



DAVIESPARTNERSHIP

Boiler Replacement Feasibility Report

PROJECT:

Y Llwyfan Building
(Carmarthen Campus)

CLIENT:

University of Wales
Trinity Saint David

**ENERGISING
ENVIRONMENTS**

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CONTENTS

1.0	EXECUTIVE SUMMARY	1
2.0	INTRODUCTION	2
3.0	EXISTING M&E SERVICES REVIEW	3
3.1	MECHANICAL SERVICES	3
3.1.1	PLANT ROOM	3
3.1.2	HOT WATER SERVICES	4
3.2	ELECTRICAL SERVICES	5
3.2.1	INCOMING ELECTRICAL SUPPLY	5
3.2.2	GENERAL LV DISTRIBUTION	5
4.0	RECOMMENDATIONS AND PROPOSALS	6
4.1	MECHANICAL SERVICES	6
4.1.1	CALCULATIONS	6
4.1.2	AIR SOURCE HEAT PUMPS	7
4.1.3	REPLACEMENT PIPEWORK AND EMITTERS	7
4.2	ELECTRICAL SERVICES	8
4.2.1	LLYWFAN	8
5.0	BUDGET COSTS.....	9
5.1	FULL ASHP SYSTEMS	9

1.0 EXECUTIVE SUMMARY

Davies Partnership were appointed by University of Wales Trinity Saint David (UOWTSD) to review the mechanical and electrical services installations within Y Llwyfan, Carmarthen Campus, South Wales.

The main purpose of this report is to detail the feasibility of replacing the existing gas fired boilers serving the building with electric air source heat pumps (ASHP's) which are an eligible renewable technology for the Welsh Government Salix funding programme.

Generally the mechanical services installations within the Plant Room are dated and although in good working order they are reaching the end of their economic life. It is therefore approaching an appropriate moment to consider replacing the gas boilers for more energy efficient and low carbon renewable technology such as ASHP's.

It is proposed to install four commercial external ASHP units to the rear of the building within a secure compound from which distribution pipework would be routed to the existing Plant Room. The majority of the existing Plant Room installations would also be replaced.

Due to the lower operating temperatures of ASHP systems compared to gas boilers, some of the existing heat emitters would require upsizing to ensure the calculated heat outputs are achieved. The existing LTHW pipework through the building is in reasonable condition and we do envisage this being replaced.

It is recommended that a BS 4142:2014 Noise Impact Assessment is undertaken by a Specialist Acoustic Consultant. This will establish the current background noise levels for the location and calculate the increase when the ASHP's are operational to determine whether this is likely to cause a nuisance to neighbours.

Specialist input will also be required from a Structural Engineer to help design a suitable load bearing ASHP base and service duct / wall openings required into the Plant Room.

A GPR underground services survey will be required to reduce the risk of services strikes when constructing the ASHP compound and during excavation for the new underground heating mains.

Due to the age of the building, an Asbestos Refurbishment & Demolition (R&D) survey will be required prior to any removal or installation works.

A more intrusive survey work would be required by Davies Partnership to develop these proposals into detailed designs.

The total budget cost for the ASHP works is £192,250

Please refer to Section 5.0 of this report for the cost breakdowns.

Davies Partnership propose a meeting with OUWTSD once they have reviewed this report to agree the best way forward and programme for the M&E services upgrades.



2.0 INTRODUCTION

Y Llwyfan is a three storey building built in 2008 housing a number of organisations including a two storey studio that is provided with heating and cooling via a VRV installation. Heating is provided to the majority of the building via a natural gas fired heating installation serving a two pipe radiator installation.

The main purpose of this report is to review the existing mechanical and electrical services installations to determine whether it is feasible to replace the existing gas fired boilers with all-electric air source heat pumps.

The recommendations and budget costs within this report will be used to support a UOWTSD Grant Application to Welsh Government for Salix funding to fully finance the proposed renewable technology installations.

Davies Partnership undertook the non-intrusive inspection visit on the 30th November 2022.



Image 1- Y Llwyfan Front Elevation



Image 2- Y Llwyfan Rear Elevation

3.0 EXISTING M&E SERVICES REVIEW

3.1 MECHANICAL SERVICES

3.1.1 PLANT ROOM

The Plant Room is located at lower ground floor level and is accessed via an external corridor near the main reception.

The buildings incoming gas supply enters within the corner of the basement plantroom and serves a gas meter with a rated maximum capacity of 16m³/hr.

The provision of heating within the majority of the building is provided via two wall hung gas fired boilers as manufactured by Stibel their model S-CB80 with a total capacity of 71.2Kw (each) based on a flow temperature of 80°C and a return temperature of 60°C giving a **total output of 142.4Kw** .

The boilers are 15 years old (2008) are in reasonable condition within their typical life expectancy of 20 years.



Image 3- Existing Boiler Plant and Gas Meter

The heating system is pressurised via a pressurisation unit and expansion vessel both of which are located within the plantroom.

Individual flues exit the plantroom as shown on the above Image 3.

The boilers serve three variable temperature heating circuits covering the ground, first and second floors with each consisting of a 3 port valve and single head pump as listed below.

Ground Floor

Manufacturer: Grundfos
Model: UPS 32-80

First Floor

Manufacturer: Grundfos
Model: UPS 32-80

Second Floor

Manufacturer: Grundfos

Model: UPS 32-60



Image 4 - Variable Temperature Heating Circuits

The heating installation is controlled via a local controller supplied by the boiler manufacturer and no central building management systems is provided within the Y Llwyfan building. In general, the installation appears in good condition and no issues were reported.

3.1.2 HOT WATER SERVICES

Hot water is provided to all kitchen locations and toilets via local electric point of use water heaters.

3.2 ELECTRICAL SERVICES

3.2.1 INCOMING ELECTRICAL SUPPLY

The electrical service to Llywfan enters the building to the rear of the building into the electrical switch room. This switchroom is home to a floor mounted Dorman Smith Loadline panel. This panel services the entire building. This distribution appears, generally, to be in good condition.

Based on the site information it has been determined that there could be an incoming service of 630A, however, the fuse rating is unknown. Discussion with the DNO is required at the next stage to determine the Maximum permitted demand. For the purpose of this report we are basing the proposals on a 400A incoming service.

It was not possible to determine the size of the electrical cable serving the building at the time of survey. However, it would appear to be approx. 95mm per core.

Following a load monitoring exercise carried out 10.03.23 – 17.03.23, the following high-level points were noted;

- The phases are imbalanced by approx. 20-45% between phases. Specifically, the L3 phase which is notably higher than L1 & L2.
- There is a low average load usage in comparison to the expected incomer, peaking at 60A.
- The Peak load is 65A on L3.

3.2.2 GENERAL LV DISTRIBUTION

Generally, the electrical distribution is in good condition, however given the load required, it would be expected to be installing a new Distribution arrangement. Therefore, the existing switch gear would not impact the proposals.



Image 1 – Llywfan main panel

4.0 RECOMMENDATIONS AND PROPOSALS

4.1 MECHANICAL SERVICES

4.1.1 CALCULATIONS

Davies Partnership have undertaken some preliminary heat loss calculations to help establish the peak heating load for the building. We have also determined the approximate outputs of the existing heat emitters.

Item	Total	Notes
Existing boiler output	142.4 kW	2no. boilers at 71.2 kW output each
Space heating load	80kW	Heat losses undertaken for sample rooms then averaged across full building. Total includes 20% pre-heat margin
Hot water plant load	n/a	No centralised hot water plant
Total existing plant load	80 kW	
Existing heat emitter outputs based upon 55°C ΔT	105KW	Output based upon 82/71°C F&R temperatures for existing boiler system.
Adjusted heat emitter outputs based upon 30°C ΔT	77 KW	Output based upon reduced 60/40°C F&R temperatures for proposed air source heat pump system

Summary

- The above calculations indicate the existing boilers are sufficiently sized.
- We do not believe that many of the existing heat emitters will require replacing for larger emitters however costs have been included for a percentage replacement with larger heat emitters.
- Feedback from the recent exercise of lowering the boiler flow temperature during the 2022-23 period to replicate connection to a new lower temperature air to water heat pump system indicated that no complaints of a lack of heating within Y Llwyfan were received.

4.1.2 AIR SOURCE HEAT PUMPS

It is proposed to provide 3no ASHP's to serve Y Llwyfan housed within a secure fenced compound at the rear of the building.

Each unit would have an output of 33.4 KW = **133.6 kW** total. The compound size would need to be approximately 4.5m x 4m (or equivalent area).

LTHW pipework would be routed underground (or possibly externally at high level) from the compound into the existing Plant Room where a buffer vessel, pumps, plate heat exchanger, ancillary equipment and controls would all be located.

A ground penetrating radar (GPR) survey would be required before any excavation works are undertaken to confirm that the proposed compound location is suitable and if any underground services are present (e.g. drainage, pipework, electrics etc).

Once a compound location and service route has been confirmed, a Structural Engineer would then need to be engaged to help design a suitable load bearing ASHP base and service duct / wall openings required into the Plant Room.

Air source heat pumps efficiencies are affected by a number of factors including external ambient temperature (less efficient at lower ambient temperatures) and the temperature of the secondary heating circuit serving the building (less efficient at high temperatures for building circuits). There are limitations on the secondary building heating circuit temperatures air source heat pumps can generate. Though flow temperatures of up to 70°C can be achieved, 60°C is a more realistic limit to the building heating circuit whilst maintaining system efficiency.

All the existing main plant Room equipment would need to be removed as part of the ASHP conversion works as the general equipment required and layout would be different than for gas boilers.

Three new dedicated LTHW VT heating circuits would be provided to serve the heat emitters within the building as per the current arrangement and connect to existing pipework at high level.

The electrical load of an air-source heat pump system is a significant increase on the existing building demand. See section 4.2 below for further details.

There are no buildings near to Y Llwyfan and it's situated near a main road however the buildings offices are located nearby complete with opening windows and as air source heat pumps generate noise due to fans and refrigeration compressors it is recommended a BS 4142:2014 Noise Impact Assessment is undertaken by an Acoustic Specialist. The current background noise levels at the nearest sensitive noise receptor would be established and from this the increased noise breakout can be calculated for the ASHP's. Should the predicted noise levels be high then acoustic attenuators will be required to the ASHP's to help reduce noise breakout to acceptable levels.

4.1.3 REPLACEMENT PIPEWORK AND EMITTERS

As the existing heating system was originally designed to operate on an 82°C heating flow temperature, the reduction of heating system flow temperatures with a retro-fit air source heat pump system would reduce the output of all existing heat emitters.



Image 2 – Typical air source heat pump unit

At this stage we do not believe many of the existing radiators will require replacement however more detailed calculations will be undertaken during the detailed design process and radiators replaced if deemed necessary. Any replacement emitters would increase in size therefore further checks would be required regards the positioning of the heaters.

As the existing pipework was installed in 2008, we do not propose any require replacement.

4.2 ELECTRICAL SERVICES

4.2.1 Llywfan

Given the proposals are for 4 no new units and separate water heating system, with an overall advised peak load of approx. 250A total per phase.

Given the anticipated service of 400A, it could be electrically viable to install the ASHP compound for this building. This would utilise a large portion of the available capacity, but not its entirety.

To achieve this, further investigations would need to be carried out with consultation with the DNO. This can be completed at the next stage of the design.

Should it be found that the incoming supply is rated at 630A or a minimum of 400A, it would be advised a new electrical service to be derived from the panel to service a new distribution board dedicated to serve the ASHP and Water heating systems. This would require either an external feeder pillar located to the rear of the building or a space within the buildings switch room.



5.0 BUDGET COSTS

5.1 FULL ASHP SYSTEMS

Item	Total
Removal works (Plant Room – removal of redundant gas boilers, gas pipework, pumps, F&E tank, heating pipework, flue installation etc)	██████
General M&E Builderswork (openings less than 100mm)	██████
Sub-total	██████
Mechanical Services	
External ASHP installation (4 x ASHP units and associated pipework)	██████
Plant Room works (new pumps, buffer vessel, pressurisation unit, expansion vessel, pipework, thermal insulation, BMS controls and field wiring).	██████
Emitter upgrades (10no. new panel radiators and associated TRV's).	██████
Water Treatment Specialist sampling and condition report	██████
Testing & commissioning	██████
O&M manuals and as-installed drawings	██████
Mechanical Services Sub-total	██████
Electrical Services	
GRP building/ enclosure and Primary distribution within Enclosure only - EXCLUDES Existing Primary Upgrades as Not Investigated, Utility and Civils/Builders Works Costs	██████
External ASHP installation (LV power supplies)	██████
Testing & commissioning	██████
O&M manuals and as-installed drawings	██████
Electrical Services Sub-total	██████
Provisional sums and contingency	
Contingency for unforeseen works	██████
Totals	██████

All costs exclude:

- Preliminaries
- Main builderswork (all openings greater than 100mm, removal of services boxings, removal of ceilings for services removal / installation, re-decoration following removal works, general making good to match existing finishes)
- ASHP compound
- Groundworks and excavations
- Structural investigation and design
- Noise Impact Assessment
- GPR survey
- Asbestos surveys and removal works
- Detailed M&E services design
- Professional fees
- VAT