NATO Forward Scatter Station, Stenigot Lincolnshire

Roger J C Thomas, drawings by Allan T Adams

ROYAL COMMISSION ON THE HISTORICAL MONUMENTS OF ENGLAND

HISTORIC BUILDING REPORT

NATO Forward Scatter Station Stenigot
Manor Hill
Donington on Bain
Lincolnshire

February 1997

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ROYAL COMMISSION ON THE HISTORICAL MONUMENTS OF ENGLAND

Lincolnshire NBR No: 94836

Donington on Bain NGR: TF 2546 8291

Manor Hill

NATO Forward Scatter Station (NFSS) Stenigot

SUMMARY

NATO Forward Scatter Station (NFSS) Stenigot (UBIZ) was built in 1960, as a component of the 'Ace High' troposcatter communication system, which extended from NSEZ near Bjerkvik, Norway to TPAZ at Pazar on the Black Sea coast of Turkey, and to JCGZ on Cyprus. The site stands 151 metres (495 feet) above Ordnance Datum and is located some 16.09 km (10 miles) south-west of Louth, near the village of Donington on Bain. It is sited within the former perimeter of RAF Stenigot (NBR No. 94835), occupying an area of 1.911 hectares (4.72 acres). The site is contained within an illuminated security fence and it consists of a police house, guard-dog pens with runs, two oil tanks within a catchpit, a generator house, a garage, an electronics building and four parabolic antenna dishes.

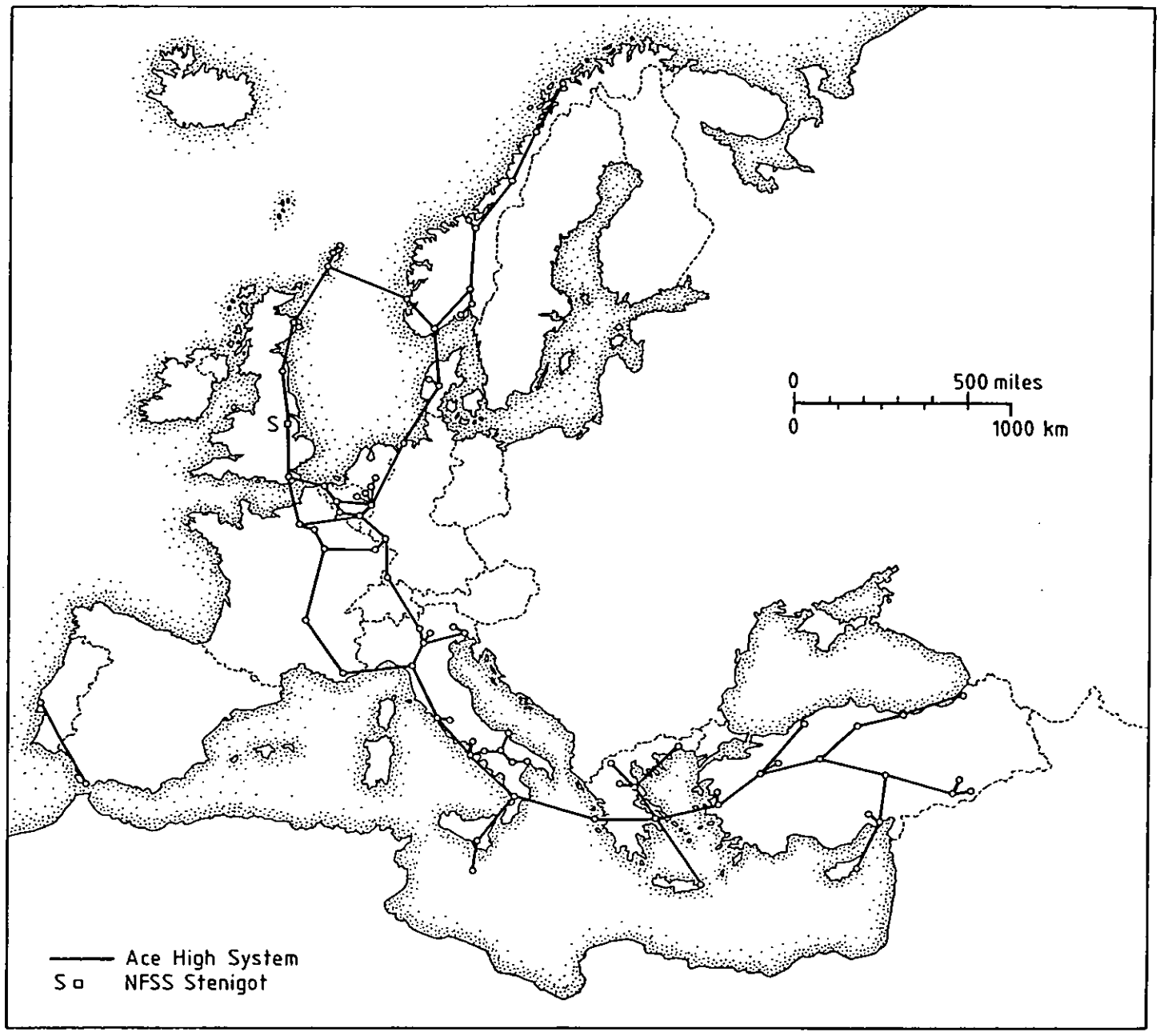
HISTORY

NFSS Stenigot is a forward troposcatter relay station, built as a part of NATO's command and control communication system. The contracts for the construction of the system were let by Supreme Headquarters Allied Powers Europe (SHAPE) in 1959. The point-to-point system for forward and lateral multi-channel links, allowing speech and telegraph circuits, was built for Allied Command Europe (ACE) and was called 'Ace High'. Construction work at Stenigot was completed during December 1960; the system as a whole became operational during a period of growing tension between NATO and the 'Eastern Block', early in 1961.

It is believed that a of total eighty-four sites from Norway (AFNORTH) to Turkey (SIXATAF) have been equipped, at one time or another with 'Ace High' troposcatter equipment. These locations included important command centres, radar sites etc., as well as the relay stations. Four sites are known to have existed

on the British mainland; Mormond Hill (UMOZ), near Fraserburgh, Brizlee Wood (UBOZ), near Alnwick, Stenigot (UBIZ), and Coldblow Lane (UMAZ), Maidstone, a further site - UMSZ also existed on the Shetland Islands. In addition, spurs were also built to three SATCOM (satellite communication) stations - USVZ, UCOZ, and UBUZ.

The precise date that 'Ace High' was stood down has not been established, but by the study of various documents left on site at Stenigot, it appears to have been during the latter years of the 1980s.



NATO 'ACE HIGH' COMMUNICATIONS SYSTEM

NATO FORWARD SCATTER STATION (NFSS) STENIGOT,
MANOR HILL, DONINGTON ON BAIN, LINCOLNSHIRE
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Surveyed: August 1995 Sheet 1 of 2
Drawn by A. T. Adams

RCHM ENGLAND

THE BASIC PRINCIPLES OF TROPOSPHERIC SCATTER COMMUNICATIONS

Any radio communication system that is required to carry a large volume of simultaneous information, needs to operate at a super high frequency (SHF). When operating at frequencies above 50MHz, the principal method of propagation of a radio wave is the 'spacewave', which travels in a straight line; i.e. 'line of sight'. Microwave communication links, operating in the region of 7000 MHz, can carry 140 Megabytes of data per second (the equivalent of ten TV programmes simultaneously).

Microwave communication is the most common mode of carrying high data rates, however, it cannot be used over large expanses of water, or inhospitable terrain, due to the need to establish repeater stations at 32.18 km (20 mile) intervals. In order to overcome this deficiency, the tropospheric scatter method of propogation can be used, as it is capable of providing communication over the horizon, without the need of numerous 'line of sight' repeater stations.

Tropospheric scatter communication requires a considerable amount of energy to be radiated at a low angle of elevation into the lower part of the ionosphere. The ionosphere is in a continual state of flux, which give local variations in refractive index. These variations result in the transmitted energy being reflected and scattered in all directions, including forward over the horizon. Due to the scattering, the signal becomes weak, but provided that it is transmitted with sufficient power, an antenna some considerable distance can receive it away. The usual frequencies of operation are 600 to 900 MHz, 1700 to 2400 MHz and 4400 to 5000 MHz.

The random nature of the scattering process can result in the signal suffering from continual fluctuations in amplitude and phase. This problem can be overcome by a process called 'frequency diversity', whereby the same message is transmitted simultaneously at two different frequencies and received by two antenna separated by a number of wavelengths, each receiving both frequencies in separate receivers. The four distorted signals are then recombined in a diversity combiner, to produce a single undistorted message.

The troposcatter communication method is sometimes called a 'brute force' system, due to the substantial amounts of energy that need to be radiated by the large antenna and concentrated in a small part of the sky. The size of the antenna and the sensitivity of the receivers are equally important in receiving the very weak scattered signal. Troposcatter systems can operate at ranges of 321.86 - 965.60 km (200 - 600 miles) and, provided sites for back-to-back repeaters can be found, the range can be extended. Apart from the military use, typical applications

of troposcatter included inter-island links and links over large areas of desert.

Today, the repeater problem has been overcome by the use of a communication satellite, which, by virtue of its altitude, can be in 'line of sight' of two points on the ground, separated by thousands of miles, making troposcatter relatively obsolete. Nevertheless, some troposcatter systems are still used for modest data bandwidths, on grounds of capital cost and for strategic reasons.

DESCRIPTION

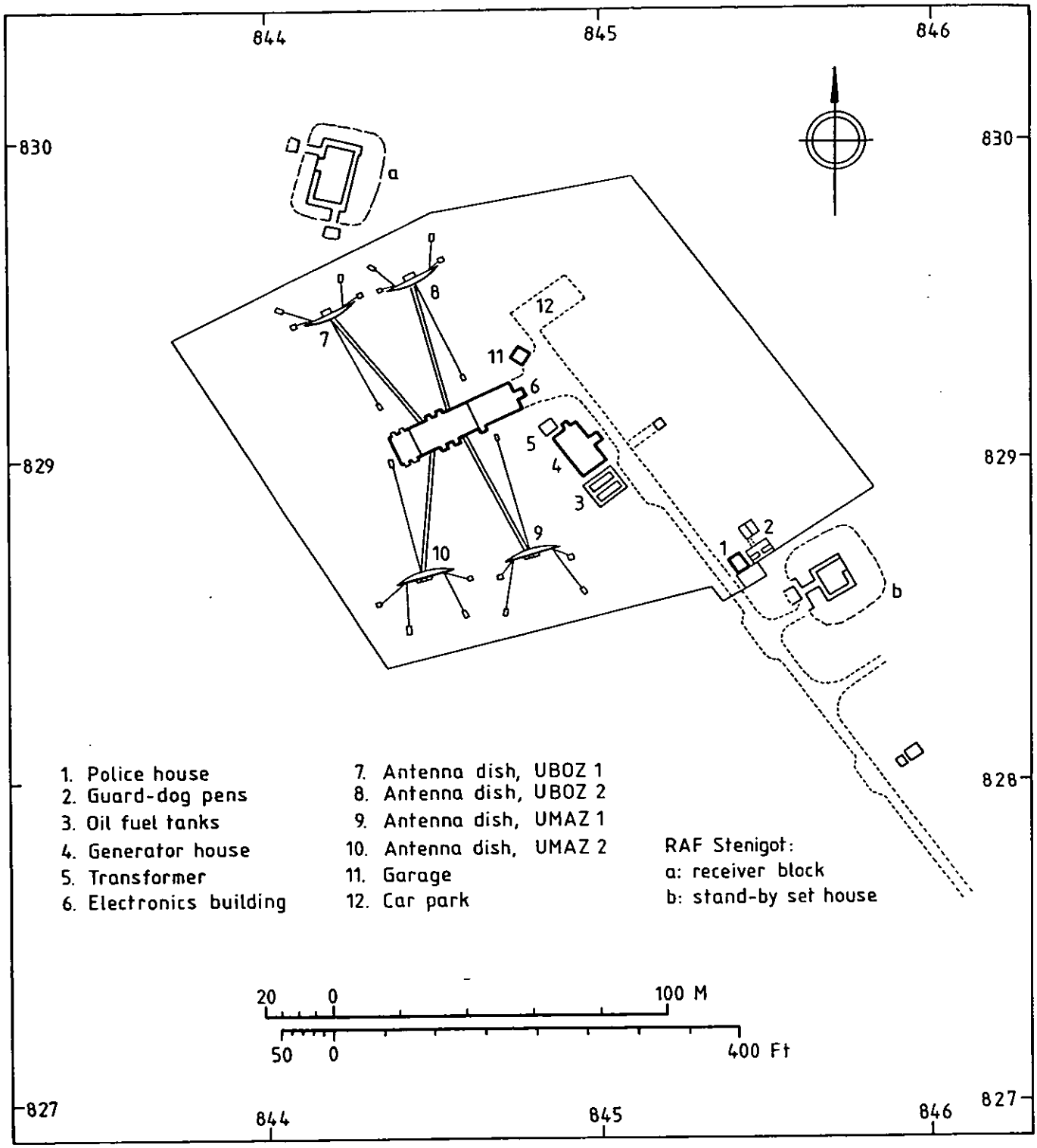
NFSS Stenigot consists of a complex of six buildings and four troposcatter antenna dishes, contained within a rhomboid plan, plastic coated, chain-link perimeter fence. Set back some 4.57-m (15 feet) from, and parallel to the perimeter fence, are a series of 3.04 m (10 foot) high lamp-posts, which supported high level illumination lamps. Access to the site is provided by a single tarmacadam road, which enters via a gateway in the south-eastern perimeter fence and terminates in a small rectangular car park with spaces for eight vehicles, adjacent to the UBOZ 2 antenna. Two steel gates flanked by a police house close the gateway.

The police house is a two-storey, rectangular plan structure, of stretcher bond brick cavity-wall construction, with a hipped Marley tile roof. It is entered by a door in the south-west elevation; it comprises a hallway and stair, guardroom, office, latrine, kitchen, rest-room, and various store-rooms. All windows are fitted with secondary uPVC double-glazing. A door in the north-east elevation permits access to the adjacent pre-cast concrete panel guard-dog pens.

Power to the site is provided by mains electricity, with the switchgear housed within the former Chain Home radar transmitter block of RAF Stenigot, with the transformers located outside. Emergency stand by power was provided by two stand-by generator sets housed in the generator house.

The generator house is a single-storey, five-bay, rectangular plan structure of cavity-wall construction, consisting of an outer skin of stretcher bond brickwork and an inner skin of concrete blocks, set between reinforced concrete wall posts, which support a corrugated asbestos sheeting gable roof, carried on light steel trusses. Access is via a flat-roofed timber porch set against the central bay of the north-east elevation. Two engine exhaust detuners/silencers are set high in the wall, one to either side of the porch. Ventilation is provided by hinged steel flaps located in the two gable walls and in the north-east elevation, two of which directly serve the engine radiators.

The interior is lit both by artificial and natural lighting. The natural lighting is provided by steel framed windows set high beneath the eaves of the south-west elevation, and an off-centre eight light steel framed window in the south gable, which lights a small workshop. The two generator sets are located centrally within the generator house, mounted on steel skids. Fuel supply equipment including day-tanks and handpumps remain intact, however, a small empty concrete bed indicates the former position of a compressor for engine starting. The switchgear and the control panel are located against the south west wall.



1. Police house
2. Guard-dog pens
3. Oil fuel tanks
4. Generator house
5. Transformer
6. Electronics building
7. Antenna dish, UBOZ 1
8. Antenna dish, UBOZ 2
9. Antenna dish, UMAZ 1
10. Antenna dish, UMAZ 2
11. Garage
12. Car park

RAF Stenigot:
a: receiver block
b: stand-by set house

NATO FORWARD SCATTER STATION (NFSS) STENIGOT,
MANOR HILL, DONINGTON ON BAIN, LINCOLNSHIRE
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RCHM ENGLAND

The generating equipment consist of a pair of 'Transicon' 380/220 volt AC generator sets, made by MacFarline Engineering Co Ltd. of Glasgow, powered by two water cooled, Rolls Royce / Petbow C range, 8 cylinder oil engines, with Smiths switch-gear. The main control panel was manufactured by Dewhurst & Partners Ltd. during 1960, under an Air Ministry contract number A32875/59/C22A. The power supply was rated at 380 volts, 3 phase, 50 cycles, while the control circuit supply was rated at 240 volts DC. The transformers for the stand by supply are located adjacent to the north gable of the generator house, in a steel framed, chain-link fence enclosure. Fuel for the stand by generator sets is stored externally in two cylindrical steel tanks, contained within a rectangular plan, concrete oil catchpit adjacent to the south gable of the generator house.

The electronics building is set at a right angle to the access road and is placed centrally between the two pairs of antenna. It is a single-storey, thirteen-bay rectangular plan structure, of stretcher bond brick cavity-wall construction, between projecting reinforced concrete wall posts, with a corrugated asbestos sheeting clad gable roof. The height of the roof is slightly raised over the six bays of the equipment hall.

The walls of the eastern five bays (office, store, rest room etc) and the western two bays (heat exchanger room) are cement rendered and painted, while the walls of the six bays of the equipment hall are fair-faced. Waveguide trunking from the antenna enter through the walls of the second and fifth bays of both the northern and southern walls of the equipment hall.

The interior is lit by both artificial and natural lighting. Natural lighting is provided by four light steel framed windows set high beneath the eaves of most of the bays in the northern and southern walls. Four two light windows in the west gable light the heat exchanger room, while a pair of two light windows in the east gable light the easternmost rooms.

A flat roofed brick porch built against the east gable, leading into a central corridor provides access. The corridor runs the length of the eastern five bays and is flanked to either side by a drafting room, rest room, office, storeroom, latrines and a workshop.

The equipment hall spans the full width of the building and equipment cabinets line both the northern and southern walls. The transmitter/receiver (Tx/Rx) equipment was manufactured for Supreme Headquarters Allied Powers Europe (SHAPE), by Radio Engineering Labs USA, under a contract issued in 1959.

All of the equipment against the north wall is labeled UBOZ. The function of each cabinet from west to east was:

Transmitter	UBOZ 1, frequency 924.72 MHz
Exciter Cabinet Type 942,	carrier frequency 924.72 MHz
Receivers, 10 KW Power,	UBOZ 1, frequency 845.52 MHz
Amplifier Type 943,	UBOZ 2, frequency 872.88 MHz
Diversity Combiner Type 944	
Receivers, 10 KW Power,	UBOZ 4, frequency 872.88 MHz
Amplifier Type 943,	UBOZ 3, frequency 854.52 MHz
Exciter Cabinet Type 942,	carrier frequency 952.08 MHz
Tranmitter	UBOZ 2, frequency 952.08 MHz

The entire transmitter/ receiver (Tx/Rx) equipment against the south wall is labeled UMAZ. The function of each cabinet from east to west was:

Transmitter	UMAZ 1, frequency 908.88 MHz
Exciter Cabinet Type 942,	carrier frequency 908.88 MHz
Receivers, 10 kW Power	UMAZ 1, frequency 857.04 MHz
Amplifier Type 943	UMAZ 2, frequency 874.04 MHz
Diversity Combine Type 944	
Receivers, 10 kW Power	UMAZ 4, frequency 874.04 MHz
Amplifier Type 943	UMAZ 3, frequency 857.04 MHz
Exciter Cabinet Type 942,	carrier frequency 931.00 MHz
Transmitter	UMAZ 2, frequency 931.00 MHz

In addition to the Tx/Rx equipment, other cabinets are located in the equipment hall. A high capacity dehydrator manufactured by Droogtechniek & Luchtbehandeling N.V., Rotterdam, Holland, serial no. 1884221 is located against the west wall, and various pieces of mains power management equipment are located against the eastern wall. This equipment includes two voltage regulator cabinets, each containing two 5 KVA Type 8910 voltage regulators manufactured by Van Der Heem, The Hague, Netherlands, and a switching cabinet.

All of the equipment remains relatively intact, however, on closer inspection, it was noted that the 10KW klystrons were missing from the transmitters and some valves were missing from the receiver racks. The transmit paths exit the equipment hall via aluminium 29.2 cm (11½ inch) wide waveguides (WG3; WR1150); the transition from the 7.9 cm (3 1/8 inch) runs to the waveguides are present, but the intermediate coaxial runs above the cabinets and the receiver coaxial runs are missing.

A door set centrally in the west wall of the equipment hall allows access to the heat exchanger room. This room contains four Worthington - Simpson heat exchange pump units for water-cooling. The heat exchangers are vented externally on both sides of the room, by bitumastic painted, galvanized steel ducting, which pass up the wall and rise above the verge of the roof.

The site is equipped with two pairs of 18.28-m (60-foot) diameter, parabolic dish antenna. The height of the centres of the northern pair of parabolic dishes, UBOZ 1 & 2, is approximately 15.23 m (50 feet) above ground level, while the centres of the southern pair, UMAZ 1 & 2, are approximately 18.28 m (60 feet).

Seven steel girder lattice legs, anchored to large concrete blocks support each dish. The legs are attached to the dish at two points on the lower circumference and one centrally to the rear. The attachment point located to the rear, is carried clear of the reverse face of the parabola by six tubular steel supports. The aluminium panels of the dish are bolted in concentric circles onto a parabolic girder framework.

Two brackets on the upper circumference of the dish carry tubular supports for the waveguide and the front-fed feedhorn. The cross-site feeder from the electronics building to each dish, takes the form of an aluminium WG3 (WR1150) waveguide supported on tubular scaffolding poles, protected from the elements by a timber cover, clad with roofing felt. Flexible connectors dated 1959, are used at each joint in the waveguide. The receiver feed consists of 6.3-cm (2½-inch) coaxial cable on the antenna, changing to 7.9 cm (3 1/8 inch) at ground level.

Visited by: Roger J C Thomas and Nicola Wray, 02/03 Aug 1995.
Report by: Roger J C Thomas.
Medium Format Photography: Roger J C Thomas.
Drawn Archive: Allan T Adams.

Addendum

NFSS Stenigot is no longer extant, having been demolished during the Spring of 1997.

ACKNOWLEDGEMENT

Squadron Leader Opie, Flying Officer Millington, Paul Barker and Chris Lester have provided assistance with access, field survey and documentary research for this report.

Sources:

SD 727 (2nd Edition), Royal Air Force Manual – Control and Reporting 1 (MoD, Jan 1969)

D Campbell, *War Plan UK* (London, 1983).

D Campbell, *The Unsinkable Aircraft Carrier* (London, 1984).

G Hartcup, *The Silent Revolution* (London, 1993).

P Laurie, Beneath the City Streets (London, 1979).

Aviation and Marine International, Feb. 1975, p. 33.

Schedule of Structures/Features, 03 August 1995

Structure/Feature	NGR
Police House	TF 84543 82864
Guard-dog Compound	TF 84543 82877
Guard-dog Run	TF 84548 82870
Fuel Tanks & Catchpit	TF 84502 82891
Generator House	TF 84491 82903
Transformer	TF 84487 82910
Electronics Building	TF 84460 82912
Garage	TF 84478 82932
UMAZ 2 Antenna	TF 84444 82856
UMAZ 1 Antenna	TF 84486 82866
UBOZ 2 Antenna	TF 84448 82953
UBOZ 1 Antenna	TF 84418 82937

List of RCHME Photographs NBR.No: 94836

Neg.No.	Subject
AA95/5254	General view from main gate, viewed from the east.
AA95/5261	Police House and main gate viewed from the south.
AA95/5262	Guard-dog Compound to rear of the police house, viewed from the south west.
AA95/5255	General view of site from the police house, viewed from the east, portrait format.
AA95/5256	" (COLOUR)
AA95/5257	UMAZ 1 & 2, troposcatter antenna, silhouetted against the sun, viewed from the east north east.
AA95/5258	UMAZ 1 & 2, troposcatter antenna, rear view viewed from west north-west.
AA95/5259	as above, view framed by the support legs of UBOZ 1.
AA95/5260	" (COLOUR)
AA95/5253	UBOZ 1 troposcatter antenna viewed from the north-west.
AA95/5249	UBOZ 2 troposcatter antenna viewed from the north-west.
AA95/5250	" (COLOUR)
AA95/5251	General view of site from the north.
AA95/5252	General view of site from the west.
AA95/5263	Generator House viewed from the east.
AA95/5264	" interior, detail of control panel against the south west wall.
AA95/5265	" interior, pair of Rolls Royce / Petbow diesel generator sets, viewed from the west.
AA95/5266	Diesel Oil Fuel Tanks within a concrete walled catchpit, adjacent to the Generator House, viewed from the east.
AA95/5267	Electronics Building viewed from the west.
AA95/5268	" viewed from east north east.

List of RCHME Photographs NBR.No: 94836

Neg.No.		Subject
AA95/5269	"	interior, equipment hall viewed from south south-west.
AA95/5270	"	interior, equipment hall, detail of UBOZ 1 transmitter cabinet.
AA95/5271	"	interior, heat exchanger room, viewed from the south.

LIST OF AERIAL PHOTOGRAPHS HELD BY RCHME.

Vertical Photographs

Sortie	Date	Frame No.	NMR Library No.
OS 75246	12 June 1975	149 - 152	9843

Low level Oblique Photographs

TF 2582/15	17 July 1996	NMR 12852/32	(35mm COLOUR)
TF 2582/16	"	NMR 12852/33	"
TF 2582/17	"	NMR 12852/34	"
TF 2582/18	"	NMR 12852/35	"
TF 2582/25	"	NMR 12853/01	"
TF 2582/26	"	NMR 12853/02	"
TF 2582/35	21 July 1997	NMR 17011/01	"
TF 2582/36	"	NMR 17011/02	"
TF 2582/37	"	NMR 17011/03	"
TF 2582/38	"	NMR 17011/04	"
TF 2582/39	"	NMR 17011/05	"
TF 2582/40	"	NMR 17011/06	"
TF 2582/41	"	NMR 17011/07	"
TF 2582/46	"	NMR 17000/33	"
TF 2582/47	"	NMR 17000/34	"
TF 2582/48	"	NMR 17000/35	"
TF 2582/19	17 July 1996	NMR 12870/08	(6x6cm B&W)
TF 2582/20	"	NMR 12870/09	"
TF 2582/21	"	NMR 12870/10	"
TF 2582/22	"	NMR 12870/11	"
TF 2582/23	"	NMR 12870/12	"
TF 2582/24	"	NMR 12870/13	"
TF 2582/27	21 July 1997	NMR 17020/42	"
TF 2582/28	"	NMR 17020/43	"
TF 2582/29	"	NMR 17020/44	"
TF 2582/30	"	NMR 17020/45	"