Reprinted from: Gloucestershire Society for Industrial Archaeology Journal for 1992 pages 18-26

ELECTRICITY GENERATION AT LONGFORDS MILL

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1 Introduction

Woollen cloth manufacture ceased at Longfords Mill, Minchinhampton, in June 1990 and the premises were vacated. The site had been used for this purpose by the Playne family and successor companies incorporating the name Playne since 1759 (1). It is a very good example of a woollen mill complex that has grown peicemeal over two centuries. The Royal Commission on the Historical Monuments of England (RCHME) recorded the site in the summer of 1990 and noted 58 separate structural units of varying size and construction including 14 listed buildings (2). There are examples of the tall narrow water-powered stone buildings of the 18th century and the squatter, broader steam driven buildings of the mid-19th century, through to the single storey, electrically powered brick built sheds of the 20th century.

In 1806 the large mill pond was constructed covering 18 acres. It is reputed that at one time there were five waterwheels on site. Such were the demands for power that in 1815, 1823 and 1826 steam powered beam engines by Boulton & Watt were installed at Longfords (1-3). By the early part of the 20th century much of the machinery in the mill was powered electrically. The company installed their own electrical generating plant, much of which remains today. Indeed, in just one building there is a 1904 steam engine, a water turbine of circa 1920 and two large diesel engines from around the time of the Second World War. The water turbine and the two diesel sets each has its own electricity generating equipment and switchgear to enable it to operate in parallel with the local electricity distribution network. It is thought that the public supply first became available in the 1920's. In later years the plant was used in a 'standby' capacity and most of the power used on site was supplied by the public supply. However the installation proved to be invaluable during the 'Miners strike' of 1974 because while the rest of Britain was suffering a 'three-day week' almost full production was maintained at Longfords (4).

The building housing the equipment is possibly the oldest on the site and certainly one of the most interesting. Its importance and its contents have been recognised in its recent upgrading from listed status Grade II to Grade II*. The machinery is included in the list description and this should afford some protection to this fascinating and probably unique collection.

In late 1991 the author recorded the machinery and contacted the manufacturers (or their successors) for information that they might hold on the equipment. It is pleasing to note that information was available in all four cases and that the firms were most helpful. The following notes give a brief description of the machines and the buildings which house it.

2. Brief Description of the Buildings (ST 8666 9920)

The buildings housing the power machinery are denoted as numbers 2 and 3 on the insurance plan adopted by RCHME to identify the buildings for their survey (2). The RCHME report describes No.2 as:

"A stone-built four-storey woollen mill of ten bays dating from the mid- or early eighteenth century. The building is vernacular in its materials, construction and external detailing, but its scale is comparable with early Gloucestershire factories dating from later in the eighteenth century. There is good architectural evidence of a water power system with two waterwheels but the upper stories were probably used for hand-powered processes".

The mill is orientated north-to-south and straddles a leat flowing in an easterly direction from Longfords Lake. A second parallel watercourse passes in a culvert to the south of the building. The internal plan dimensions are 24.3 by 5.6 metres (approximately 80 by 18 feet). On the east wall of the ground floor there are a pair of wide-arched openings which mark the position of the former head races. However no internal evidence survives of the original water-power system.

KEY

AB	Brush Alternator
AE	English Electric Alternator
AL	Laurence Scott Alternator
DA	Allen Diesel
DP	Petter Diesel
DY	Dynamo
I	Inlet to Turbine
SE	Steam Engine
SW	Switchgear
T	Turbine

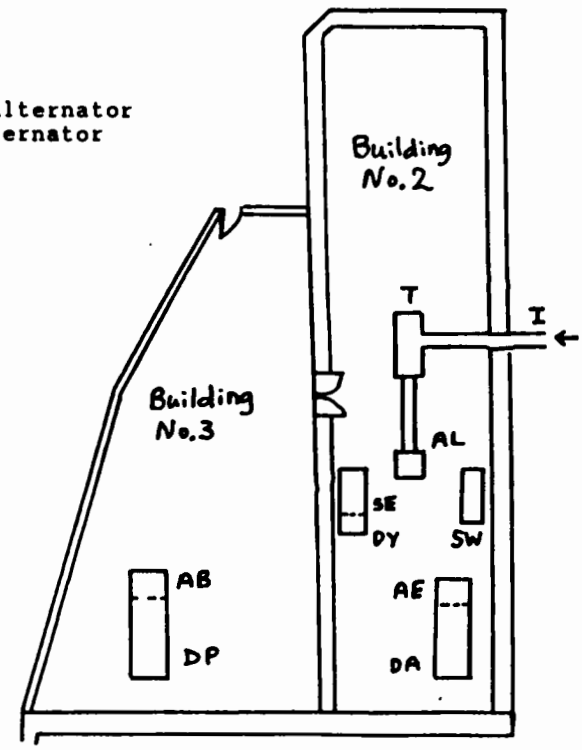


Figure 1

Schematic Showing the Layout of the Power Machinery (Not to scale)

The steam engine, turbine and Allen diesel engine are located on the ground floor of building No.2. The Petter diesel engine is in building No.3 which is a single storey lean-to building attached to the west wall of No.2. (Figure 1)

3 General Description of the Equipment

The Technical details have been summarised in an appendix.

3.1 Bellis & Morcom Steam Engine

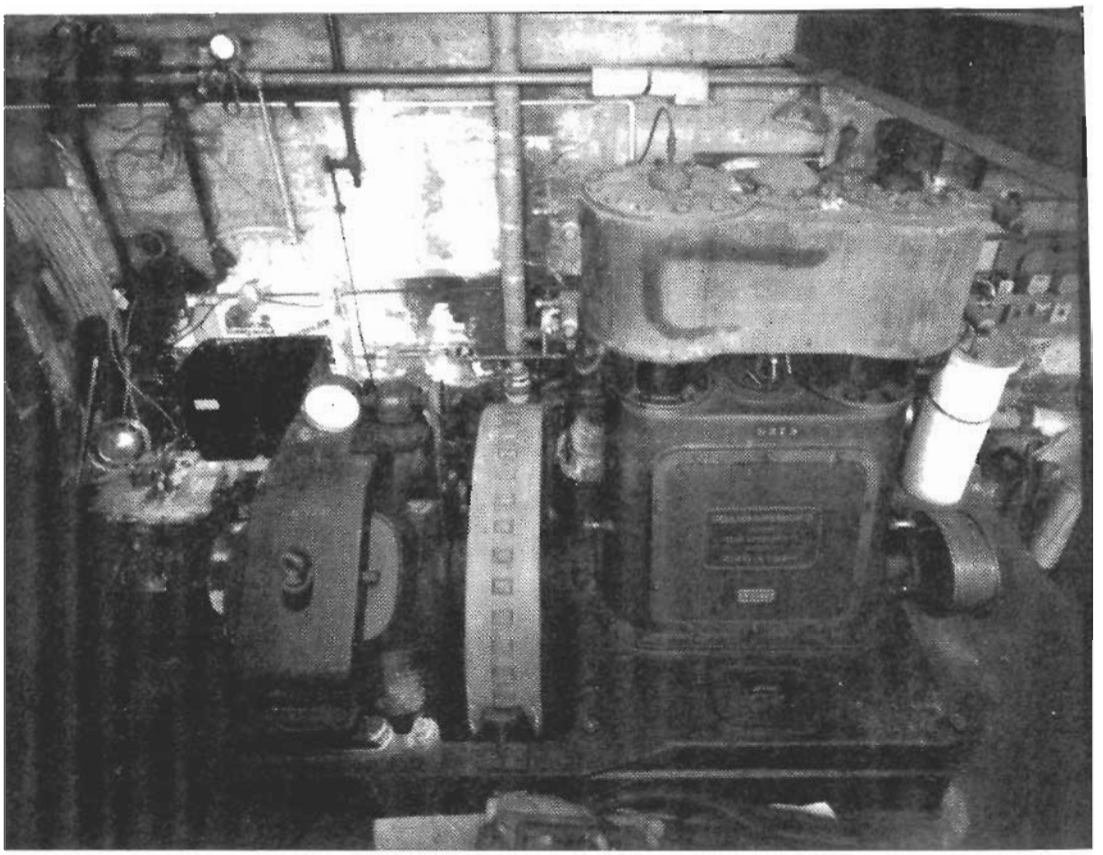
The steam engine is of the inverted vertical compound type (Figure 2). Its 'order book' date is May 1904 and the model number is C8S. The nominal output from the two cylinder engine is 100 BHP (75 kW). A letter from Bellis & Morcom in 1991 states that the original customer was Mather and Platt who equipped the engine with one of their 75Kw 320 Amp 235 Volts DC Dynamos and sold it on to the firm of Goodlass Wall & Co. The latter were paint manufacturers (Walpamur) based near Liverpool. The dynamo connected to the steam engine is by Mather and Platt. It is consistent with the description of the one fitted in 1904 and may well be the original dynamo.

The letter gives the date for acquisition of the engine by Playnes as approximately 1917. It is not known when the engine was last used. However, it was presumably still serviceable in 1924 when Bellis & Morcom have a note referring to Hunt and Winterbotham rather than W Playne and Co. Today the engine appears to be in relatively good condition with most of its ancillary equipment such as valve gear and governor still intact. It is not connected to the electrical system.

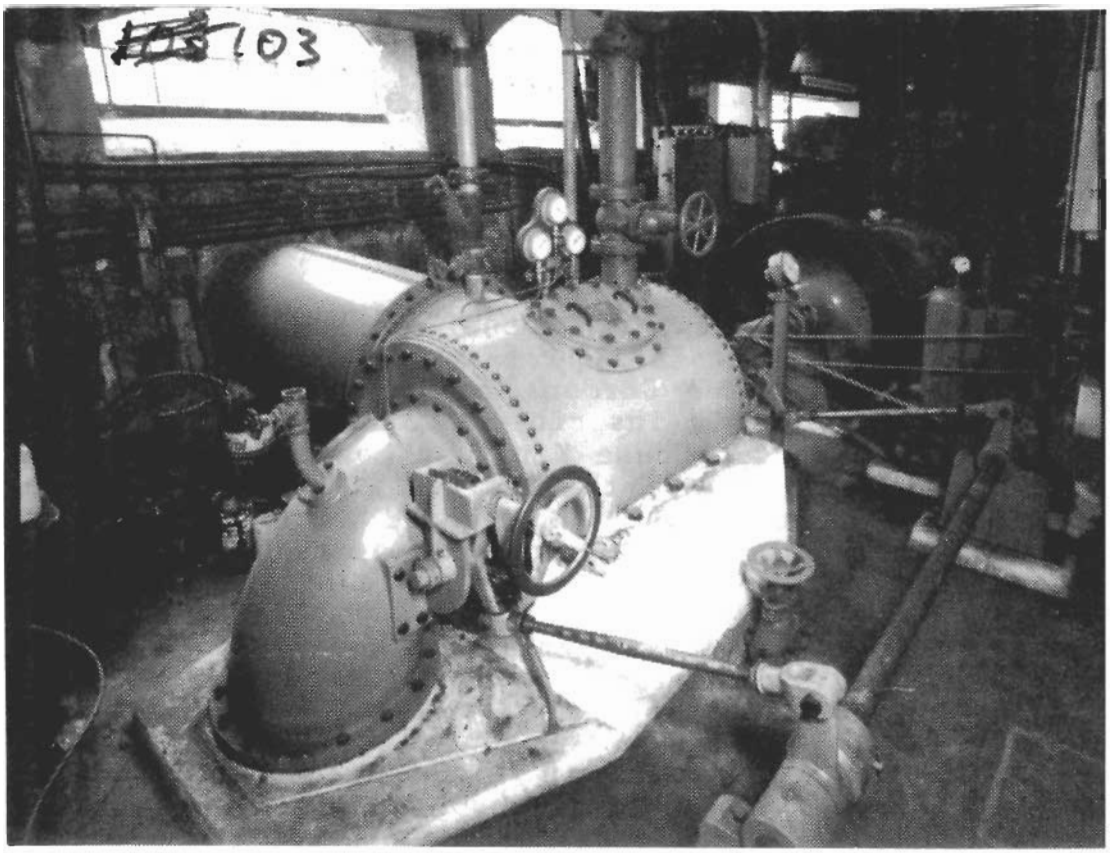
3.2 Gordon Water Turbine

The turbine is of a somewhat unusual design that can be described as a double Francis type (Figure 3). It bears the manufacturers plate "James Gordon Engineers and Contractors London". A second plate is inscribed "Richard H Stotesbury". The former were at Windsor House Kingsway London in the early part of this century. In 1928 they merged with Gilbert Gilkes & Co. of Kendal to form Gilbert Gilkes and Gordon. A design closely resembling the Longfords turbine appears in the Gordon catalogue of 1925 but does not appear in the 1912 catalogue suggesting that it dates from after 1912 and before 1928 (6). Stotesbury was a locally based engineer who in 1904 was a director of the Excelsior Engineering Co of Stroud (7).

It has been suggested that James Gordon acted as supplier of turbines manufactured in Sweden, USA and Switzerland in addition to or instead of manufacturing his own (8). There is a story locally that the Longfords machine was one of only two



Above: Bellis & Morcom; Below: Gordon Turbine.
Both photographs courtesey of the Royal Commission on Historical Monuments England .



that were imported from either Sweden or Switzerland. The same story says that the other machine is in a museum somewhere in the south of England. Unfortunately, it has not been possible to ascertain the truth of either of these statements.

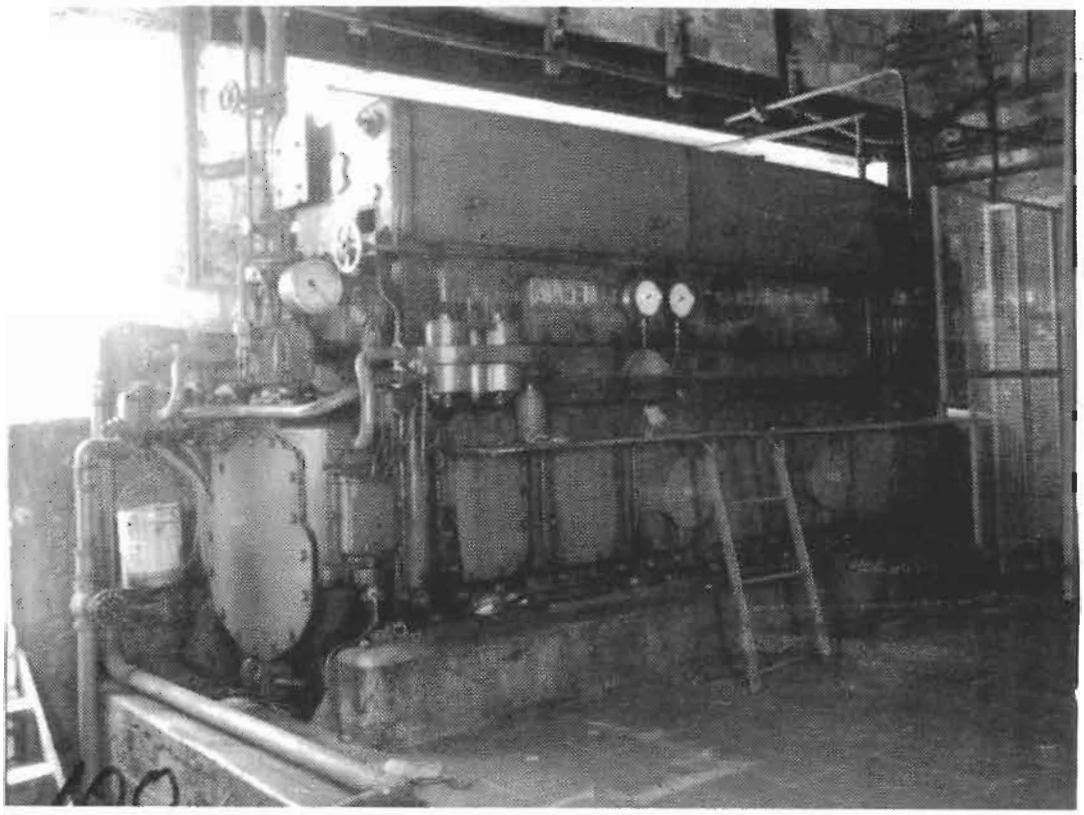
A single inlet pipe supplies water from Longfords Lake to the centre of the turbine casing which consists of a horizontal cylinder set at right-angles the supply pipe. The water passes outwards in both directions along the axis of the casing through the two runners and leaves by the corresponding outlet or draft tube at each end of the cylinder. The draft tubes immediately turn through 90 degrees and descend vertically to discharge the water to the tailrace. Both runners are mounted on the single output shaft which drives the flywheel which in turn drives the alternator. The main shaft is carried by two pairs of split bearings made of lignum vitae which is a very hard dense wood which resists water well. It was necessary to replace the wooden bearings every few years.

The speed of the turbine at the inlet is controlled by varying the angle of the ring of guide vanes at the inlet of each runner. The guide vanes are adjusted automatically in operation by a governor which monitors the speed of the output shaft and has its oil pressure pump powered by the same shaft. Should the speed vary the appropriate valve in the governor opens and oil from the pump moves the rod connected to the valve guides. This makes the necessary adjustments to the angle of the guide vanes until the correct speed is restored. The angles of the two sets of guide vanes can be adjusted manually and independent of one another. In principle this permits the turbine to be operated on just one runner and therefore half maximum power if necessary. However this would cause a large stress to applied to the thrust bearing. Pressure gauges show the head of water above the turbine and the amount of suction in the draft tubes. An advantage ofreaction turbines like this one is that the effective head in operation is the sum of these two quantities. At Longfords this amounts to approximately 25 feet head. The last recorded run was February 16 1988 when it was operated for 4 hours.

The alternator was built by Laurence Scott Electromotors of Norwich and Manchester. The output is 125 kVA and is dated 1947. It is therefore much newer than the turbine.

3.3 Allen Diesel Engine

It has been rumored locally that this unit with its utilitarian casing has been, or was destined to be used in a submarine. The very detailed records supplied by W H Allen shows that this was not true but it is possible to see how that story might have arisen. The engine is a six cylinder model rated at 232 BHP (173 kW). It was originally ordered in March 1945 for delivery one year later and intended for ship-board service.



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Allen Diesel (Photograph courtesey of the Royal Commission on Historical Monuments England).

For some reason the order was cancelled during manufacture and Allen's documentation for the engine refers to "altered for industrial use" and "transferred to works number K2/72971 Hunt and Winterbotham". The engine was subsequently delivered about September 1947. The reference to Hunt and Winterbotham rather than Playne is not surprising as both companies where part of the same group by then. Allen's records show that the engine has had only one owner and one location from new. The 'spares supplied' records do in fact refer to William Playne & Co. as the owners of the engine. These entries cover the period 1948-68.

The manufacturers further advise that this design has a cast iron frame and suggest that the "G-forces generated by a depth charge attack would crack the engine frame". It was therefore not suitable for use in submarines. Furthermore, the firms 1939/45 war diary does not include submarine work in a long list of wartime activities.

3.4 Petter Diesel Engine

This is the most powerful unit of the four and the one most recently installed at Longfords Mill. It was originally supplied to the cloth manufacturers, MacKays, at Trowbridge in about 1938 and was moved to Longfords in the mid 1970,s when they closed. The engine is a four cylinder version of the 'Superscavenge' model which was produced in large quantities in 2,3,4,5, or 6 cylinder versions between 1936 and 1950 (5).
It is reputed that the purchase price was about 3000 when it came to Longfords but the transport and installation costs were an additional 3500. The Brush Alternator with it is rated at 445 kVA and thus appears to be capable of considerably greater output than the engine rating of 286 kW.

3.5 Electrical Switchgear

A bank of three "6 foot" racks near the east wall contain the necessary instrumentation, excitation control and protection equipment and switchgear for the Petter diesel engine, turbine and Allen diesel engine, respectively, looking from left to right. Some the equipment for the turbine system bears the manufacturers name, Crompton, and that for the Allen engine bears the name Brush. A syncroscope is provided to enable each generator in turn to be synchronized and run in parallel with the local electricity distribution network. Synchronization is the process whereby the voltage frequency and phase of the generator output are adjusted to be precisely those of the supply network. The generator may then be safely connected to the network. Failure to observe this could result in costly damage to the equipment. The set of power factor correction capacitors nearby were provided to compensate for the highly inductive load presented by the electric motors in the mill.

4 Concluding Remarks

At the time of writing (February 1993) the Longfords Mill remains vacant and is on the market at a sum considerably less than the original asking price of 2.5 million in mid-1990. As the economic recession of the last few years shows no sign of ending it is very difficult to predict what new use the site may ultimately be put to.

It is clear, however, that such a diverse collection of power generating equipment, in-situ, under one roof is a remarkable and an extremely important survival. Its importance lies not in the individual components, interesting as they might be but in the collection as a whole. The II* listing that building and its contents have been given rightly acknowledges their

importance. Whatever future use the site is put to it is vital that the collection is retained and preferably suitable arrangements are made to permit access by interested members of the public.

APPENDIX

TECHNICAL DETAILS OF THE MACHINERY

A.1 BELLISS & MORCOM STEAM ENGINE - MATHER & PLATT DYNAMO

Model C8S Compound Engine
Year of Manufacture 1904
Cylinders High pressure 10 inch (254 mm) diameter
Low Pressure 16 inch (406 mm) diameter
Stroke 9 inch (229 mm)
Steam pressure at engine stop valve 100 psig.
Exhaust pressure, non-condensing i.e. atmospheric
Steam temperature, superheated to 420 deg. F (216 deg. C)
Output, normal 100 B.H.P (75 kW), max 130 B.H.P (97 kW)
Valve Gear, G.E.Bellis. Running speed, 450 rpm
Original Customer, Mather & Platt (Park Works Manchester) for Goodlas Wall & Co

Dynamo Mather & Platt 75kW, 320 amps 235 volts DC

A.2 GORDON WATER TURBINE - BRUSH ALTERNATOR

Manufacturer or supplier James Gordon Engineers, Kingsway, London. No serial number found.
Type, Double Outlet Francis Turbine.
Cylindrical casing (horizontal).
Size 1210 mm diameter by 1470 mm long (approx.).
Each runner has 24 blades and is mounted on a horizontal axis
Main bearings formed from split blocks of lignum Vitae wood.
Inlet tube 1090 mm outside diameter
Outlet tubes 660 mm ditto

Alternator built by Laurence Scott Electromotors Ltd Norwich & Manchester. Output 125 kVA 415 Volts 3 phase 50Hz Speed 500 rpm. Dated 1947.

A.3 PETTER DIESEL ENGINE - BRUSH ALTERNATOR

Model Superscavenge No 4RA 504
4 cylinder 384 BHP (286 kW) 600 rpm
Brush Alternator (dated 1947)
Output 445 kVA 415 Volts 3 phase

A.4 ALLEN DIESEL ENGINE - ENGLISH ELECTRIC ALTERNATOR

Manufacturer W.H. Allen Sons & Co Ltd Bedford
Completed 1947 Model Works No. K2/72971
232 BHP (173 kW) 6 cylinder 550 rpm
Piston diameter 240 mm diameter 300mm stroke

Generator built by English Electric Co Ltd London
Bradford Works Serial Number 1N2266 117 Size D13
A.C. 170 kVA 415 Volts 3 phase 235 Amp 1000rpm 50 Hz

Acknowledgements

The author gratefully acknowledges assistance and information provided by many people including the following:

Professor A G Crocker, Mr J K Major, Mr J R Simmons, Mr K A Falconer (RCHME) Mr I Mackintosh (Stroud Museum Association Textile Group), Mr D F Poole (Lister-Petter) Mr F A Wycherley (Belliss & Morcom)
Mr G G Mobbs (NEI formerly W H Allen)
Mr D Taylor (Gilbert Gilkes & Gordon) Mr G J Terrett Mr G Jellyman Mr H G Rose, Mr K F Ott, Mr P F Stephens & Members of the International Steam Engine Research Group.

References:

(1) A History of Playne of Longfords Mills, 200th Anniversary, by A T Playne and A L Long published privately by the Company (copy in Gloucestershire Record Office).

(2) Royal Commission on the Historical Monuments of England, Historic Building Report , Longfords Mill Minchinhampton Gloucestershire, 1991.

(3) Wilson, R, Hosiery Manufacture at Dunkirk Mills Nailsworth, GSIA Journal for 1990, pp 32-42.

(4) Mr Godfrey Jellyman Private Communication 1991.

(5) Mr Keith Ott Private Communication 1991.

(6) Professor Alan Crocker Private Communication 1991.

(7) Industrial Gloucestershire, 1904, published by Chance and Bland, Gloucester p 33.

(8) Gribbon, H D, The History of Water Power in Ulster, David & Charles, 1969 p 29.