St Peter and St Paul
Little Gaddesden

Revised Heating Strategy for
The Church and Thomas Field Hall

29 January 2021

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1 Introduction

1.1.1 This document provides an outline of the strategy to be adopted to improve the heating arrangements in the Church and to provide heat to the Thomas Field Hall.

1.1.2 The principle change from the strategy presented to the DAC in July 2020 is a change from the proposed radiator solution in place of the existing fan coil units. While radiators were initially attractive, the very high cost of 7 column cast iron radiators, and the numbers needed to keep the return water temperature low enough to ensure the boiler operates in condensing mode, was prohibitive.

1.1.3 It has therefore been decided to retain the existing fan coil units and add a further two units to reduce return water temperatures and reduce to some extent the current excessive 8 hour preheat period. To limit noise during services and especially recordings in the Church, it is proposed to control all fan coil unit speeds so that they can be used at high speed for preheat and low speed during the service even though the output is reduced. In practice it has been found that the resulting temperature drop in the Church using low fan speeds, when occupied is limited over a 60-minute period and was tolerable,

1.1.4 The approach with fan coil units is compatible with the possibility of installing an air source heat pump in the future to achieve zero carbon heating. When this is done it will probably be necessary to consider further fan coil units due to the lower mean water temperature required for air source heat pumps. There are locations in the Church that could accommodate additional fan coil units, but the required numbers of radiators could not be accommodated.

1.1.5 Further detail for the work in work packages 2B, to 2E inclusive, identified in section 1.2 below is given in sections 2 to 6 below.

1.2 Stratgey

1.2.1 Six work packages are proposed to improve the heat provision in the Church and also improve overall efficiency.

Work Package	Outline of works in Package
2A	Fit a new 100kW oil fired condensing boiler in place of the existing unreliable and non-condensing boiler. Marginally higher output but much more efficient.

Work Package	Outline of works in Package
2B	Provide a thermal store connected to the new 100kW to serve the newly constructed Thomas Field Hall. This will operate in the same manner as a large low loss header with primary and secondary pumps.
2C	Fit electric heating to serve the choir stalls on the south side of the Chancel, and the choir stalls on the North side and also near the East Window. Use of heated cushions, under pew heating and radiant heating has been considered, but discounted in favour of a simple under pew fan convector solution which has been tried over several winters. Central controls would limit the operating time so they could not be left on when the Church was unoccupied.
2D	Install two new fan coil units to match the existing fan coil units at the rear of the Church. One on the west wall behind the font and one in the Bridgewater Chapel on the south wall.
2E	Install comprehensive heating controls providing optimum start, remote time and temperature control and monitoring via iPhone / Android. Logging of run time etc. In addition, automatic frost protection in the Church, and separately in the boiler house is to be provided along with pump “run-on” controls, override facilities etc from a new control panel in the boiler house replacing the existing adhoc wiring and domestic controls.
2F	Passive measure to reduce heat loss in the Church as set out in section 1.2.2 below.

1.2.2 The work associate with package 2A and 2E is almost complete as it is entirely within the boiler house and not the interior of the Church.

1.3 Passive Measures

1.3.1 At Present, the South Door is used as the main entrance exit, and people arriving for a service tend to stand in the doorway admitting large quantities of cold air during winter. Some Churches have overcome this by constructing glazed lobbies with a secondary door but space does not permit this at St Peter and St Paul, and it probably would not be acceptable visually to many.

1.3.2 The solution at St Peter and St Paul is to make the Ambulatory entrance on the North wall the main entry exit point during winter at least. It has the following advantages:

- The Ambulatory will effectively form a large lobby and limit unwanted infiltration.
- Plenty of space for people arriving and departing to mingle without disturbing those in Church.

- On departure it is near the new kitchen and additional space is available in the Hall for the congregation to have coffee.
- It is closer to the car park and the new paving provides a visually linked outdoor space for use in summer.

1.3.3 Passive measures to reduce heat loss and hence running costs to the Church are to be considered by the PCC and implemented progressively with appropriate tradesmen and/or voluntary labour and will include:

- Improving the air tightness of all glazing.
- Improve the air tightness of inner and outer south Doors, the external doors to the electrical space, and the Bridgewater Chapel, and the West Door.
- Limiting air flow from the top of the bell tower (open to fresh air) and the body of the tower. Caulking joints in flooring and considering air flow limiting transfers where the bell ropes penetrate the floor.
- Possibly fitting an additional glazed inner south church door so it is possible for welcomers to see visitors arriving.
- Moving the hymn book and other tables back from the South door so that there is more rooms and visitors do not stand waiting with the door left open.
- Fitting door closers to the external and internal doors at the South Porch.
- Air pressure testing to assess air leakage at eves and elsewhere.
- Secondary glazing over existing windows and in particular the east window and the north window by the organ to improve comfort in the Chancel.
- Separating off spaces that do not need heating or do not need heating all the time e.g., the tower and the Bridgewater Chapel.
- The possibility of additional thermal insulation (this has limited effect without fundamentally altering the nature and character of the Church and is not really an option in St Peter and St Paul).

2 Work Package 2A New Boiler for Church

2.1 Introduction

2.1.1 This work is now complete as part of the Thomas Field Hall project.

3 Work Package 2B – Thomas Field Hall Heat supply

3.1 Introduction

3.1.1 It was intended to install a separate boiler for the TFH with its own controls. This would have been complex due to the limited space in the boiler house and would require an addition flue discharge affecting the external appearance of the Church near the tower.

3.1.2 As a more cost effective and practical alternative it is now proposed to install a thermal store in the boiler house capable of storing sufficient heat for the TFH for a period of about 20- to 50 minutes depending on the external weather. This will act like a low loss header commonly used on boilers serving different zones and will limit the burner cycling on and off over short periods.

3.1.3 Burner short cycling can affect boiler life and increase servicing costs.

3.1.4 As a passive device, the store, similar to a domestic hot water storage cylinder, but with no additional controls, or flue requirements, is a significantly more cost-effective solution.

3.2 Corrosion Inhibitor

3.2.1 The thermal store, being steel needs a corrosion inhibiter to be circulating in the water supply.

3.2.2 A 3.5 litre dosing pot will be fitted to enable the corrosion inhibitor to easily be added.

4 Work Package 2C Local Electric Heating

4.1 Introduction

4.1.1 There is no heating in the Chancel and extending the existing low pressure hot water distribution pipework in the Church to serve the choir stalls, is difficult and would involve lifting a significant number of floor tiles and floor excavation.

4.1.2 Therefore, it is proposed that local electric fan heaters are provided for use during services to mitigate as far a possible down draughts from the East Window and provide some local heat for the choir and organist during services.

4.1.3 Consideration has been given to the use of electric radiant heating at high level, but it is felt that the glow and visibility of this type of heating would detract from the interior.

4.1.4 The fan heaters will be normal domestic types and plugged into new socket outlets located beneath pews. The outlets are to be centrally controlled with push button timers set to 90 minutes to avoid the possibility that electric heaters are left on when the Church is unoccupied.

4.1.5 The use of electric fan heaters has been tested on a temporary basis and found to be useful. It is not intended that the heaters be used outside occupancy periods to preheat the space but just to provide low level warm air during services.

4.2 Installation

4.2.1 The existing single phase incoming power supply has been upgraded to 3 phase (as part of the TFH works) and it is proposed that the existing phase continues to serve the Church, one additional phase serves the TFH and one additional phase serves the electric heating.

4.2.2 A new six-way electrical distribution board is to be installed adjacent to the existing electrical boards in the cupboard accessed from the north aisle by the organ solely for use by the heaters.

4.2.3 Six radial outgoing ways each protected by 16A ELCBS will supply the outlets,

4.2.4 Radial white FP200 cabling is to be run alongside existing white cabling serving 13A switched socket outlets in the locations shown on the drawing.

5 Work Package - 2D Additional Fan Coil Units

5.1 Introduction

5.1.1 The pipework serving the existing fan coil units is in two circuits and it is proposed to put a new fan coil unit at the end of each circuit. By using a larger temperature drop the water volume required for a given fan coil unit rating will be lower and it is not necessary to change pipework sizes or the pumps.

5.2 Commsioining

5.2.1 Pressure gauges have been fitted to the pumps on each circuit to measure water flow rate and the flow rate to each fan coil unit will be set up by monitoring flow and return temperature to each fan coil unit.

5.2.2 The overall flow rate will be adjusted to achieve a return water temperature of 55^{o}C enabling the boiler to operate at maximum efficiency.

6 Work Package 2E Controls

6.1 Introduction

6.1.1 It had been hoped to install a comprehensive Building Management System (BMS) to operate the heating in the Church and Thomas Field Hall with facilities for set up and interrogation both local and remotely, with monitoring of temperatures and in particular, relative humidity in the Church. However, the costs at about £50,000 were prohibitive.

6.1.2 Instead, a smaller scheme engineered by us will provide a similar level of control including:

- Separate optimum start times for the Church and the Hall. (This saves energy compared with a fixed start time based on the coldest days of the year.)
- Ability to programme ad hoc start times remotely from a smart phone up to a week in advance.
- Ability to remotely monitor internal temperatures and check that heating has started.
- Separate frost control for the Church, Hall, and the boiler house.
- Speed control for the fan coil units.
- Key switch override should the internet connection fail.
- Pump overrun controls to dissipate the boiler temperature at the end of the heating period.
- Recoding of Church demand hours.
- Recording of burner operating hours.

6.1.3 The material cost of this is in the order of £500 and with voluntary labour much more affordable.

6.2 Mechanical Ventilation with Heat Revovery (MVHR) System in the Hall

6.2.1 The MVHR in the hall shall be set to run for an hour a day (adjustable in light of experience) at a background level to keep the space fresh. During occupancy a PIR will increase the volume to maximum and post occupancy a relative humidity sensor will keep it running to dissipate moisture in the space. It will provide sufficient fresh air for 10-12 people and larger gatherings will required the windows to be opened should the gather last for say than an hour.

6.3 Temperature and Relative Humidity

6.3.1 Periodically monitoring temperature and relative humidity at 10 or 15 minute intervals over a couple of weeks, will be undertaken to establish dew point and the risk of condensation.

6.3.2 There are artefacts in the Church (predominantly wood and painted plaster) that are susceptible to damage by rapid changes in relative humidity and the long preheat period and relatively high internal air change rate assists in limiting the rate of change.

6.3.3 No apparent damage has occurred to date and care will be taken not to overheat the Church and, in the future, as passive measures to limit unwanted infiltration are undertaken, moisture readings will be taken in external walls in a number of test locations to ensure that that moisture levels are reasonable.

6.3.4 Should it be an issue, to control relative humidity in the Church after a larger gathering, it is proposed to have a “blow through” by opening doors and limiting moisture build up. This is self-regulating to some extent as people leaving tend to increase the air change rate.

6.4 Electricity Consumption

6.4.1 The current on each of three incoming supply phases is be monitored and trend consumption logs (kWhr) identified by the utility company recorded data from the installed smart meter.

- The Church
- Church Electric Heating
- The Thomas Field Hall

Each of which is on a different phase.