

THE CLIVEDEN GENERATOR HOUSE

GARY MARSHALL

Among the less well-known structures at Cliveden, and currently not accessible to the public, is the late Victorian electrical generator house hidden in woodland near the house. The building was erected in c.1894–5, shortly after Cliveden was acquired by William Waldorf Astor, at the time one of the world's wealthiest men. It formed part of a wider trend in this period for country houses to adopt electricity, and new estate technologies more generally. Unfortunately the building has been allowed to deteriorate throughout the second half of the 20th century and only now is the National Trust undertaking a programme of research, investigation and physical conservation works to ensure its survival. This article describes the outcomes of historic research undertaken by volunteers, and recording carried out by Oxford Archaeology.

INTRODUCTION

In recent years there has been an increase in the interest of how country houses were serviced and how they functioned and as part of this change in emphasis the National Trust is looking at ways to restore and reuse Cliveden's electrical generator house. Oxford Archaeology has been commissioned to undertake a wide-ranging investigation to ensure the restoration works are undertaken with a comprehensive understanding of the building. This has included a detailed programme of historic building recording including metric survey, historical research, photographic and analytical recording, specialist analysis, and interpretive drawings to show the likely original form of the roof. The following description is an abridged summary taken from their report (Gill 2017). Excavation of the interior was assisted by members of the BAS Active Archaeology Group. The interpretation has been greatly assisted by a group of National Trust volunteers uncovering a wealth of historical information held in the Astor papers at the Museum of English Rural Life (MERL). Dr Ian West from the Country House Technology Project at Leicester University visited the site several times to provide expert analysis.

SETTING AND CONTEXT

Though not listed in its own right, the generator house lies within the curtilage (150m north-east) of Cliveden's grade I listed mansion, at the base of a wooded slope forming part of the 'Rushey Valley' (grid ref. SU 9115 8529). Sadly, the main generating plant has all been removed, leaving various

concrete bases, ducts and other evidence providing clues to the building's former operations. Various plans between 1749 and 1818 show that in this period there was a group of buildings in this area, labelled (1749) as an ice house, a spair (sic) stables, a reservoir and an engine house. There is a strong possibility that the 'reservoir' refers to the tall brick tower that survives today at the top of the slope overlooking the generator house. A later 1849 inventory notes a water engine in this area with 'horse wheel' and thatched roof, so presumably the original engine house was still standing at the time when the Duke of Sutherland acquired the property. The omission of this building from the 1875 Ordnance Survey map implies that it had been demolished by this date.

There is reasonable certainty over the date of the generator house which was to succeed it, firstly because it is shown on the 1897 OS map, secondly because it is referred to rather disparagingly in *The Gardener's Chronicle* dated June 22 1895:

Another 'improvement' is the electric light, for which we noticed a shed to hold an enormous steam boiler, and the necessary machinery is being constructed at a point in a dell not far distant from the mansion. How bizarre this all seems to us in this quiet retreat! We think any means of lightning preferable about such grounds as these, as this glaring searchlight.

Cliveden had been acquired by Astor in 1893, so clearly the generator house formed part of his early estate improvements, possibly to the designs of John Loughborough Pearson (and/or his son Frank) who undertook works in the early 1890s and remodelled the interiors in 1893. Generator houses such as this

would sometimes be designed by the company supplying the plant, or by a stock builder rather than an architect, but at Cliveden the aesthetics of the building were of some importance and suggest the hand of an architect. Various ledgers and payrolls at the Centre for Bucks Studies (principally 1897–1916) show that a father and son team, Thomas and William Waugh, were responsible for running the engines. Thomas is listed from 1897 when his yearly wages were £91, and in the following year £104. William probably replaced his elder brother, Walter, as the latter was working as an electrical engineer in Fulham by 1911 (Fulham census returns). It would also appear that their sister, Charlotte, served as their replacement in 1916–17 after the two brothers had enlisted in the Army (source: employment cards held at Cliveden). A ledger from 1906 includes a separate page covering expenses on electricity and within this are entries for coal, coke, oil, freight, carriers etc. as well as an entry for the ‘Electrical Storage Co Ltd’ for a storage battery valued at £15 14s. The electrical output of the generator house would have been stored in glass cells containing a weak acid, using direct current (DC) rather than alternating (AC). DC was gradually losing out to AC by the end of the 19th century, but for country houses and private customers generating their own supply DC remained popular well into the 20th century, partly because it was initially seen as being safer. The same document has an entry for ‘Vulcan Boiler and General Insurance (Electrical Engine & Boiler) £2’, confirming the use of steam to supply power to the generating sets.

Unfortunately, in the absence of surviving evidence of the plant much reliance has to be placed on documentary evidence to interpret the evolution of technology in the building. No drawings have been found to illustrate the original layout, but there is valuable information contained in documentation from 1914 (MERL), when plans for an overhaul were being considered. After 18 years of operation the original plant would have been seen as old-fashioned and obsolete, in the light of advances in technology. In January 1914 Marshalls of Gainsborough provided quotations for supplying a new ‘Type L’ steam engine, also for undertaking repairs to the existing ‘M Type’ steam engine. The quotation states that the existing (Marshalls) boiler was suitable for reuse with the proposed new engine, and that a vertical feed water heater would be installed at the same time. Blueprints, also dating from

January 1914 (Figs 1 & 2), show the southern half of the generator house with the two horizontal steam engines (one Type M and one Type L proposed) in the engine room orientated north to south and configured to drive the dynamos via belts. The plan is of interest because it shows the engine house’s boiler located in the south-west room, later to become the workshop. The fact that the boiler room was at the south-west corner presumably meant that the coal store was in the north-western room.

Shortly after the quotations were received from Marshalls, an electrical engineering consultant called Adrian Collins was appointed to guide the upgrade. In a letter dated 8 June 1914 he advised that compound engines, rather than the single-cylinder engines with belt drive used for the past 18 years, be chosen. Collins was urging that the estate move over entirely to oil, not least because it would avoid the inconvenient fumes from the boiler house reaching the mansion. His advice was for three oil engines, one booster and a new switchboard, while reusing the existing battery. Subsequent correspondence confirms (August 1914) that these engines were built by Gardners of Hulme, Manchester, as Collins warns that with the declaration of hostilities against Germany the Government had taken over the factory, thus possibly threatening the completion of the order. Collins’ fears were not realised as the engines appear to have been despatched on 5 September. At the same time it would appear that three continuous current shunt-wound multi-polar dynamos by Messrs Newton Ltd were also delivered. Two 500 gallon oil tanks were provided by a local ironmonger called J Budgen and installed in the garage area above the generator house. To facilitate the installation of the new plant the old (steam) engines were removed, despite suggestions from Collins that steam could provide a backup if oil proved unobtainable due to wartime demands. This proved not to be the case, but at a later date (August 1917) a priority certificate from the Ministry of Munitions to allow Cliveden to acquire lead for lining the batteries was declined. The basis of the application was that it was to light the military hospital erected in the grounds at Cliveden.

An interesting glimpse into the operations of the generator house is given by an account from Waugh of his hours of working over the Christmas period of 1914. Between Christmas Eve and 30 December Waugh started work each day at 4 or 5 am to start the engines and begin charging the battery, which

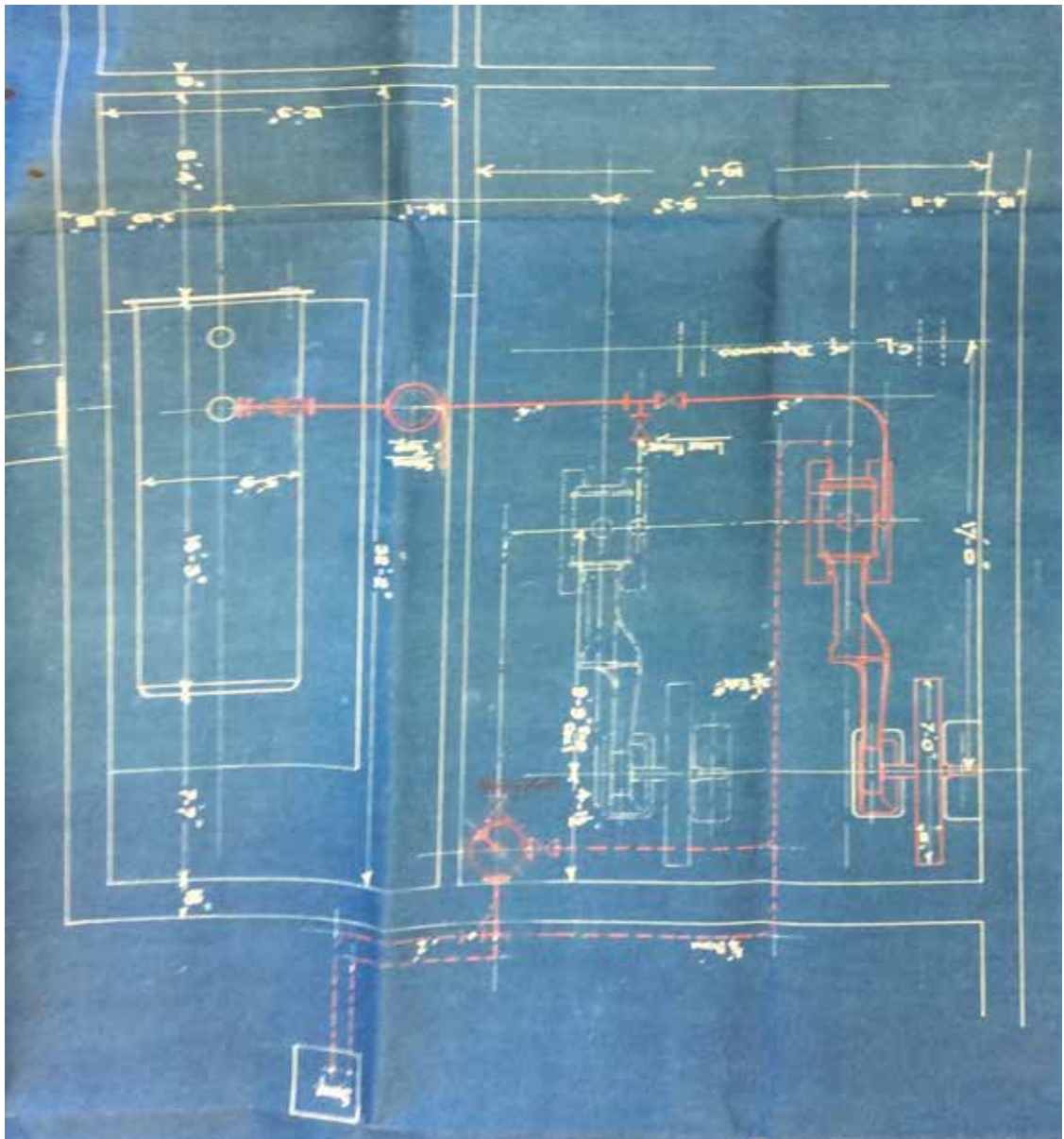


FIGURE 1 Plan of the southern half of the generator house (Jan 1914) showing proposal for new steam engine and other features in red. Courtesy the Museum of English Rural Life (Courtesy of the University of Reading, Special Collections)

would continue until the early afternoon. He would then go to the Taplow Lodge engine house to run separate engines supplying the wider estate, later returning to Cliveden to get things ready for the next day. During this Christmas week Waugh would

generally only return home at 1 am. He remained in charge of the engines installed in 1914, but seems to have struggled to adapt to the new technology as initial teething problems were blamed on his inexperience with the new type of engine.

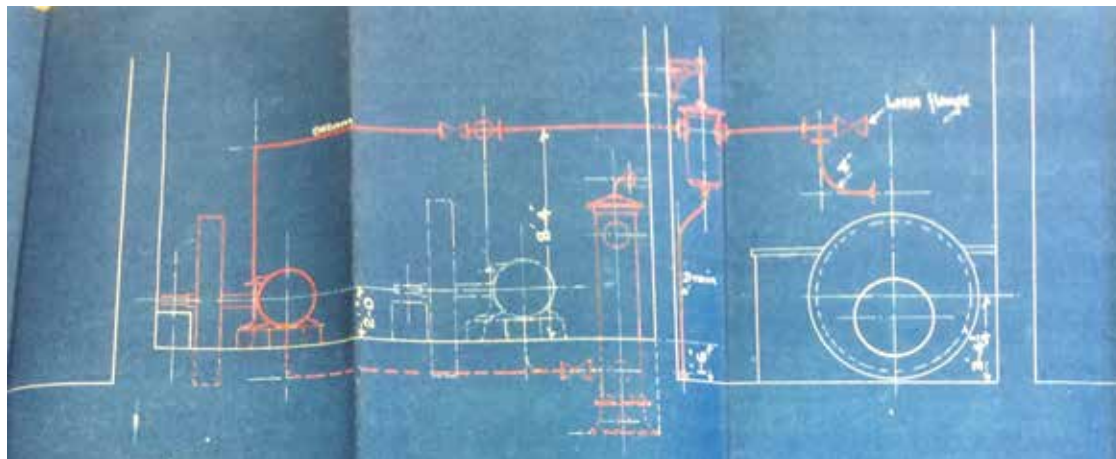


FIGURE 2 Section (north facing) through the southern half of the generator house (Jan 1914) showing proposal for new steam engine and other features in red. Courtesy the Museum of English Rural Life (Courtesy of the University of Reading, Special Collections)

Unfortunately there is much less documentation for the 1920s and '30s, though in 1923 the possibility of connecting to the mains grid was considered. The 10hp Gardner engines had now been running for 9 years and were in need of an overhaul. Waugh, who finally retired in 1937, remained in favour of updating the existing engines since the battery unit could guarantee a source of power. Converting to mains supply would also mean having to adapt all fittings to run on AC current, rather than DC. For the time being the mains option was dropped and in c.1932 a Vickers-Petter 100hp diesel engine was installed for battery charging, presumably still retaining the Gardner engines. This additional capacity seems to have partly been a response to the increasing demands for power in the house, especially the increasing use of refrigerators. There was also a need to upgrade the main power cable to the house in response to this demand.

Further consideration to mains connection was given in 1940, as the Canadian Red Cross Memorial Hospital was being supplied in this way. However, connection was postponed until after the war and it was not until 1948 that it was finally made. Connection would have occurred sooner if it hadn't been for negotiations arising between Lord Astor and The National Trust, who had acquired the estate in 1942, over who should pay for the new supply. Up to the point of connection electricity continued to be supplied from the increasingly

outdated generator house, £600 having been spent on the engines in April 1946 and then £1000 on the batteries in October. Considerations were already being given to the future use of the generator house; one option suggested was a dwelling house and another, which seems to have been implemented, was a workshop for a carpenter.

The documentary record is silent on what subsequently happened to the generator house, although one informal account suggests the engines were exported to India or Africa in the 1960s.

DESCRIPTION OF THE GENERATOR HOUSE

The generator house is a single storey building with a rectangular plan (16.8 x 8.5m) and walls which are brick on the exterior with dressed stone cladding. Despite its function it has a relatively high-quality design and level of detailing. Astor may have been keen to showcase the building and its contents: though hidden in the dell, it was originally intended to be seen from the access drive which passed c. 35m to the east. Later it was screened by woodland and the application of a grey paint over the stonework. It has hardwood doors and timber mullion windows with leaded lights showing the influence of the Arts and Crafts Movement, which would have been at its height at this time in both Britain and America. The

building had a gablet-type roof *i.e.* hipped with a small gable towards the ridge. The low, shallow-pitch roof and deep eaves would also have given the building something of an organic appearance. The original roof covering remains unknown but a reddish asbestos-based tile, patented at the turn of the 20th century, was probably added as part of the 1914 alterations. Surprisingly there is no evidence of chimneys or indeed fireplaces within the building, but a chimney must have been in place to serve the original steam boiler.

Internally the building is divided into five rooms (Figs 3 and 4) with an off-centre spine wall to accommodate the larger size of the two main rooms *i.e.* the engine room and accumulator room. Their higher status is reflected by the use of white glazed bricks supplied by Joseph Brooke and Sons of Hipperholme, Calderdale and Candy & Co of Newton Abbot in Devon. The engine room would have been the functional heart of the building, housing the engines and dynamos. Sadly, none of the historic plant survives, but the room retains numerous sunken ducts, concrete bases and traces of pipework. As referred to above, there were originally two horizontal steam engines powering belt-driven dynamos, but the arrangement of the surviving bases and features is from the 1914 overhaul when the oil engines were installed. The evidence appears to relate to two horizontal oil engines in this room with matching features. One was set close to the south wall, the other in the northern half of the room, but with sufficient working space between the two engines. Each setting retains a concrete base (Fig. 5), plus an adjacent flywheel pit, bearings beyond this to support the flywheel and then further concrete bases beyond this for holding the dynamos. At one end of each base there is a large pit connecting to a duct that extends beyond the footprint of the building and then continues to a set of brick exhaust chambers to the south-east of the building. The function of these pits remains uncertain, but they may have housed silencer boxes for the oil engines.

At the north end of the engine room is a large enclosure which would formerly have housed the electrical switch gear. This is documented in the 1914 overhaul and replaced a previous slate-backed panel, transferred to the Taplow Lodge generator house. The switch gear was set on large sheets of non-conducting marble, but sadly only fragments remain after a concerted effort at some stage to

remove the copper fittings. They do, however, retain a number of ivory labels with lettering indicating the various components of the generator house. A moulded timber cornice above the enclosure still retains the setting for a large circular clock.

The battery or accumulator room in the north-east corner of the building housed a series of lead-acid cells on storage racks. Evidence of these racks survives in the form of small post-holes and a drainage channel in the quarry tile floor; however, the room is otherwise sadly devoid of any fittings. It had a slatted wooden ceiling which allowed potentially explosive hydrogen fumes to escape and vent through louvres in the roof. In 1914 the Electric Power Storage Company provided a quotation for supplying either 58 new cells in glass boxes, or for providing 58 new wooden, lead-lined cells. Glass cells appear to have been used, as during the excavation of the generator house fragments of straight-sided glass jars were recovered, together with glass rods for separating the metal plates suspended in the acid, and glass cups for standing the cells on. Each cell would have produced a 2 volt charge, so the room is likely to have housed at least 50 cells, plus some spares, providing a collective 100 volt charge.

In the south-west corner, the current workshop is thought to have been the original boiler house, based on the blueprint plan of 1914. Its conversion to a workshop with benches, shelves, a vice and line-shafting (Fig. 6) to provide power via a belt drive may have taken place c.1948, as Lord Astor speculates on the potential future use of the space as a carpenter's workshop in 1946. Power for the belt drive would have come from the adjacent room, hereafter referred to as the vestibule, which connects directly with the north-west engine room. The most significant surviving feature is a low concrete base (2.00 x 2.15m) against the south wall and edged with white glazed tiles. This appears to be a secondary insertion as it lies within a secondary broad opening connecting the vestibule with the engine room. The most likely use for this base was to support the two boosters known to have been added to the plant in 1914, together with the oil engines and dynamos. These were small dynamos driven by electric motors, intended to boost the supply from the batteries if one or more of the cells failed. At a later date this base was reused to house a small engine or motor which drove the belts powering the workshop machinery. Sloping holes in the south wall provide evidence of where the belt would have passed from

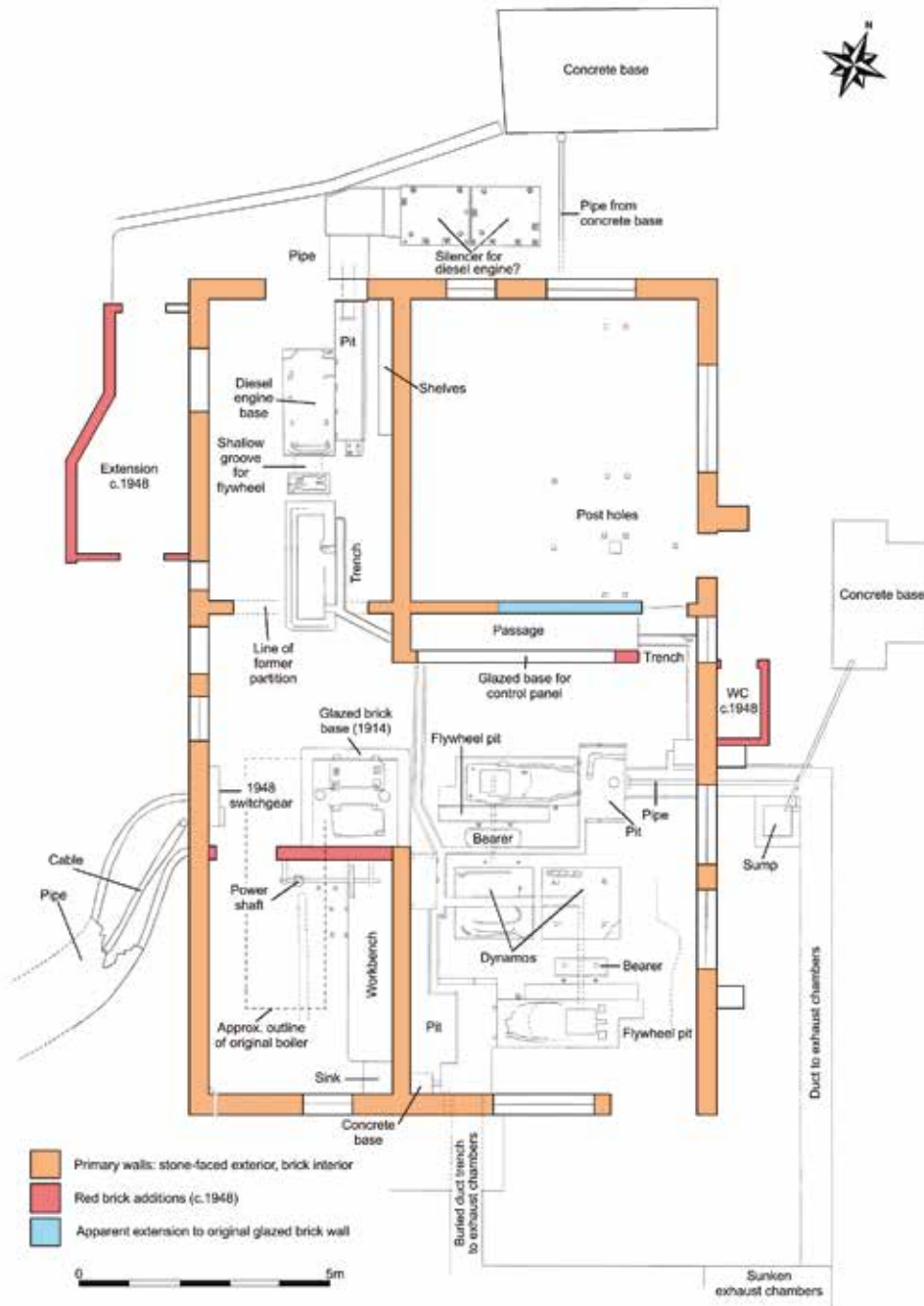


FIGURE 3 Ground floor plan of the generator house



FIGURE 4 Bird's eye photogrammetric view of the generator house looking north

the engine to the aforementioned line shafting. Against the west wall is a collection of high-current AC switchgear made by Fosters (*Fosters Transformers and Switchgear Ltd*), including a 3-phase electricity cable, a main isolator switch and other switchgear probably relating to when the house was connected to the grid in 1948.

The final room in the suite of five rooms is located in the north-west corner, measuring 6.1 x 3.7m. It now forms a single space with the adjacent vestibule, but evidence in the ceiling, together with surviving wall stubs, shows that the two spaces were almost certainly originally sub-divided. Originally this space probably served as the coal store for the adjacent steam boiler. The surviving three concrete bases in this room are believed to relate to the Vickers-Petter diesel engine installed c.1931. Unlike the other bases these are not clad with glazed white bricks. A substantial pit alongside the most northerly base almost certainly accommodated the flywheel. It includes a large iron pipe which probably served as the exhaust. A

set of timber shelves set against the east wall and divided into 49 compartments is believed to have held tools and was probably installed in 1948 when the building was converted to a workshop.

EXTERNAL FEATURES

A concrete base immediately to the east of the building may have housed water tanks for cooling the 1914 oil engines (Fig. 7). To the immediate north of the building sits a large rectangular concrete slab which is thought to have supported an oil tank, whilst two slightly smaller slabs to the west have iron loops in their top surface at each corner, and are thought to cover chambers (yet to be revealed). They may have served as silencer chambers for the 1930s diesel engine and are believed to be connected to a crude chimney c.35m east of the building, constructed from a reused cast-iron drainpipe set vertically in concrete. Situated 4m to the south-east of the generator house is a set of four sunken brick chambers linked to the building by brick-lined ducts



FIGURE 5 Engine bases looking north-west



FIGURE 6 General view of the workshop as seen from above

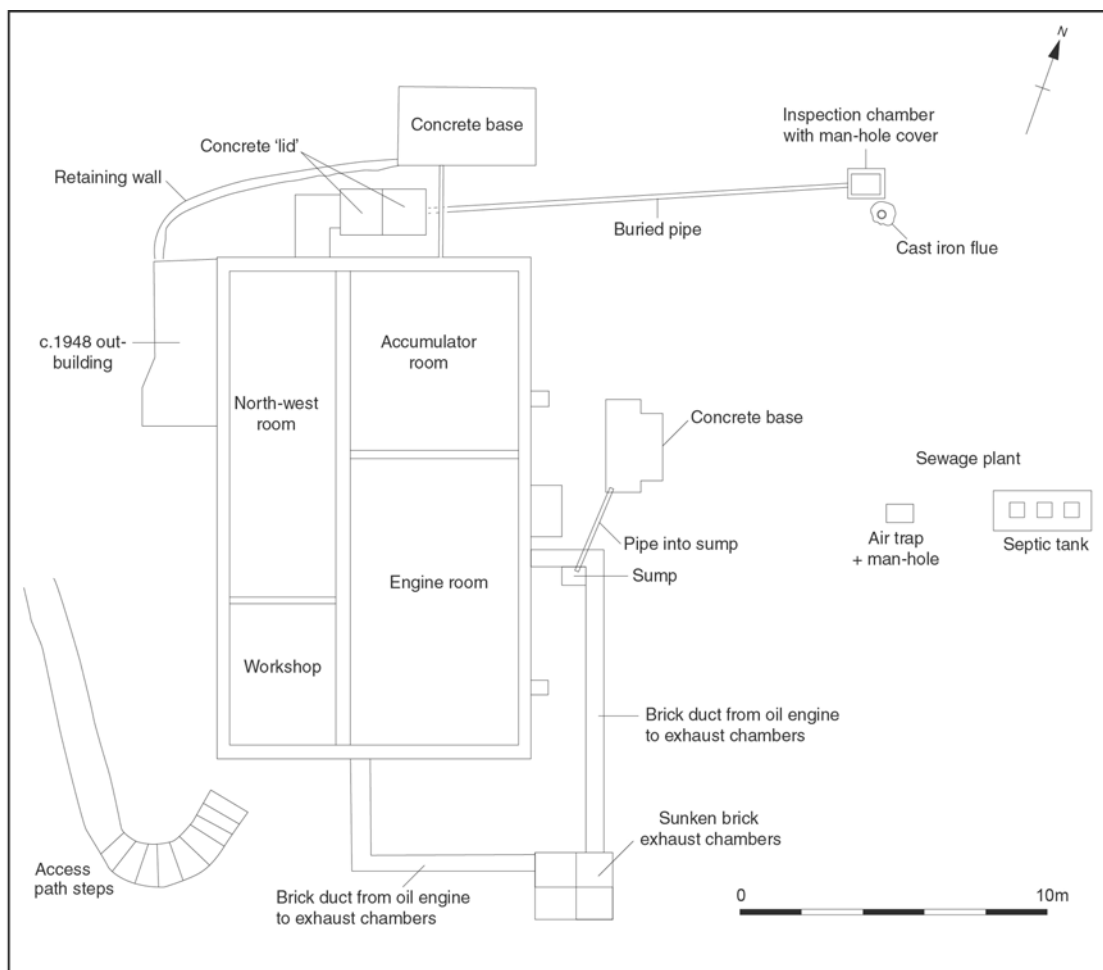


FIGURE 7 Site plan showing external structures

(Fig. 8). These features are clearly related to dealing with the exhaust gases arising from the oil engines, possibly as silencing chambers or as condensers.

A small brick-built privy attached to the east wall is thought to have been added as late as 1948. Also from this phase a single-storey outshot attached to the west side of the building uses identical bricks and retains a corrugated iron roof supported on softwood timbers. Its purpose remains uncertain, but it contains wiring for 3-phase electrical equipment.

CONCLUSION

The generator house was clearly of considerable importance to the functioning of the house prior

to the Second World War, a period which is of particular note in the history of Cliveden when 'The Cliveden Set' came to national prominence. It was constructed in the 1890s and formed part of a wave of country houses rapidly adopting new technologies such as electric power. Concern for aesthetics in the building's design was unusual for this type of structure and future research may reveal the identity of the architect who attempted to give the building something of a traditional appearance. The same concern for aesthetics continued in a major upgrade of the building's plant, which saw further use of white-glazed brick and the insertion of a fine arched doorway to the main engine room.



FIGURE 8 Brick-built silencing or condenser chambers outside the south-east corner of the generator house

The building is a good example of the type of structure that was too frequently neglected by conservation or heritage bodies in the 20th century, including the National Trust. It has been disused without intervention for almost 50 years, possibly longer: indeed, the only alteration during this period was to remove the asbestos slate roof, an action which has possibly accelerated the rate of decay. The National Trust now wishes to conserve the building and the process of reversing its decline will commence with the reinstatement of the roof in 2018. The project has been enhanced by the evidence gained from on-site recording undertaken by Oxford Archaeology and from the wealth of historical material unearthed by volunteers researching the Astor papers at the MERL. Historical evidence shows that the original building had a pair of horizontal steam engines driving the dynamos via belts. The electrical output from these was stored in glass cell batteries which in turn supplied the house with 100 volts direct current. Very little, if anything, survives of the original plant. The main arrange-

ment of engine bases which does remain probably relates to the oil engines installed in 1914 as part of the major upgrade. In c.1931 a more powerful diesel engine was installed and in 1948 Cliveden was finally connected to the main national electrical network. It then appears that the building was a relay point in the local high-voltage network and was reused as a workshop. The reinstatement of the roof represents only the first step in the recovery of the generator house and much remains to be done, particularly with the conservation of the interior. At the time of writing its future use is undecided, but following the 2018 structural restoration the National Trust's ambition is to evaluate ideas for the building to enter a new phase in its history.

REFERENCES

- Gill J 2017 *The Generator House, Cliveden, Buckinghamshire, Historic Building Investigation* Oxford Archaeology (copy deposited with the Bucks County HER)