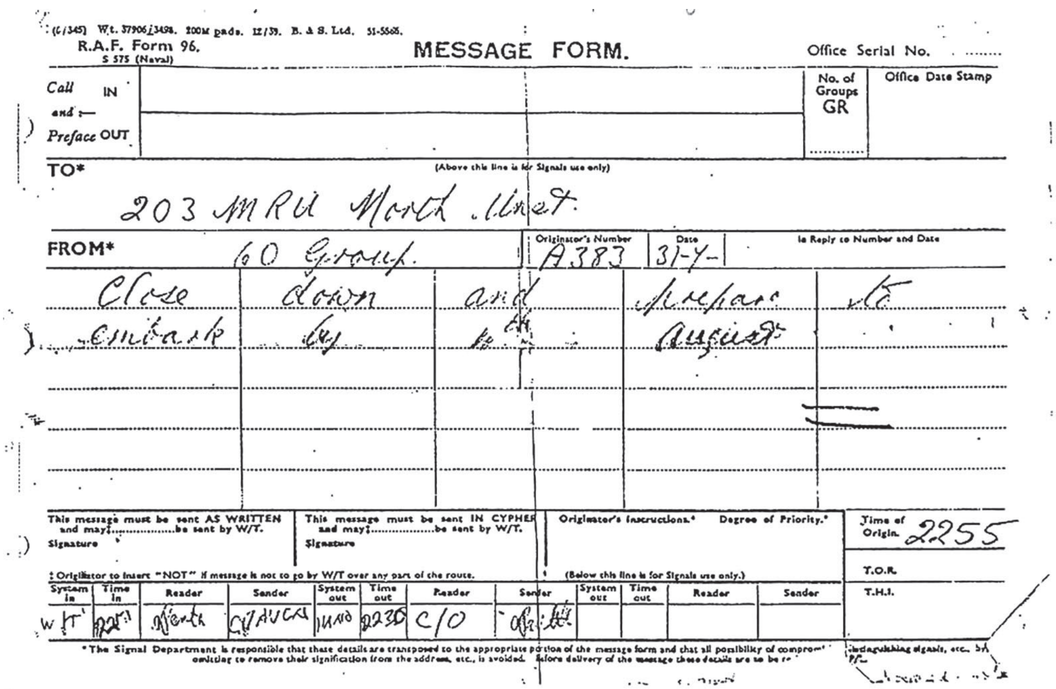
Type	Radar station
Subtype	Mobile Radio Unit (AMES Type 9)
Region	Shetland
NGR	HP 647 097
NMRS	HP60NW 185
In use	28 May – 4 August 1940

In March 1940 Pilot Officer Len Pittendrigh was tasked with setting up No 203 MRU at Baltasound on Unst. This was no easy matter and involved the convoy of ten vehicles driving all the way from Kidbrooke to Leith and then unloading in Baltasound on 16 May. The selected site for the unit was of little use and Pilot Officer Pittendrigh decided to set up on the Keen of Hamar, despite the fact there was no track up the hill (TNA, AVIA 7/709; Pittendrigh, 1992: 7–11).

Len Pittendrigh recalls setting up the radar on top of the hill:

We set about climbing the Keen of Hamar; the trick was to zig-zag up the slope. On the top with its magnificent view, we set up my 10 foot by 6 foot insulated hut and next to it a store-cum-office and then the cookhouse for myself, the watch crews and others on duty. The Receiver and Transmitter vehicles were driven, pushed and towed uphill until with gasps of relief, everything was on site.

Then came the snags, or was it sabotage? We were totally dependent on radio contact with the outside world and all our gear was battery operated and the Coventry Climax powered battery charger appeared to have been damaged – perhaps deliberately. There appeared no way


(C/345) Wt. 37906/3498. 200M pads. 12/39. B. & S. Ltd. 51-5565.
R.A.F. Form 96.
S 575 (Naval)
MESSAGE FORM.
Office Serial No.
Call IN and — Preface OUT
No. of Groups GR
Office Date Stamp
(Above this line is for Signals use only)
TO* 203 MRU North Unst.
FROM* 60 Group.
Originator's Number A383
Date 31-7-
In Reply to Number and Date
Close down and prepare to embark by 4th August
This message must be sent AS WRITTEN and may‡..................be sent by W/T. Signature
This message must be sent IN CYPHER and may‡..................be sent by W/T. Signature
Originator's Instructions.* Degree of Priority.*
Time of Origin. 2255
‡ Originator to insert "NOT" if message is not to go by W/T over any part of the route.
(Below this line is for Signals use only.)
T.O.R.
T.H.I.

System in	Time in	Reader	Sender	System out	Time out	Reader	Sender	System out	Time out	Reader	Sender
W/T					2230	C/O					

*The Signal Department is responsible that these details are transposed to the appropriate portion of the message form and that all possibility of compromise is avoided ... before delivery of the message these details are to be re...

151 The signal sent to No 203 MRU instructing it to close down.
(© Len Pittendrigh)

in which we could charge our batteries and Unst, being so remote, there was no easy way of obtaining spares and no way of ordering them without a radio. I solved the problem by tapping the 120 volt dc field of the main diesel alternator and connecting the batteries up in series to give a 4 amp charge. This took several days and even when contact with Sumburgh was established, every message took ages as it first had to be encoded and then transmitted by morse by newly trained operators. None of them could handle more than 10 words per minute. With the spares ordered, there was only the radar to fix.

Setting up the transmitter and receiver masts without mechanical aids called for all hands to be present. With this done, earthing the system was a problem as solid rock is an insulator. Later, when we plotted our first aircraft, I felt our Herculean efforts were worthy of a pat on the back but no congratulatory signal came …

One morning about 2.00 am the Signals NCO woke me with a de-cyphered signal from No 60 Group via my HQ on Sumburgh Head. It said, 'Shut down station and prepare to evacuate to the Mainland Stop.' After all the trouble to get switched on this seemed unbelievable. Frantic signals between myself and HQ 60 Group, Leighton Buzzard, got nowhere so I refused to do anything until I received a properly authorised signal. In due course this arrived and later a chartered ship came to take off my Adjutant and all the men, except for myself and 2 NCO Radio Mechanics to hand over to whoever was to arrive.

The 'properly authorised signal' referred to was sent by No 60 Group to No 203 MRU on 31 July 1940 and read: 'Close down and prepare to embark by 4th August' (Pittendrigh, 1992: 7–15).

Watsness

Type	Radar station
Subtype	Chain Home Low (AMES Type 2)
Region	Shetland
NGR	HU 1842 5090
NMRS	HU15SE 21
In use	February 1942 – 4 August 1945

Watsness, a 1941 Type CHL with common aerial working and power turning, went on the air in February 1942. At the end of March the station was noted as having given a good performance and filled a very bad gap in radar coverage that existed to the west of the Shetland Islands (TNA, AIR 26/100).

A gridded mask was fitted to the PPI tube during July 1942. This replaced the grid painted on the face of the tube and thereby increased the range of the PPI by 10 miles. Prior to this, it had only been possible to see up to a range of 50 miles on the PPI. The station was able to pick up the Northern Lights during the month, seen between 0° and 20°. The effect was a great increase in 'grass', or background reflections, but operations were not affected since aircraft were rarely seen in that direction (TNA, AIR 26/100).

On 16 September 1942 the station performed well in plotting Hostile 256, which attacked Fair Isle. It was later discovered that at the time Watsness was plotting this track, the aircraft was flying at a height of only 50 feet. Further evidence of the excellent performance of Watsness on very low-flying aircraft came during May 1943, when aircraft at heights of 1,000 feet or less were seen at ranges of 4½, 20, 43 and 59 miles. However, the station was also achieving very good long-range plots, such as on 10 March 1943 when Fighter 163 was picked up due south at 208 miles (TNA, AIR 26/100).

Flying Officer Eric Anderson was posted to Watsness in February 1945 and recalls the jolt to the system of winter in Shetland:

Perhaps you can imagine the shock of Atlantic gales sweeping in with horizontal rain to the west coast of Shetland in February to someone who has been over 4 years in the warm desert! Fortunately, there was a large fireplace in the mess (built by a previous Canadian CO) and plenty of coal! (Eric Anderson, pers comm)

Watsness CHL closed down on 4 August 1945 and the station was placed on care and maintenance (TNA, AIR 26/92).

Westburn

Type	Radar station
Subtype	CD/CHL (AMES Type 2)
Region	Aberdeenshire
NGR	NJ 9567 2000
NMRS	NJ91NE 20
In use	12 June 1942 – 4 February 1944

152 Westburn CD/CHL T & R Block with the aerial array and gantry removed, taken in June 1948 as work started to convert the building into a house.
(© Elizabeth Cooper)

Westburn was built as a Triple Service CD/CHL station (ie all three services were involved in its operation) by the War Office, with work being completed during May 1942. However, there was a delay in the installation of telephone lines and it was therefore not until 10.15 pm on 12 June that the station first reported operational to Inverness Filter Room (TNA, AIR 26/100).

Several interesting tracks were plotted during June 1942, including F128 and F126 at ranges of 143 and 136 miles respectively. These two fighters were plotted at a height of 14,000 feet. Aircraft below 1,000 feet were plotted to a range of 38 miles. Shipping was plotted consistently well, with convoys flying barrage balloons for protection being plotted up to 30 miles away (TNA, AIR 26/100).

The station was converted to continuous rotation on 23 July 1942. This meant that it was no longer necessary to rotate the aerials backwards and forwards to avoid entangling the feeder lines, but instead the aerial could be rotated continuously in one direction. Also on 23 July the PPI tube was commissioned, which made plotting much easier. As a result of these improvements, the station was able to regularly plot tracks up to 150 miles during August, with a plot of 163 miles being passed on 25 August – this was beyond the limit of Westburn's plotting table. On the night of 15/16 August the station plotted numerous fighters and hostiles at ranges between 120 and 156 miles during an air raid on north-east England (TNA, AIR 26/100).

Desmond Whitehouse recalls:

I was posted to RAF Westburn as a Radar Mechanic (then known as Radio Mechanic for security reasons) on 8th October 1942, my first posting after radio training school … I was told that the plotting table was an Army type … Otherwise the only other Army connection was a US Army Commanding Officer who took charge for a short period in 1943.

At first we were accommodated in Orrok

House but we were moved to the Nissen huts in the grounds of Orrok House when the WAAFs arrived in, I think, December '42 or January '43. Most of the time there was only one other English Radar Mechanic – the others were Canadians and New Zealanders …

We were divided into four watches, each watch comprising one mechanic and four or five operators. A watch would work in 8 hour shifts 16.00 till midnight, 08.00 till 16.00, midnight till 08.00 then we were free till 16.00 the following day. It was usually the mechanic's job to make the tea and make something palatable from the rations provided, often augmented by eggs found in the garden of Orrok House – we did not discourage the hens from the neighbouring farm from using nests in the garden. Another of the mechanic's jobs was the maintenance of the lighting plant at Orrok House – a dynamo driven by a 2-stroke petrol engine which was nearing the end of its useful life. Every time it failed the house was plunged into darkness; the mechanics were always blamed! …

Every morning the first question asked on going on watch was 'Where is Weather Willie?' This weather reconnaissance plane appeared every morning off the coast and, presumably being stripped of all armaments, flew at the then fantastic speed of 400 mph. We usually sent up a fighter to intercept it but I don't remember it being caught. It was usually the highlight of the day.

I will always remember the night of 31st December 1942 – all the operators were Scottish and, being the only Sassenach on the watch I was on my own until about 5.00 am. We had a very busy time – I was dancing from the operating positions reading both range & bearings and to the plotting table to report to the filter room and the same day they changed the phonetic alphabet to suit the Americans from the old Ack, Beer, Charlie to Able, Baker, Cork, Dog, etc. and our local square became Monkey Nuts. I changed it exactly on midnight as instructed much to the confusion of the filter room WAAFs who, I think, were still suffering from the effects of Hogmanay. The Luftwaffe on the other hand were very active. (Desmond Whitehouse, pers comm)

The station plotted hostiles on 23 occasions during October 1942. 'Weather Willie' was still making regular appearances, typically at a range of about 140 miles, and Westburn was usually able to obtain about a dozen plots before losing him (TNA, AIR 26/100).

Unfortunately a defect in the turning gear meant that Westburn was off the air at the time of the raid on Aberdeen on the evening of 21 April 1943, and thus was unable to track the incoming bombers. However, Westburn did see another interesting incident on the afternoon of 9 May, when Hostile 214 circled Westburn CD/CHL several times. The ground defences of the station went into action, but after a few minutes two Supermarine Spitfires from No 165 Squadron based at RAF Dyce came on the scene and escorted the hostile away. The ground defence personnel were later congratulated by No 60 (Signals) Group on the action taken (TNA, AIR 26/100). In actual fact, the hostile was Junkers Ju 88R-1 D5+EV of *10 Staffel, Nachtjagdgeschwader 3*, which defected from Aalborg and landed at Dyce at 4.00 pm, equipped with the latest German airborne radar, FuG 202 *Lichtenstein BC*. This equipment was subsequently examined closely by RAF Intelligence, and the information gained proved of great value in the battle against German night fighters (Ramsey, 1990: 261; Streetly, 1978: 179).

A WAAF Supervisor and WAAF Operators arrived at Westburn at the beginning of May 1943, with the training of the operators being supervised by their officer (TNA, AIR 26/100).

Westburn CD/CHL ceased operations at 12 pm on 4 February 1944 and dismantling of the station commenced the same day (TNA, AIR 26/92).

Whale Head

Type	Radar station
Subtype	Chain Home (AMES Type 1)
Region	Orkney
NGR	HY 7642 4356
NMRS	HY74SE 23
In use	29 March 1942 – 15 March 1946

In January 1941 Whale Head CH radar station was under construction (Air Ministry, 1950 (1): 547), and this work was still under way when, on 8 March, a Junkers Ju 88 came from the north-east, circled the site and then dived on it, dropping four bombs. Two hit the site, of which one did not explode. The other destroyed four huts, killing one civilian workman and injuring another five. The Ju 88 returned and dived to 500 feet, machine-gunning the site as it approached, before climbing steeply and returning in the direction from which it had come (Hewison, 1990: 329). The station was again attacked on 22 June when four bombs were dropped on waste ground 50 yards from the station. Fortunately, these caused no damage or casualties. Despite these attacks, work on the construction of the station progressed well and by the end of October the only remaining work was the completion of the generators in the Main Power House (TNA, AIR 26/92).

Following the laying of telephone cables and other minor work, Air Ministry Experimental Station No 51, Whale Head, became operational on 29 March 1942 (TNA, AIR 26/92). Whale Head was an all-round looking CH station, the four lines of shoot being 45°, 135°, 225° and 315°.

The maximum range achieved during April 1942 was 146 miles. On 31 May, Whale Head plotted Hostile 294 for a distance of 160 miles. The aircraft, a Junkers Ju 88, was intercepted and claimed as damaged. The maximum range for May was 167 miles. Hostile activity continued in June, with H251 tracked on the 11th, H297 on the 12th, H292 on the 18th and H285 on the 25th, although none were intercepted. The maximum range that July was 182 miles. During October, Whale Head was noted for its outstanding performance in producing height information (TNA, AIR 26/92).

During November 1942 a high-power amplifier was installed, which increased the transmitter peak output power from 400 to 800 kilowatts. The amplifier was, in fact, capable of much greater output but required a new array, under construction at that time, before the power could be increased beyond 800 kilowatts (TNA, AIR 26/92). Tony Bridgewater, Senior Technical Officer No 70 (Signals) Wing, recalls that at the time Whale Head was the most powerful station ever built (Tony Bridgewater, pers comm). One of the receivers was modified to full RF8 form during February 1943, which added to the capabilities of the station. More significantly, the high-

153 Whale Head from the Domestic Site, showing the two 350 foot transmitter towers on the left, the two 240 foot receiver towers in the centre and the 105 foot IFF mast next to the right-hand receiver tower. (© Kenny Foubister Collection)

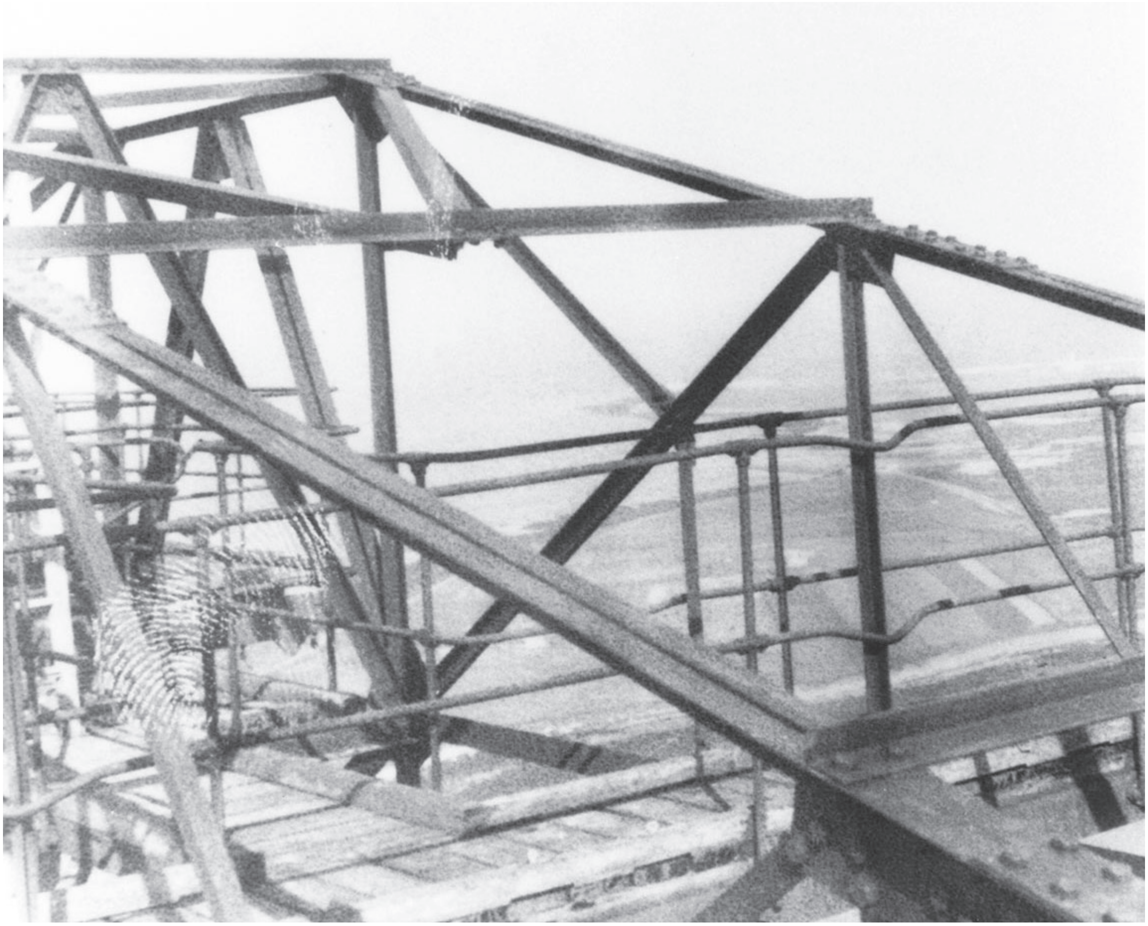
power aerial array came into use during March and produced an increase in the station performance (TNA, AIR 26/92).

John Wightman was a Radar Mechanic at Whale Head from May 1943 until November 1944:

Because Sanday was so remote, the Ministry of Food could not economically arrange for the collection of the small output from the farms on the island. Accordingly, the crofters were happy to sell eggs, cheese and butter to us. I had a large screw-top jar of butter which I used to take to meals – reckon I used to get through two weeks civilian rations every day! On evening watch 18.00 to 23.00 and night watch 23.00 to 08.00 we used to cook eggs and chips in the kitchen we had established in T Block. Sometimes I would buy a lobster and cook it before going on watch. Then had a gourmet feast around midnight. A really big lobster cost the equivalent of 15 p, a medium-sized one 12 p. The islanders were great conservationists – they always threw the small ones back …

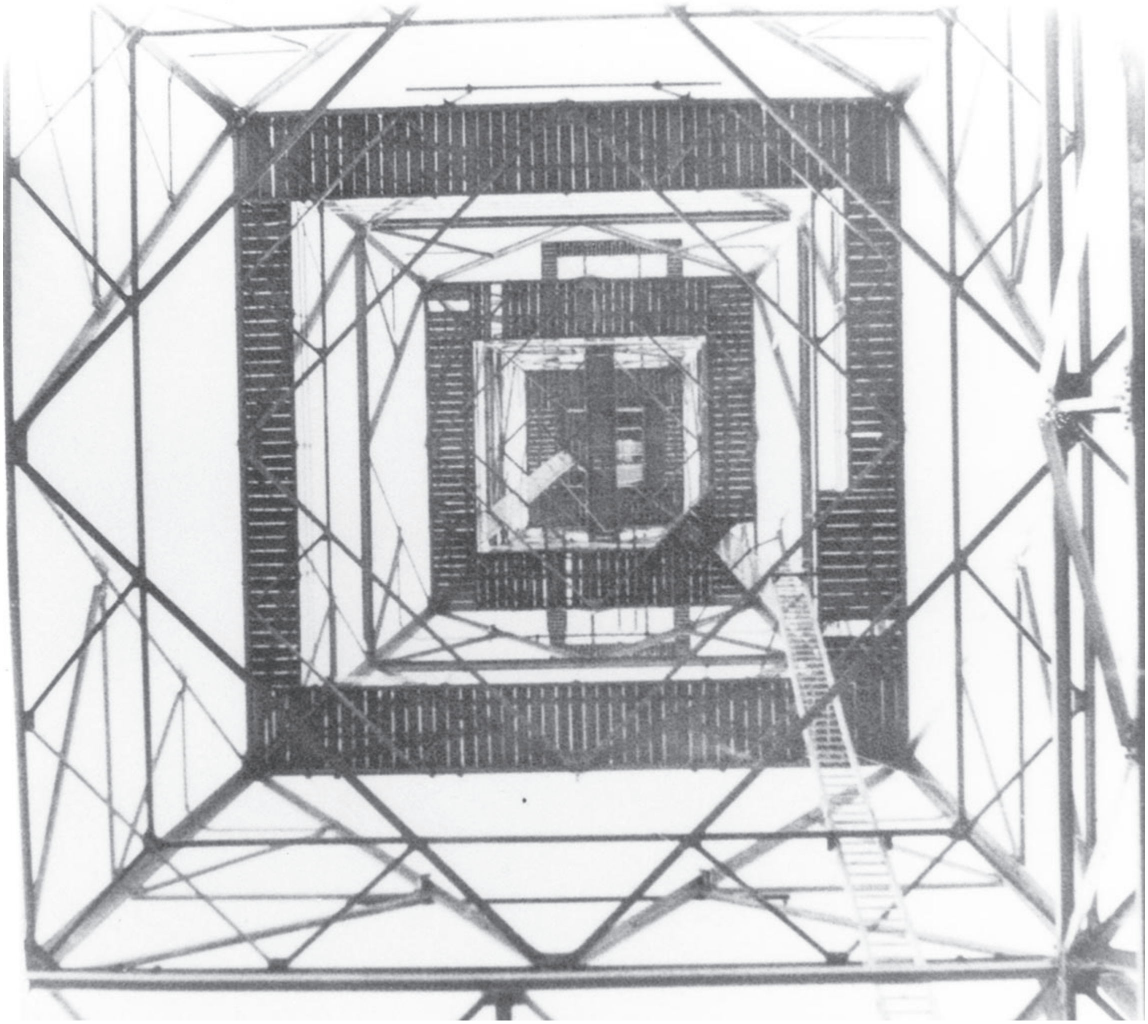
The transmitter hall in T Block was about 40 feet by 20 feet. One night the plaster ceiling, an estimated 2 tons, fell down. Fortunately the mechanic was in another part of the building or he would have been, at the least, seriously injured. Apparently, during construction the concrete of the inner, flat roof had been insufficiently 'keyed', hence the fall. The station went off the air because plaster blocked cooling fan intakes and the tilt switches cut off the power. The stand-by equipment was equally affected. From memory I think the station was off for less than an hour, but it took us a week to clean up the mess.

At the power station, the diesels had governors to maintain engine speed and hence voltage. The governors were chain driven and one evening



154 The top of one of the 350 foot transmitter towers at Whale Head.
(© Kenny Foubister Collection)

when load was high, the chain on the engine in use broke … the cause was probably metal fatigue in the chain … The load caused the Blackstone to slow down so that voltage dropped from the usual 220 to 240 volts ac to about 170 volts. The megawatt PA [power amplifier] would not operate with low primary voltage on its power supply so the power supply to the big amplifiers was fitted with an 'undervolt' relay. This dropped out as it was designed to do, and thus the main component of the load was removed from the power line. Now the diesel started to race and generator output rose to well over 300 volts as fuses in remaining circuits started blowing. The diesel mechanic on duty got everything shut down and ran up the other generator. The whole episode took probably a little over ten seconds but it took us a full week to repair the damage done to the radar gear. We were back on the air in a few minutes with the stand-by equipment and in fact the transmitter in use had suffered no damage. Fortunately the spare RF7 in R Block was off and could be brought into use, but the operational one was badly damaged. Fuses were really designed to protect against short circuit of capacitors and not voltage surges, so there were multifarious obscure

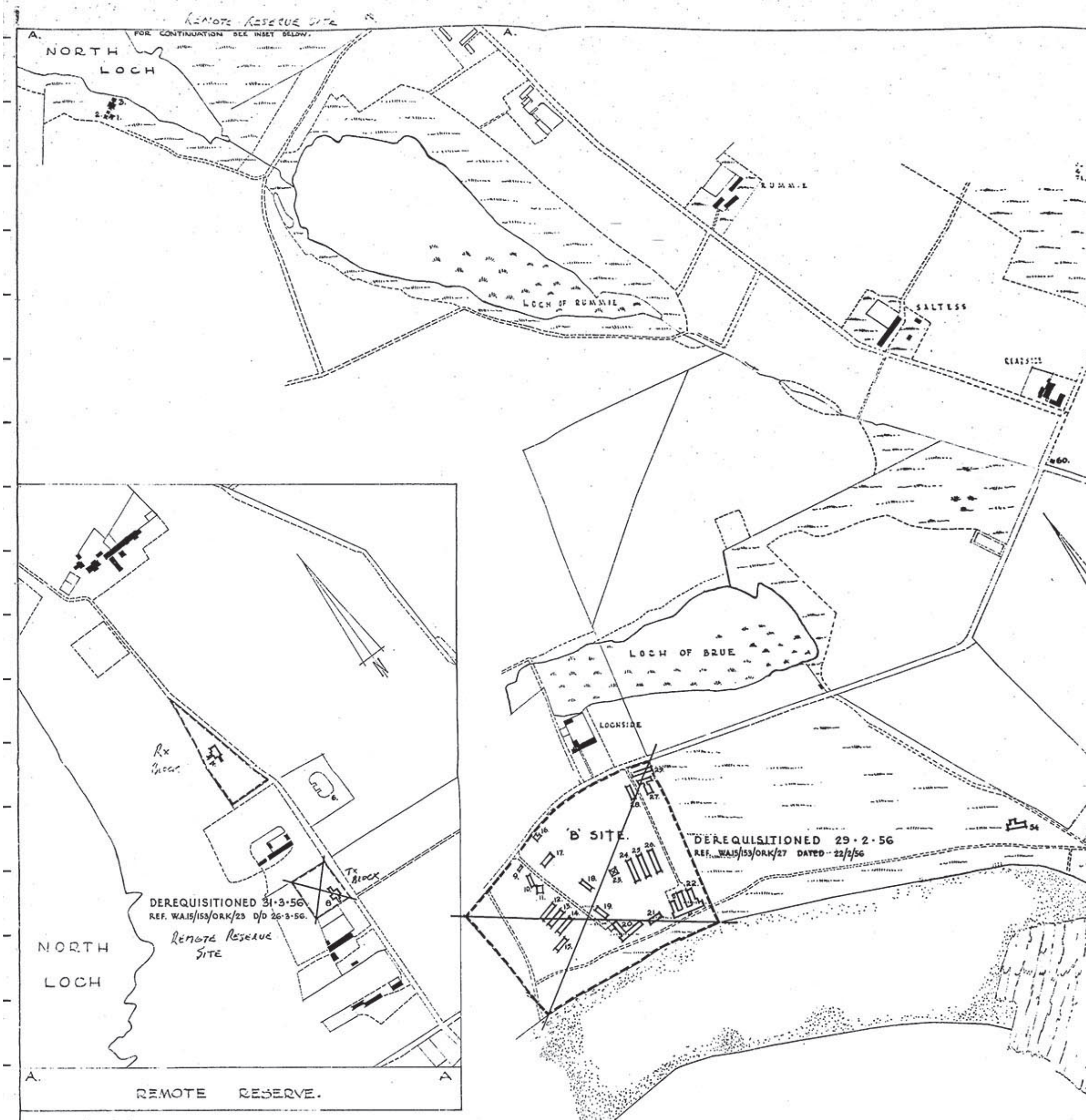


155 Looking up one of the 350 foot transmitter towers at Whale Head.
(© Kenny Foubister Collection)

faults in the receiving circuits. (John Wightman, pers comm)

Whale Head was equipped with a searchlight for the purpose of directing lost aircraft to the nearest suitable airfield. It was first used on 18 November 1943 to direct a Short Sunderland flying boat from Sullom Voe to a safe landing at Alness (TNA, AIR 26/92).

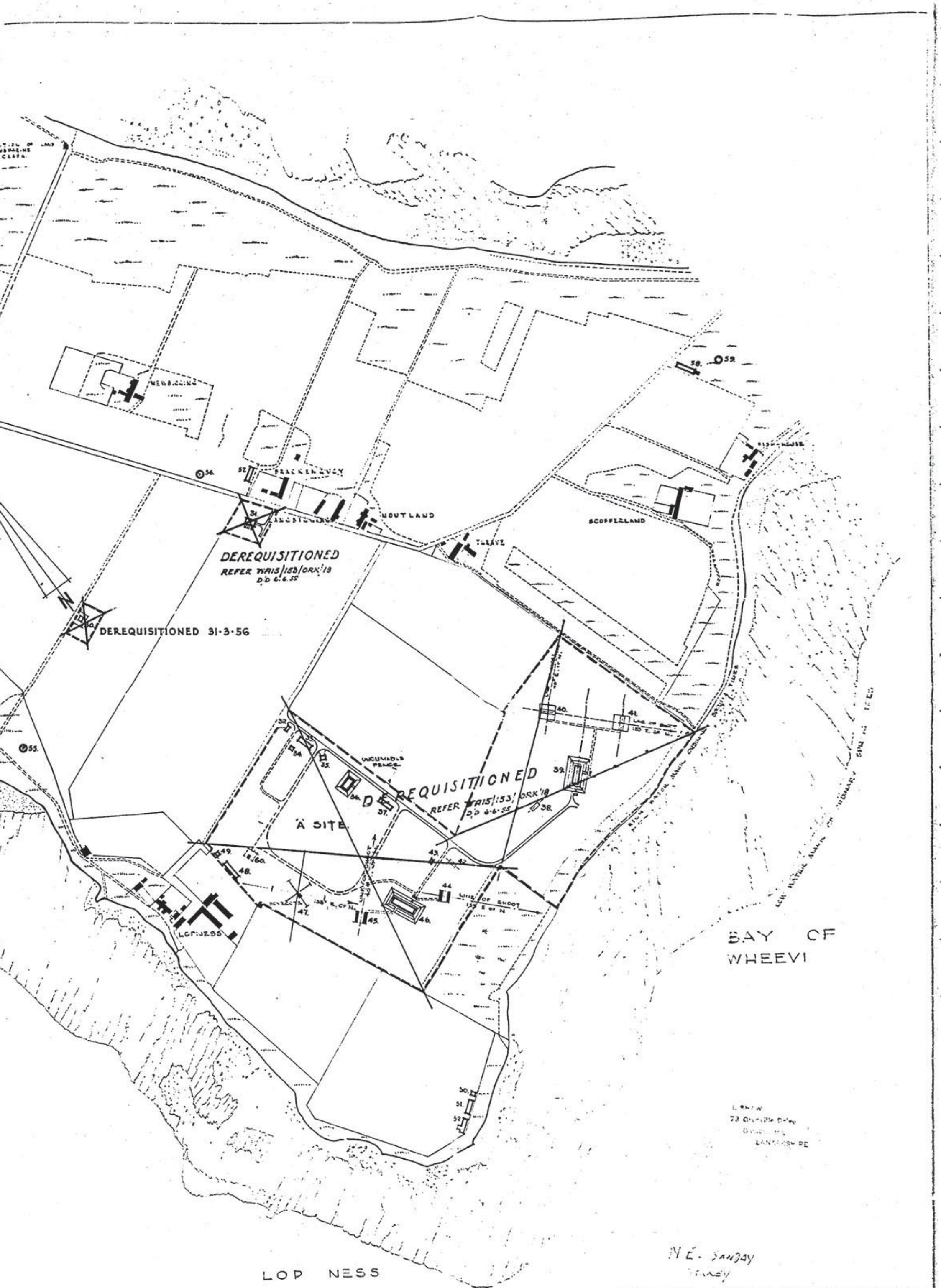
Further improvement was made to Whale Head with the installation of a megawatt amplifier driven by an MB2 transmitter, constructed by staff at Headquarters, No 70 (Signals) Wing, between 11 and 25 February 1944. This equipment proved its worth on 30 May when a Junkers Ju 88 was shot down mainly as a result of the height information from Whale Head. The station passed heights of 24,000 feet; the hostile was intercepted at 23,000 feet (TNA, AIR 26/92).



REFERENCE

Nº	DRG. Nº	BUILDING		Nº	DRG. Nº	BUILDING	Nº	DRG. Nº	BUILDING	Nº	DRG. Nº	BUILDING
1.	WA15/384/41	WATER STORAGE TANK & TOWER		22.	9283/40.	N.A.A.F.I & INSTITUTE.	43.	9047/40	ARMY TROOP HQ.			
2.	" "	PUMP HOUSE.		23.		WATER (FIRE) POOL 150,00 GALS.	44.	3889/40	"R" TOWER. 240' TIMBER LATTICE			
3.	WA15/336/41	FILTER BED & DOSING CH^BR.		24.		BARRACK HUT.	45.	" "	" " " " "			
4.	16087/40	"R" BLOCK.	REMOTE	25.		" "	46.	7111/40	"R" BLOCK.			
~~5.~~	~~16436/40~~	~~"R" TOWER.~~		26.		" "	47.	15046/41	105' GUYED MAST & I.F.F. CUBICLE.			
6		POWER HOUSE.		27.	9048/40.	OFFICERS MESS.	48.		BARRACK HUT. (ARMY)			
~~7.~~	~~16435/40~~	~~"T" TOWER.~~	RESERVE	28.		EQUIPMENT STORE.	49.		ABLUTIONS "			
8.	16091/40	"T" BLOCK.		29.	9048/40.	OFFICERS QTS. PART USED AS OFFICE	50.		BARRACK HUT. "			
9.	FCW 4392 WA15/375	"B" SITE GUARD HOUSE.		30	" "	AMMUNITION STORE.	51.		" " "			
10.		GARAGE.		31	9205/40.	MAIN POWER HOUSE.	52.		" " "			
11.	WA15/176/41	GARAGE & CYCLE STORE.		32.	9047/40.	"A" SITE GUARD HOUSE	53.		GUN PIT.			
12.	9048/40.	BARRACK HUT.		33.	" "	H.Q OFFICE (USED AS STORES)	54.		BARRACK HUT. (ARMY)			
13.	" "	" "		34.	9048/40	FIRST AID POST.	55.		GUN PIT.			
14.	" "	" "		35.	" "	GARAGE & CYCLE STORE.	56.		" "			
15.		SALVAGE HUT.		36.	13881/40	STAND BY POWER HOUSE.	57.		BARRACK HUT. (ARMY)			
16.	1975/41	A-M-W-D OFFICES.		37.		OFFICERS MESS & QRS (ARMY)	58.		" " "			
17.	17901/40	SICK QUARTERS.		38.		AIR RAID SHELTER	59.		GUN PIT.			
18	15476/40	SLEEPING SHELTER.		39.	7451/40	"T" BLOCK.	60.	9047/40	PETROL STORE.			
19.	9048/40	ABLUTIONS.		40.		"T" TOWER. 350' STEEL LATTICE						
20.	" "	DINING RM. (USED AS CINEMA)		41.		" " " " "						
21.	" "	ABLUTIONS.		42		AIR RAID SHELTER						

156 Whale Head site plan. (© Historical Radar Archive)



S.E. Nº 13 WORKS AREA. H.H W.B.M. 23 : 6 : 42	WHALE HEAD RECORD SITE PLAN	D. of W. WA15/548/42 AIR MINISTRY.

Preparations were made during June 1945 for observations to be made on the effect of the solar eclipse on 9 July on ionospheric scatter, principally modifications to one of the RF8 receivers to provide a 400 mile range on the tube. The observations were carried out from 1 to 16 July and indicated that there was no noticeable decrease in scatter during the eclipse, but that it did decline towards sunset every day (TNA, AIR 26/92).

Whale Head CH ceased operating at 4.30 pm on 15 March 1946 due to the closure of No 13 Group Filter Room (TNA, AIR 26/93).

Windyhead Hill

Type	Radio Navigational Aid station
Subtype	Gee Slave (AMES Type 7000)
Region	Aberdeenshire
NGR	NJ 8549 6187
NMRS	NJ86SE 27
In use	14 November 1942 – 31 March 1946

Construction of the Northern Type 7000 Chain began during June 1942. The chain comprised four stations: Burifa Hill (Master and Monitor), Scousburgh (Slave), Sango (Slave) and Windyhead Hill ('C' Slave) (TNA, AIR 29/147).

The Northern Type 7000 Chain became operational at 2 pm on 14 November 1942, 24 hours ahead of schedule. On 1 March 1943 operational trials of the Northern Chain began. Northern Type 7000 Chain signals provided navigational assistance for numerous operations for the next three years, including heavy bomber raids on St Nazaire, Stettin, Berlin, Hanover, Le Mans and Frankfurt, as well as the large attack on the rocket research facility at Peenemünde on the night of 17/18 August 1943. Various other raids used Gee coverage from the Northern Chain, including USAAF 8th Air Force attacks on Trondheim, Bremen, Kiel and Hamburg. The coverage was also used for minelayers in the North Sea and Baltic, and for Coastal Command strike aircraft attacking shipping off the Norwegian coast. There is not space here to list every operation in which the chain was involved, but this gives some idea of the extensive use to which the Northern Chain coverage was put (TNA, AIR 29/147).

The Northern Type 7000 Chain closed down at 11 pm on 31 March 1946 and Windyhead Hill was placed on care and maintenance (TNA, AIR 26/93).

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