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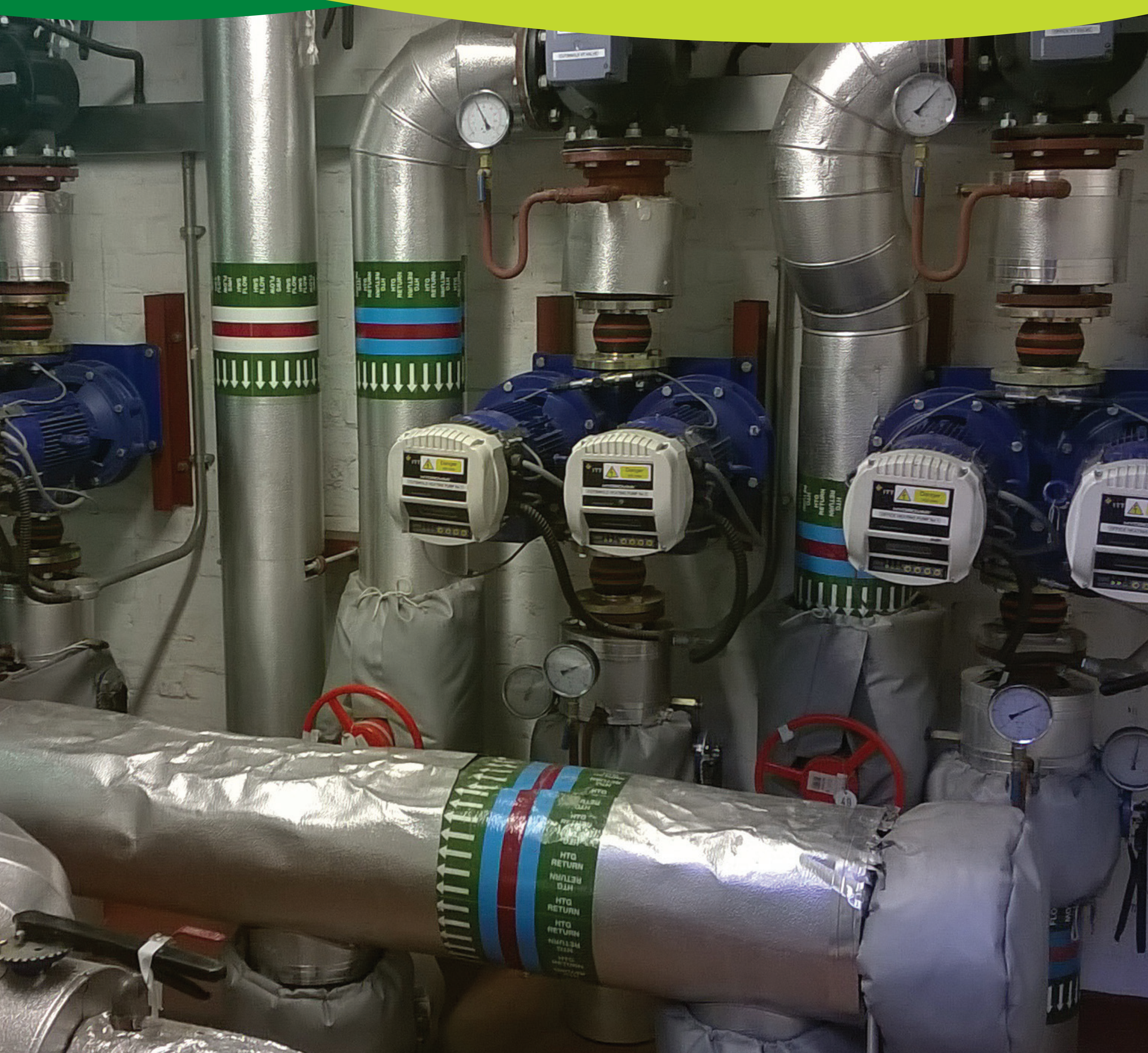
# Guidelines for connecting to heat networks

## Part 2 – a guide for building services designers connecting to Bunhill Heat and Power

(A supplement to Islington Environmental Design Planning Guidance)



# Contents

# Guidelines for connecting to heat networks

## Part 2 – a guide for designers of building services connecting to Bunhill Heat and Power

This guidance is for information only. Islington Council gives no warranty as to the accuracy of the information provided and accepts no liability for any loss, damage or inconvenience caused as a result of reliance on this information.

We recommend consulting with appropriate legal and engineering professionals before signing any agreements or undertaking any design work.

**Part 1**
A guide for developers and building owners

**Part 2**
A guide for designers of building services

**Part 3**
Islington connection terms

This document is **Part 2**

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# 1. Background

This publication sets out PART 2 of Islington's District Heating Connection Guidelines to provide technical guidance for those intending to connect to the existing Bunhill Heat and Power network. This guide (PART 2) should be read in conjunction with PART 1, which sets out the benefits to developers/owners and their responsibilities in connecting to heat networks.

This document forms supporting guidance to Appendix 1 of the Environmental Supplementary Planning Document[1] (SPD) in order to provide more detailed guidance on connection to Bunhill Heat and Power network. This document provides guidance on how new developments and existing buildings in Islington should be designed, built and operated to be compatible with connection to the Bunhill Heat network. Many of the principles will be applicable to other heat networks, however, you should speak to your particular Heat Network Operator to verify their specific requirements.

The guidelines set out in this document will be kept under review as technologies, policies and practices advance and will be updated accordingly.

PART 2 is a technical guide aimed at building services Mechanical & Electrical designers involved in designing and implementing district heating. It will also be useful to building operators and facilities managers when connecting to heat networks.

This guide is in three parts:

| | |
|---|---|
| **Part 1**<br>A guide for developers and building owners | **Part 1** explains the benefits and responsibilities of connecting to district heating |
| **Part 2**<br>A guide for designers of building services | **Part 2** is a technical guide specifying how connections should be made |
| **Part 3**<br>Islington connection terms | **Part 3** provides legal terms and draft agreements relevant to making a connection to Bunhill Heat and Power (for relevant parties only) |

[1] Environmental Design Planning Guidance – Tackling fuel poverty, enhancing quality of life and environment for all (Islington Council) (2012)
http://www.islington.gov.uk/services/planning/planningpol/pol_supplement/Pages/Environmental-Design.aspx

# 2. Likely heating system configuration options

Islington Council prefer INDIRECT connections to Bunhill Heat and Power and this guide reflects that approach – i.e. there is usually a Building Thermal Substation (main heat exchanger) or individual dwelling Heat Interface Units (HIUs) separating the building and the district heating system. However you should check with the Heat Network Operatator (HNO) to confirm their preferred approach.

There are seven likely scenarios for indirect connections:

| | |
|---|---|
| **Scenario 1A** | Residential - centralised DHW and indirect high-rise space heating |
| **Scenario 1B** | Residential - centralised DHW and direct low-rise space heating |
| **Scenario 2A** | Residential - dwelling space heating via HIU PHEx with dwelling DHW storage cylinders |
| **Scenario 2B** | Residential - dwelling space heating via PHEx with dwelling DHW PHEx (combined HIU) |
| **Scenario 3A** | Residential - direct space heating with dwelling DHW cylinder |
| **Scenario 3B** | Residential - direct space heating with dwelling DHW PHEx (Combined HIU) |
| **Scenario 4** | Non-residential - direct commercial space heating and centralised DHW |

**Acronyms: (PHEx) Plate Heat Exchanger, (DHW) Domestic Hot Water, (HIU) Heat Interface Unit**

Connections and adaptation arrangements for these scenarios are shown in Table 2.1, overleaf. Sections 4-10 set out examples of detailed pipework arrangements, interfaces and control strategies for each of these seven scenarios. Section 11 shows alternatives for condensing boilers and larger boilers. Section 12 sets out wider technical specifications covering any connection scenario.

| | ALL HAVE BUILDING THERMAL SUBSTATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | GROUP | TYPE | MAIN FEATURE | SECONDARY FEATURE | EXISTING SCENARIO | SPACE HEATING SOLUTION | DHW SOLUTION | METERING SOLUTION |
| RESIDENTIAL | 1 | 1A | **Centralised DHW** | **High-rise indirect space heating** | Residential - Centralised DHW and indirect high-rise space heating | Building Thermal Substation & Central Space Heating PHEx | Central storage calorifiers | Block metering OR separate central Space Heating & DHW meters |
| | | 1B | **Centralised DHW** | **Low-rise direct space heating** | Residential - Centralised DHW and direct low-rise space heating | Building Thermal Substation | Central storage calorifiers | Block metering OR separate central Space Heating & DHW meters |
| | 2 | 2A | **Dwelling Space Heating PHEx [HIU]** | **Dwelling DHW cylinder** | Residential - Dwelling Space Heating via HIU PHEx with dwelling DHW storage cylinders | Building Thermal Substation AND Local Dwelling space heating HIU's | Local dwelling storage cylinders | Block metering AND may have individual dwelling meters in HIU's |
| | | 2B | **Dwelling Space Heating PHEx [Combined HIU]** | **Dwelling DHW PHEx [Combined HIU]** | Residential - Dwelling Space Heating via PHEx with dwelling DHW PHEx (combined HIU) | Building Thermal Substation AND Local Dwelling HIU's (Space Heating & DHW) | Local instantaneous via HIU | Block metering AND may have individual dwelling meters in HIU's |
| | 3 | 3A | **Direct Space Heating** | **Dwelling DHW cylinder** | Residential - Direct space heating with dwelling DHW cylinder | Building Thermal Substation | Local dwelling storage cylinders | Block metering AND may have individual dwelling meters |
| | | 3B | **Direct Space Heating [Combined HIU]** | **Dwelling DHW PHEx [Combined HIU]** | Residential - Direct space heating with dwelling DHW PHEx (Combined HIU) | Building Thermal Substation | Local dwelling instantaneous Plate Heat Exchangers | Block metering AND may have individual dwelling meters in HIU's |
| Non Residential | 4 | | **Direct Space Heating** | **Centralised DHW PHEx** | Non Residential - Direct commercial space heating and centralised DHW | Building Thermal Substation but with tertiary solutions for CT, VT and LT | DHW Thermal substation | Block metering only |

**Table 2.1 Most likely district heating scenarios**

# 3. Next steps

Based on the general scenarios, solutions and specifications provided below, you should draw up schematics, control strategies and fully dimensioned drawings for your planned specific solution. This should also include a clear estimate of the total future energy consumption of the building, based on the guidance provided in section 12.1.

Your final design must then be submitted to the heat network operator (HNO) for formal review before work goes ahead or the design becomes fixed. Any changes to your design that impact the operation of the heating system must be notified to the HNO within one week of changes being made.

The detailed pipework arrangements and control strategies set out in sections 4 to 10 are recommended 'template' solutions for each of the seven most likely scenarios. Designers can provide alternative solutions but these must be submitted to the HNO. Islington Council do not accept any liability for the designs submitted or ultimately installed.

Your design team must be led by a Chartered Engineer or equivalent. The qualifications of the M&E consultant carrying out the design must be submitted to the HNO along with the design.

It is recommended that if you are looking to connect to Bunhill Heat and Power, you review PART 3 of this guide which provides a draft 'Heat Supply Agreement' and a draft 'Deed Of Grant Of Easement For Heat Supply'. 'PART 3 – Islington District Heat connection terms' is available on request from the Islington Heat Network Operator.

# 4. Key design issues

It is important to recognise that this guide is about design WITHIN the building. It aims to ensure that the internal building services work in harmony with the heat network to promote high efficiency across the whole scheme and within each building.

Once connected, even with hydraulic separation, your design will affect the operation of the whole network. In particular:

- Your heating system should be designed and commissioned to achieve low return water temperatures, particularly at low or zero demand. Using low temperature heating systems like underfloor heating or large surface area radiators can be a way to achieve this.
- The difference between flow and return temperatures in the secondary distribution networks (your heating system) must be kept as large as possible.
- Plant (heat exchangers, pumps, valves etc.) should not be oversized and should be capable of low turndown.
- Two-port control valves and variable speed pumping should be used to avoid returning high temperature water back to the heat exchanger.
- The building and internal building services should be designed, commissioned, maintained and operated to comply with the CIBSE/ADE CP1 Heat Networks Code of Practice.[2]
- A common feature of all six residential scenarios is that the space heating is controlled by a differential pressure sensor or valve. The sensor will maintain a constant head across the radiator, which means that with the correct TRV selected, the radiators will modulate in temperature rather than turning on and off. This provides more accurate control of radiator and room temperatures. Low Kv TRVs, which have a high resistance to flow, are required on each radiator.

All new-build and retrofit designs must meet the current Building Regulations. In particular the requirements set out in Part L and the supporting documents including the Domestic and Non-Domestic Building Services Compliance Guides.

The detailed pipework arrangements and control strategies set out in sections 4 to 10 are recommended 'template' solutions for each of the seven most likely scenarios. Designers can provide alternative solutions but these must be submitted to the HNO.

The Islington Heat Network Operator is keen to work with connection parties to try and import other sources of heat (e.g. waste urban heat),[3] and they should contact the Islington Heat Network Operator to discuss how this might be possible.

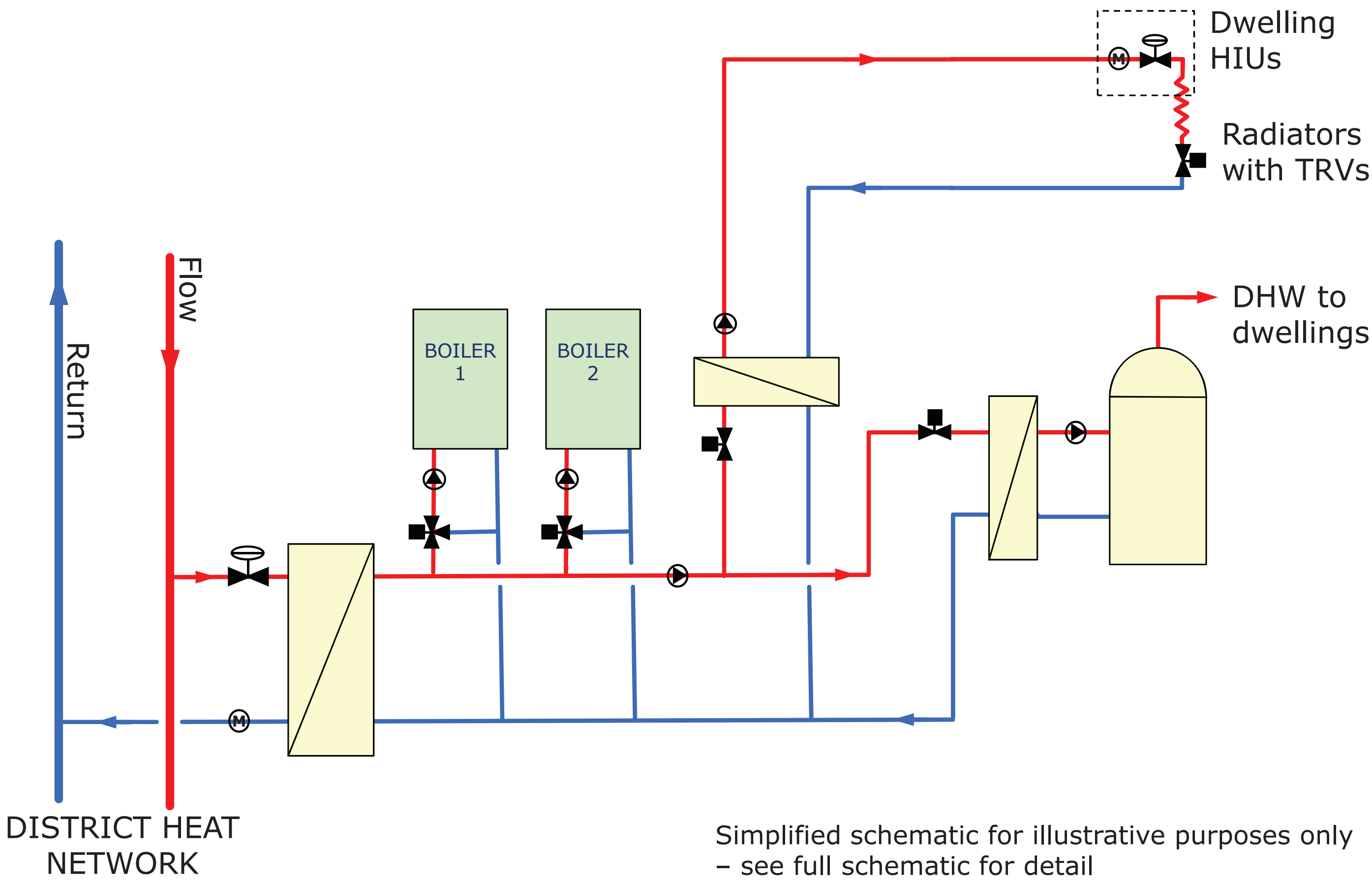
[2] CIBSE/ADE CP1 Heat Networks Code of Practice - raising standards for heat supply (2015)
[3] London's Zero Carbon Energy Resource: Secondary Heat (GLA Report) (2013)

# 5. Scenario 1A – Residential, centralised DHW and indirect high-rise space heating

### Description

Centralised residential space heating and centralised DHW – i.e. central boilers and central DHW storage calorifier with a Building Thermal Substation, central storage calorifiers and central space heating Plate Heat Exchanger (PHEx) providing a pressure break in high-rise buildings.

| TYPE | MAIN FEATURE | SECONDARY FEATURE | EXISTING SCENARIO | SPACE HEATING SOLUTION | DHW SOLUTION | METERING SOLUTION |
|---|---|---|---|---|---|---|
| 1A | Centralised DHW | High-rise indirect space heating | Residential - Centralised DHW and indirect high-rise space heating | Building Thermal Substation & Central Space Heating PHEx | Central storage calorifiers | Block metering OR separate central Space Heating & DHW meters |




Simplified schematic for illustrative purposes only – see full schematic for detail

## Overview

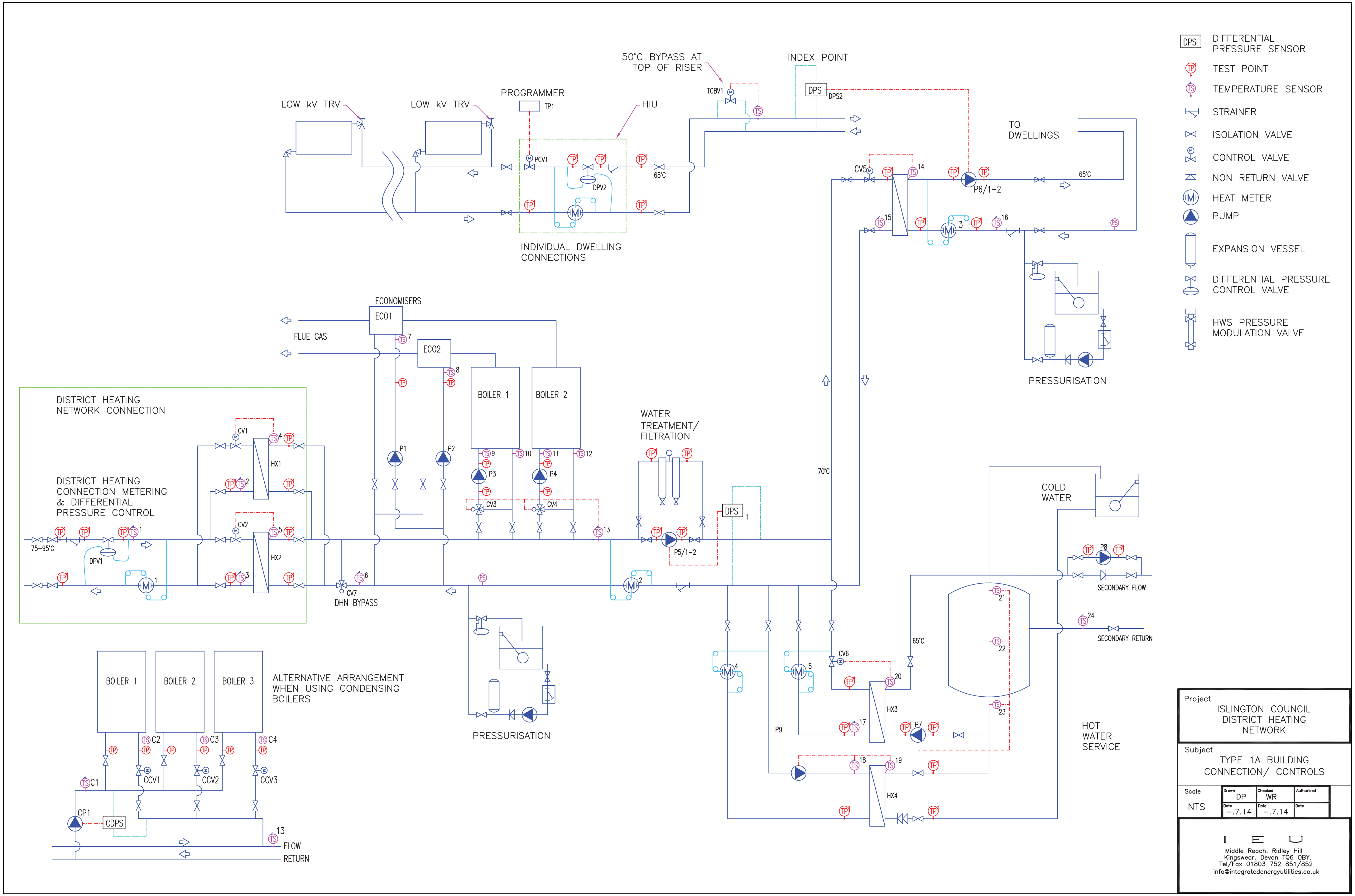
This represents the first of six solutions to connect a communal residential heating system. This scenario might typically be found in an existing housing context. As with all the scenarios represented in this document, a Building Thermal Substation provides hydraulic separation from the primary distribution network.

When connecting to the Bunhill Heat and Power network, boiler plant is retained on the secondary network to provide peak load and standby for this demand only – it cannot currently provide heat back to the primary network at the moment.

DHW is provided by a further plate heat exchanger serving a central calorifier. In this scenario a separate centralised plate heat exchanger serves the spacing heating load without the need for dwelling HIUs. This may be a high rise heating system, which may require a pressure break between the boilers and the heating system.

| Advantages | Disadvantages |
|---|---|
| • Centralisation, both hot water storage and space heating minimises maintenance requirements within the dwelling.<br>• Pressure separation between circuits in high rise buildings.<br>• Avoids the need for dwelling HIUs | • Additional plate heat exchangers for both space heating and hot water mean slightly higher return temperatures. |
| **Do** | **Don't** |
| • Use split headers.<br>• Use a 2 port injection valve for weather compensation rather than a 3 port valve. It has better regulating characteristics than 3 port valve.<br>• Use weather compensation control to lower the distribution temperature in milder weather, reduces running costs and can help provide low return temperatures.<br>• For larger boilers, use a separate economiser to achieve condensing operation.<br>• Use a modulating distribution pump controlled by differential pressure to maintain temperatures across the boiler.<br>• Use Low Kv TRVs – in combination with DPC valves, radiators then modulate in temperature rather than going hot and cold.<br>• Consider using a Jockey pump to deliver heating energy at low flow rates. | • Use low loss headers.<br>• Use 3 port injection valves for weather compensation. 3 port valves don't cope well with pressure.<br>• Use unnecessary bypass arrangements. |

The following provides a recommended schematic pipework layout and control strategy for this scenario. This is a suggested solution for this scenario; designers can provide alternative solutions but these must be submitted to the Heat Network Operator for review.



DIFFERENTIAL PRESSURE SENSOR
TEST POINT
TEMPERATURE SENSOR
STRAINER
ISOLATION VALVE
CONTROL VALVE
NON RETURN VALVE
HEAT METER
PUMP
EXPANSION VESSEL
DIFFERENTIAL PRESSURE CONTROL VALVE
HWS PRESSURE MODULATION VALVE
LOW kV TRV
LOW kV TRV
PROGRAMMER
TP1
HIU
PCV1
DPV2
INDIVIDUAL DWELLING CONNECTIONS
50°C BYPASS AT TOP OF RISER
TCBV1
INDEX POINT
DPS
DPS2
TO DWELLINGS
65°C
CV5
P6/1–2
PRESSURISATION
ECONOMISERS
ECO1
ECO2
FLUE GAS
BOILER 1
BOILER 2
P1
P2
P3
P4
CV3
CV4
WATER TREATMENT/ FILTRATION
P5/1–2
70°C
DISTRICT HEATING NETWORK CONNECTION
DISTRICT HEATING CONNECTION METERING & DIFFERENTIAL PRESSURE CONTROL
CV1
CV2
HX1
HX2
DPV1
75–95°C
CV7
DHN BYPASS
PRESSURISATION
COLD WATER
P8
SECONDARY FLOW
SECONDARY RETURN
CV6
HX3
HX4
P7
P9
HOT WATER SERVICE
BOILER 1
BOILER 2
BOILER 3
ALTERNATIVE ARRANGEMENT WHEN USING CONDENSING BOILERS
C1
C2
C3
C4
CCV1
CCV2
CCV3
CP1
CDPS
FLOW
RETURN
Project
ISLINGTON COUNCIL DISTRICT HEATING NETWORK
Subject
TYPE 1A BUILDING CONNECTION/ CONTROLS
Scale
NTS
Drawn
DP
Checked
WR
Authorised
Date
–.7.14
Date
–.7.14
Date
I E U
Middle Reach. Ridley Hill
Kingswear. Devon TQ6 0BY.
Tel/Fax 01803 752 851/852
info@integratedenergyutilities.co.uk

| BUILDING CONNECTION & ADAPTATION ARRANGEMENTS | | | | | |
|---|---|---|---|---|---|
| **TYPE** | **MAIN FEATURE** | **SECONDARY FEATURE** | **EXISTING SCENARIO** | **SPACE HEATING SOLUTION** | **DHW SOLUTION** |
| **1A** | Centralised DHW | High-rise indirect space heating | Residential - Centralised DHW and indirect high-rise space heating | Building Thermal Substation & Central Space Heating PHEx | Central storage calorifiers |
| **HEATING PLANT ROOM CONTROL STRATEGY** | **District Heating HX temperature and pressure differential control** - CV1&2 are controlled to maintain HX1 & HX2 secondary temperatures as measured by temperature sensors TS4 & TS5 respectively. The differential pressure across the heat exchangers and control valves is controlled by direct action DPV1. Control Valve CV7 shall by-pass the DHN in the event that DHN flow temperature measured by TS1 falls below 60C. | | | | |
| | **Large Boiler** [with separate economizer] control - Each boiler is fitted with a shunt pump designed for e.g. 15C temperature differential at full load. The pumps are switched on with the boiler and switched off with e.g. 5 minute pump over run. When the boilers 1 & 2 are switched on CV3 is controlled in two stages the first to recirculate to achieve a minimum inlet temperature of 65C as measured by TS9 & TS11 respectively and the second to maintain a system supply temperature of e.g. 70C as measured by TS13. The boilers are brought on in stages, if boiler 1 is unable to meet the required system temperature within a time [say 30 minutes] control valve CV3 is opened fully to the system and Boiler 2 is brought into operation and the system supply temperature measured by TS13 controlled by CV4. Economizer pumps P1 & P2 are switched on and off with the respective boiler shunt pumps. | | | | |
| | **Alternative Small Condensing Boiler control** - boiler circulation pump CP1 is controlled to maintain a fixed differential pressure as measured by sensor CDPS1. The pump is switched on when a boiler is switched on. Boiler control valves CCV1-3 open when one boiler is switched on. The boilers will operate under their own control to maintain an outlet temperature. The boilers shall be switched on/off according to the system demand for heat as measured by (70-TS5)*flow rate as measured by M2[l/sec] *4.18 | | | | |
| | **Boiler house Circulating pumps** - Pumps P5 1&2 are controlled in stages to maintain a fixed differential pressure e.g. 0.5 bar, as measured by DPS2 | | | | |
| | **Heat Distribution System HX3 temperature control** - CV5 is controlled to maintain HX3 secondary temperature at e.g. 70C as measured by temperature sensors TS14. The flow temperature at the top of each riser is maintained at e.g. 50C by direct acting thermostatically controlled temperature by-pass valve TCBV1. | | | | |
| | **Heat distribution pumps control** - Heat distribution pumps P6 1&2 are operated in stages to maintain a heat distribution system index pressure measured by DPS2 at e.g. 0.6 bar. | | | | |
| | **Hot Water Service heating control** - CV6 is controlled to maintain a hot water HX3 secondary outlet temperature of e.g. 65C as measured by temperature sensor TS20. Storage cylinder circulating pump P7 is switched on and off by temperature sensors TS22 [60C] and TS23 [60C]. HWS secondary circulating pump P8 operates continuously. HX4 preheats HWS. Circulating pump P9 is speed controlled to maintain a temperature differential of e.g. 5C as measured by temperature sensors TS19 & TS18. For one hour 2.00am to 3.00am the system shall be operated in the sterilisation mode. For this the heat exchanger secondary temperature shall be set to e.g. 70C as measured by TS20 and the pump P7 operated continuously without temperature control switching. | | | | |
| **DWELLING CONTROL STRATEGY** | The dwelling heating system pressure differential is regulated at 0.2 bar by direct acting DPV. A temperature programmer TP1 switches temperature on/off control valve PCV1. All this control and the heat meter shall be included within a purpose made heat interface unit HIU. Radiator thermostatic control valves shall be the low Kv type and preferably have wall mounted controls with an actual temperature scale. Domestic thermostats should be of the TPI type to promote close control. Programmers should preferably include optimum start control functions and be linked to boiler room BMS system. | | | | |

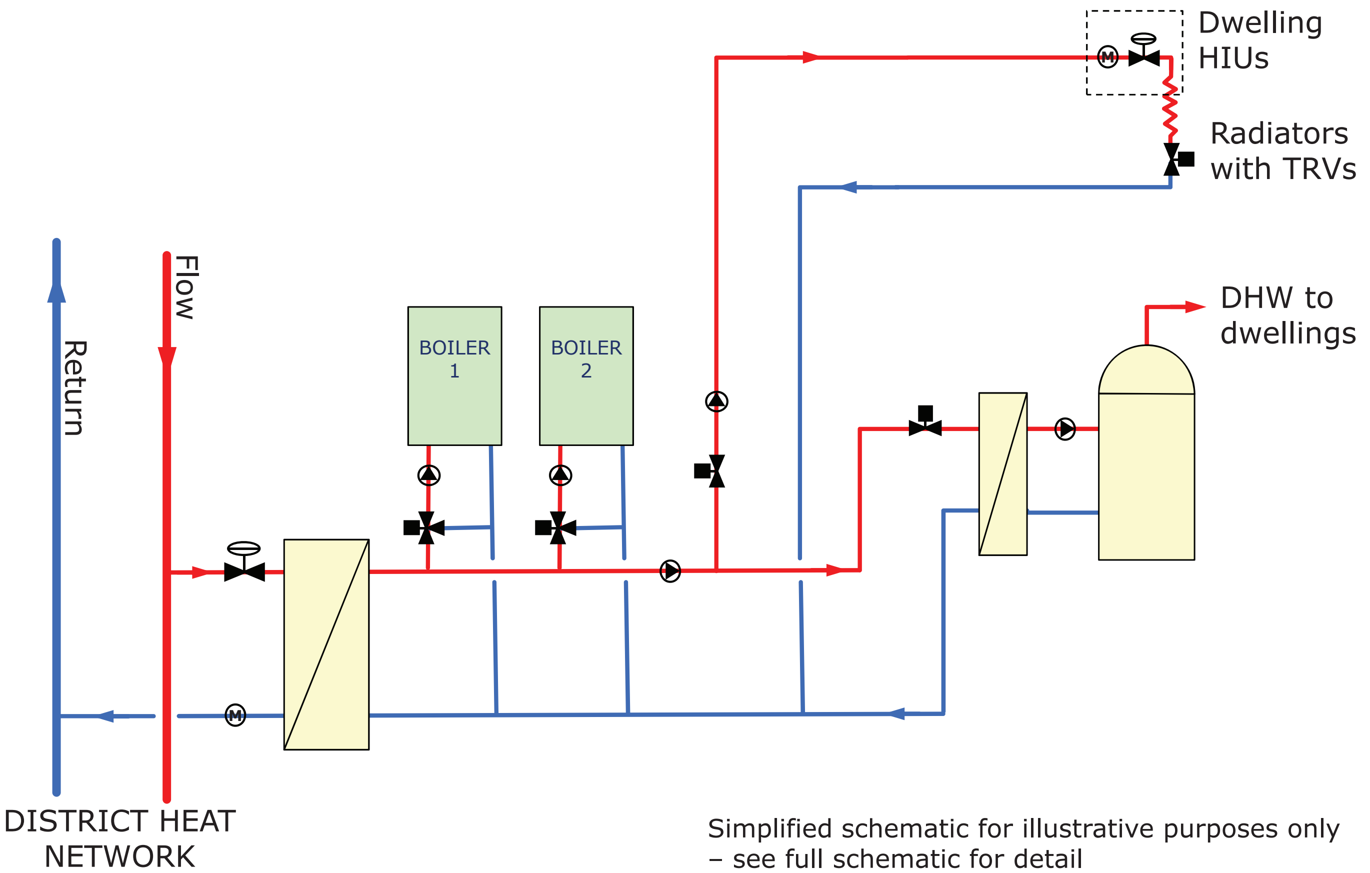
# 6. Scenario 1B – Residential, centralised DHW and direct low-rise space heating

### Description

Centralised residential space heating and centralised DHW – i.e. central boilers and central DHW storage calorifier with a Building Thermal Substation, central storage calorifiers and central space heating Plate Heat Exchanger (PHEx) providing a pressure break in high-rise buildings.

| TYPE | MAIN FEATURE | SECONDARY FEATURE | EXISTING SCENARIO | SPACE HEATING SOLUTION | DHW SOLUTION | METERING SOLUTION |
|---|---|---|---|---|---|---|
| 1B | Centralised DHW | Low-rise direct space heating | Residential - Centralised DHW and direct low-rise space heating | Building Thermal Substation | Central storage calorifiers | Block metering OR separate central Space Heating & DHW meters |

This is an alternative to 1A.



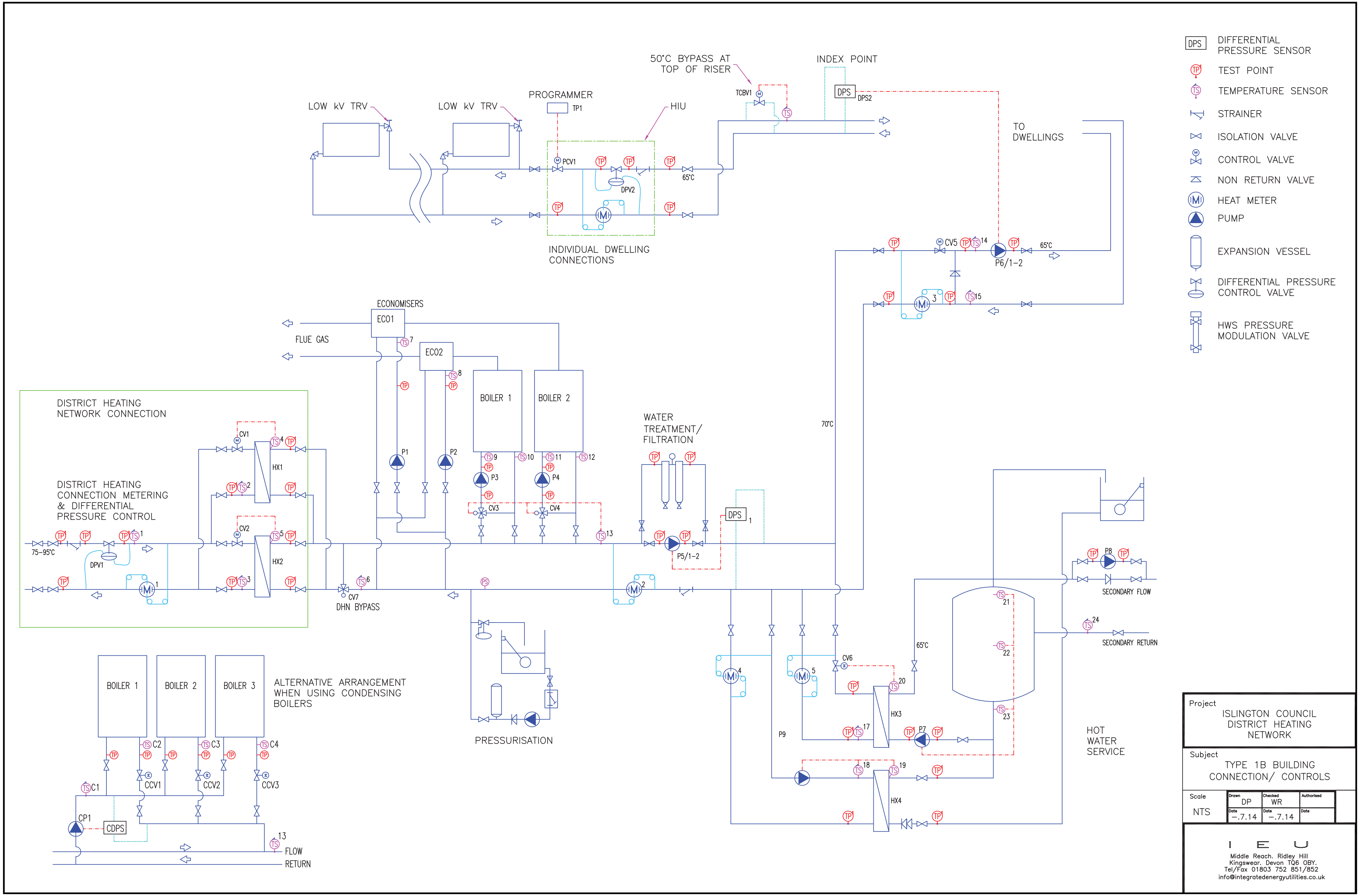

Simplified schematic for illustrative purposes only – see full schematic for detail

## Overview

This represents an alternative solution to scenario 1A. This scenario might typically be found in an existing low-rise housing context. As with all the scenarios represented in this document, a Building Thermal Substation provides hydraulic separation from the primary distribution network. Boiler plant is retained on the secondary network to provide peak load and standby for this demand only – it cannot currently provide heat back to the primary network at the moment. As with scenario 1A, DHW is provided by a further Plate Heat Exhanger (PHEx) serving a central calorifier. However in contrast to 1A, no centralised plate heat exchanger is used for the space heating load. There are no HIUs incorporating plate heat exchangers within each dwelling.

| Advantages | Disadvantages |
| --- | --- |
| • The directly connected space heating means slightly lower return temperatures than 1A.<br>• Avoids the need for dwelling HIUs | |
| **Do** | **Don't** |
| • Use split headers.<br>• Use a 2 port injection valve for weather compensation rather than a 3 port valve. It has better regulating characteristics than 3 port valve.<br>• Use weather compensation control to lower the distribution temperature in milder weather, reduces running costs and can help provide low return temperatures.<br>• For larger boilers, use a separate economiser to achieve condensing operation.<br>• Use modulating distribution pump controlled by differential pressure to maintain temperatures across the boiler.<br>• Use Low Kv TRVs – in combination with DPC valves, radiators then modulate in temperature rather than going hot and cold.<br>• Consider using a Jockey pump to deliver heating energy at low flow rates | • Use low loss headers.<br>• Use 3 port injection valves for weather compensation. 3 port valves don't cope well with pressure.<br>• Use unnecessary bypass arrangements. |

The following provides a recommended schematic pipework layout and control strategy for this scenario. This is a template solution for this scenario; designers can provide alternative solutions but these must be submitted to the Heat Network Operator for review.

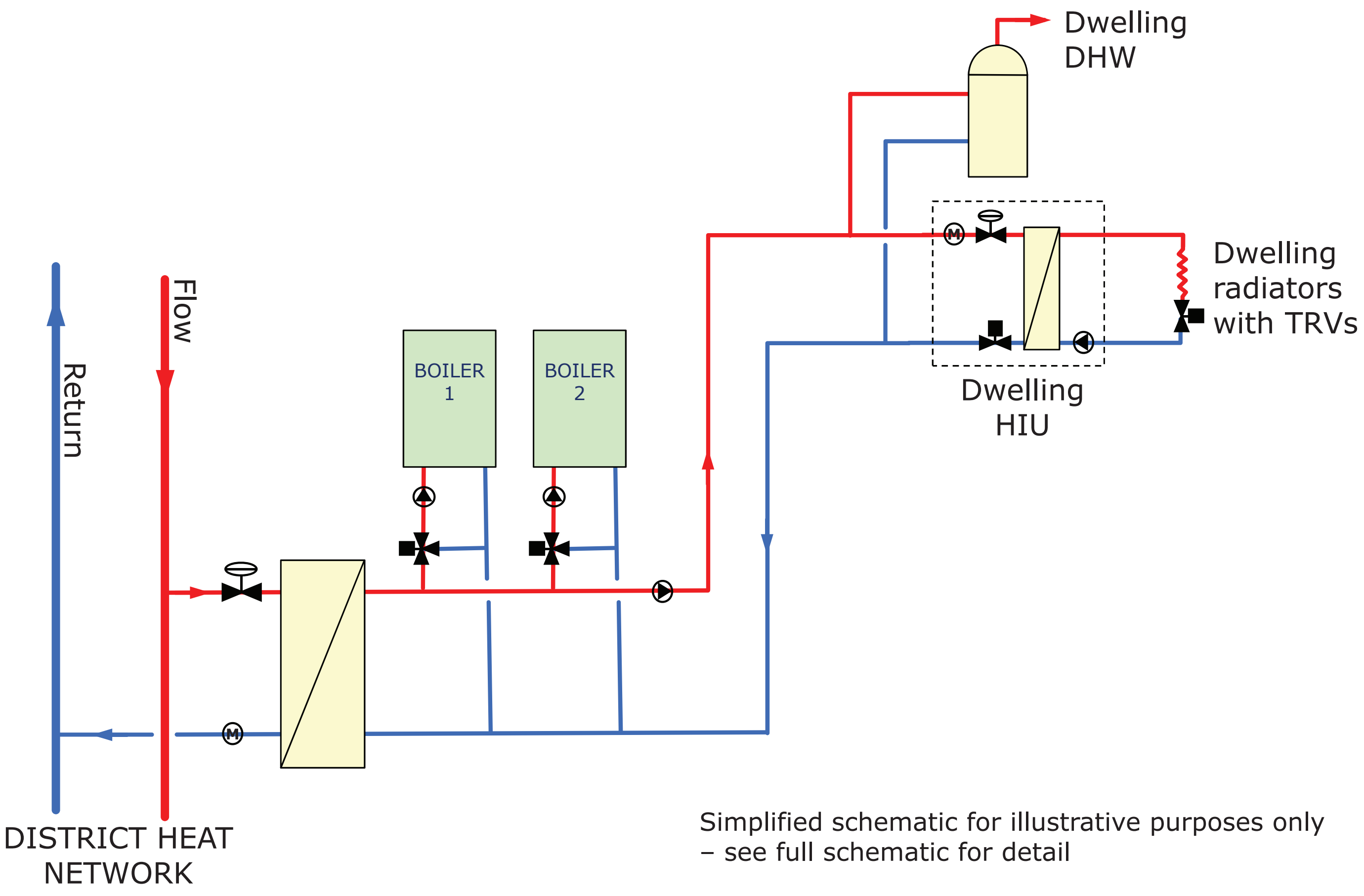

DPS DIFFERENTIAL PRESSURE SENSOR
TP TEST POINT
TS TEMPERATURE SENSOR
STRAINER
ISOLATION VALVE
CONTROL VALVE
NON RETURN VALVE
HEAT METER
PUMP
EXPANSION VESSEL
DIFFERENTIAL PRESSURE CONTROL VALVE
HWS PRESSURE MODULATION VALVE
LOW kV TRV
LOW kV TRV
PROGRAMMER
TP1
PCV1
DPV2
HIU
INDIVIDUAL DWELLING CONNECTIONS
50°C BYPASS AT TOP OF RISER
TCBV1
INDEX POINT
DPS2
65°C
TO DWELLINGS
CV5
14
P6/1-2
15
3
70°C
ECONOMISERS
ECO1
ECO2
FLUE GAS
BOILER 1
BOILER 2
P1
P2
P3
P4
CV3
CV4
WATER TREATMENT/ FILTRATION
P5/1-2
DISTRICT HEATING NETWORK CONNECTION
DISTRICT HEATING CONNECTION METERING & DIFFERENTIAL PRESSURE CONTROL
CV1
CV2
HX1
HX2
75-95°C
DPV1
CV7
DHN BYPASS
PRESSURISATION
CV6
HX3
HX4
P7
P8
P9
SECONDARY FLOW
SECONDARY RETURN
HOT WATER SERVICE
ALTERNATIVE ARRANGEMENT WHEN USING CONDENSING BOILERS
BOILER 1
BOILER 2
BOILER 3
C1
C2
C3
C4
CCV1
CCV2
CCV3
CP1
CDPS
FLOW
RETURN
Project
ISLINGTON COUNCIL DISTRICT HEATING NETWORK
Subject
TYPE 1B BUILDING CONNECTION/ CONTROLS
Scale
NTS
Drawn
DP
Checked
WR
Authorised
Date
-.7.14
Date
-.7.14
Date
IEU
Middle Reach. Ridley Hill
Kingswear. Devon TQ6 0BY.
Tel/Fax 01803 752 851/852
info@integratedenergyutilities.co.uk

| BUILDING CONNECTION & ADAPTATION ARRANGEMENTS | | | | | |
|---|---|---|---|---|---|
| **TYPE** | **MAIN FEATURE** | **SECONDARY FEATURE** | **EXISTING SCENARIO** | **SPACE HEATING SOLUTION** | **DHW SOLUTION** |
| **1B** | Centralised DHW | Low-rise direct space heating | Residential - Centralised DHW and direct low-rise space heating | Building Thermal Substation | Central storage calorifiers |
| **HEATING PLANT ROOM CONTROL STRATEGY** | **District Heating HX temperature and pressure differential control** - CV1&2 are controlled to maintain HX1 & HX2 secondary temperatures as measured by temperature sensors TS4 & TS5 respectively. The differential pressure across the heat exchangers and control valves is controlled by direct action DPV1. Control Valve CV7 shall by-pass the DHN in the event that DHN flow temperature measured by TS1 falls below 60C. | | | | |
| | **Large Boiler [with separate economizer] control** - Each boiler is fitted with a shunt pump designed for e.g. 15C temperature differential at full load. The pumps are switched on with the boiler and switched off with e.g. 5 minute pump over run. When the boilers 1 & 2 are switched on CV3 is controlled in two stages the first to recirculate to achieve a minimum inlet temperature of 65C as measured by TS9 & TS11 respectively and the second to maintain a system supply temperature of 70C as measured by TS13. The boilers are brought on in stages, if boiler 1 is unable to meet the required system temperature within a time [say 30 minutes] control valve CV3 is opened fully to the system and Boiler 2 is brought into operation and the system supply temperature measured by TS13 controlled by CV4. Economizer pumps P1 & P2 are switched on and off with the respective boiler shunt pumps. | | | | |
| | **Alternative Small Condensing Boiler control** - boiler circulation pump CP1 is controlled to maintain a fixed differential pressure as measured by sensor CDPS1. The pump is switched on when a boiler is switched on. Boiler control valves CCV1-3 open when one boiler is switched on. The boilers will operate under there own control to maintain an outlet temperature. The boilers shall be switched on/off according to the system demand for heat as measured by (70-TS5)*flow rate as measured by M2[l/sec] *4.18 | | | | |
| | **Boiler house Circulating pumps** - Pumps P5 1&2 are controlled in stages to maintain a fixed differential pressure e.g. 0.5 bar, as measured by DPS2 | | | | |
| | **Heat Distribution System HX3 temperature control** - CV5 is controlled to maintain secondary temperatures as measured by temperature sensors TS14. The flow temperature at the top of each riser is maintained at e.g. 50C by direct acting thermostatically controlled temperature by pass valve TCBV1. | | | | |
| | **Heat distribution pumps control** - Heat distribution pumps P6 1&2 are operated in stages to maintain a heat distribution system index pressure measured by DPS2 at e.g. 0.6 bar. | | | | |
| | **Hot Water Service heating control** - CV6 is controlled to maintain a hot water HX3 secondary outlet temperature of e.g. 65C as measured by temperature sensor TS20. Storage cylinder circulating pump P7 is switched on and off by temperature sensors TS22 [60C] and TS23 [60C]. HWS secondary circulating pump P8 operates continuously. HX4 preheats HWS. Circulating pump P9 is speed controlled to maintain a temperature differential of e.g. 5C as measured by temperature sensors TS19 & TS18. For one hour 2.00am to 3.00am the system shall be operated in the sterilisation mode. For this the heat exchanger secondary temperature shall be set to e.g. 70C as measured by TS20 and the pump P7 operated continuously without temperature control switching. | | | | |
| **DWELLING CONTROL STRATEGY** | The dwelling heating system pressure differential is regulated at 0.2 bar by direct acting DPV2. Temperature programmer TP1 switches temperature on/off control valve PCV1. All this control and the heat meter shall be included within a purpose made heat interface unit HIU. Radiator thermostatic control valves shall be the low Kv type and preferably have wall mounted controls with an actual temperature scale. Domestic thermostats should be of the TPI type to promote close control. Programmers should preferably include optimum start control functions and be linked to boiler room BMS systems. | | | | |

# 7. Scenario 2A – Residential, dwelling space heating via HIU PHEx with dwelling DHW storage cylinders

## Description

| TYPE | MAIN FEATURE | SECONDARY FEATURE | EXISTING SCENARIO | SPACE HEATING SOLUTION | DHW SOLUTION | METERING SOLUTION |
|---|---|---|---|---|---|---|
| 2A | Dwelling Space Heating PHEx [HIU] | Dwelling DHW cylinder | Residential - Dwelling Space Heating via HIU PHEx with dwelling DHW storage cylinders | Building Thermal Substation AND Local Dwelling space heating HIU's | Local dwelling storage cylinders | Block metering AND may have individual dwelling meters in HIU's |



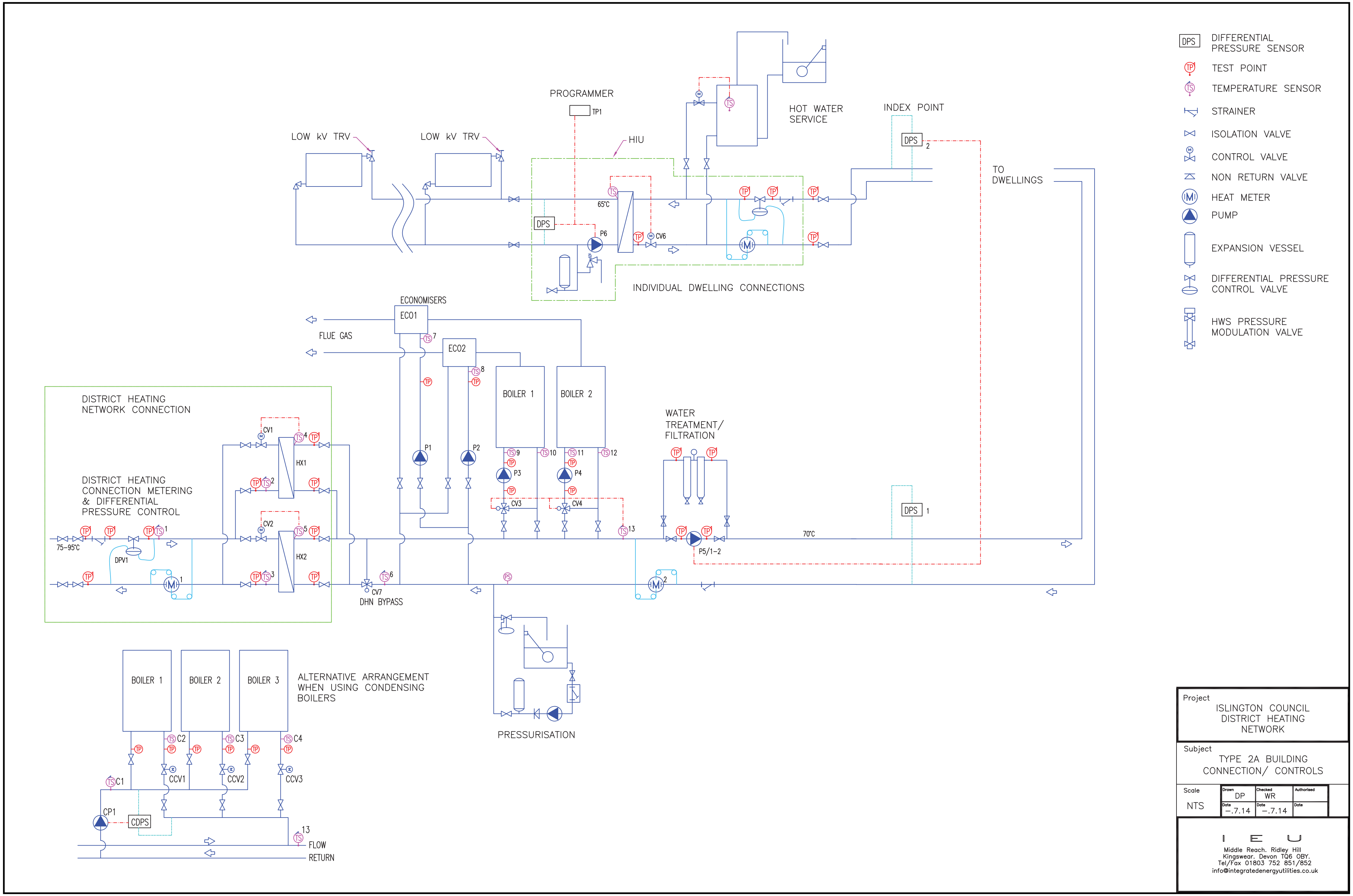

Simplified schematic for illustrative purposes only – see full schematic for detail

## Overview

This scenario might typically be preferred in a new-build housing context. As with all the scenarios represented in this document, a Building Thermal Substation provides hydraulic separation from the primary distribution network. Boiler plant is retained on the secondary network to provide peak load and standby for this demand only – it cannot currently provide heat back to the primary network. A two-pipe system runs directly to each dwelling. Space heating is still raised locally from a Plate Heat Exhanger (PHEx) within the HIU but hot water is raised in a local cylinder. This system is indirect in the sense that there is a HIU incorporating a plate heat exchanger within each dwelling. Existing cylinders may use a coil to heat the hot water, but a local external PHEx may be preferable on dwelling cylinders to achieve low return temperatures.

| Advantages | Disadvantages |
|---|---|
| • The use of dwelling DHW cylinders has the advantage (over central (block) hot water storage or central plate heat exchangers) of potentially limiting the amount of pipework being kept hot inside the dwelling and therefore reducing heat losses | |
| **Do** | **Don't** |
| • Use split headers.<br>• For larger boilers, use a separate economiser to achieve condensing operation.<br>• Use modulating distribution pump controlled by differential pressure to maintain temperatures across the boiler.<br>• Use Low Kv TRVs – in combination with DPC valves, radiators then modulate in temperature rather than going hot and cold.<br>• Consider using PHE to charge cylinders in place of coils to minimize return temperatures.<br>• Ensure that any new back-up electric immersion heaters have either a one-hour extension timer or an interlock to stop coincidental operation with the main DHW heating.<br>• Avoid existing electric back-up DHW systems operating at the same time as the main system.<br>• Consider using a Jockey pump to deliver heating energy at low flow rates. | • Use low loss headers.<br>• Use unnecessary bypass arrangements. |

The following provides a recommended schematic pipework layout and control strategy for this scenario. This is a template solution for this scenario; designers can provide alternative solutions but these must be submitted to the Heat Network Operator for review.

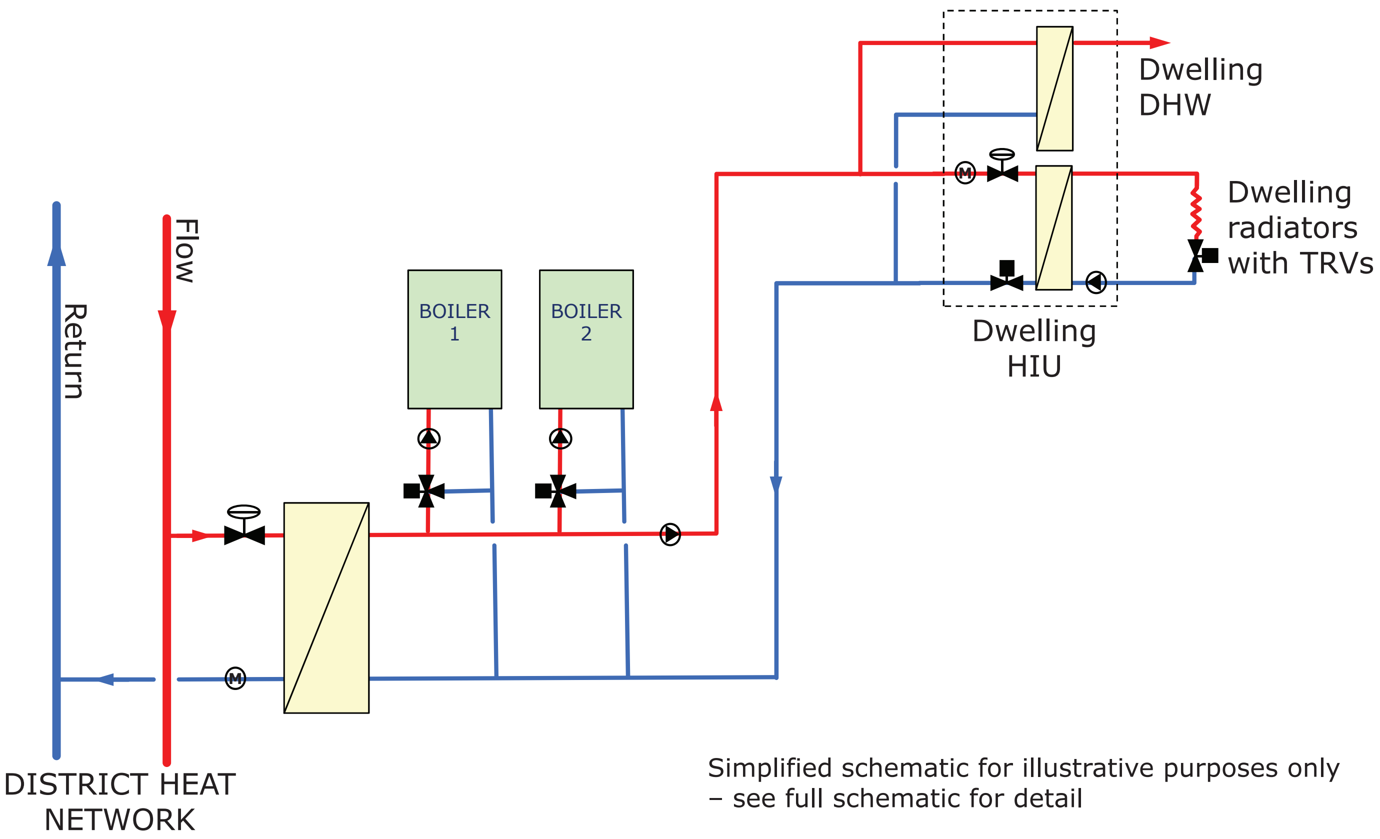

DIFFERENTIAL PRESSURE SENSOR
TEST POINT
TEMPERATURE SENSOR
STRAINER
ISOLATION VALVE
CONTROL VALVE
NON RETURN VALVE
HEAT METER
PUMP
EXPANSION VESSEL
DIFFERENTIAL PRESSURE CONTROL VALVE
HWS PRESSURE MODULATION VALVE
PROGRAMMER
TP1
LOW kV TRV
LOW kV TRV
HIU
HOT WATER SERVICE
INDEX POINT
DPS 2
TO DWELLINGS
65°C
DPS
P6
CV6
INDIVIDUAL DWELLING CONNECTIONS
ECONOMISERS
ECO1
ECO2
FLUE GAS
7
8
BOILER 1
BOILER 2
DISTRICT HEATING NETWORK CONNECTION
DISTRICT HEATING CONNECTION METERING & DIFFERENTIAL PRESSURE CONTROL
CV1
HX1
CV2
HX2
75-95°C
DPV1
P1
P2
9
10
11
12
P3
P4
CV3
CV4
13
WATER TREATMENT/ FILTRATION
P5/1-2
DPS 1
70°C
CV7
DHN BYPASS
PRESSURISATION
BOILER 1
BOILER 2
BOILER 3
ALTERNATIVE ARRANGEMENT WHEN USING CONDENSING BOILERS
C1
C2
C3
C4
CCV1
CCV2
CCV3
CP1
CDPS
FLOW
RETURN
Project
ISLINGTON COUNCIL DISTRICT HEATING NETWORK
Subject
TYPE 2A BUILDING CONNECTION/ CONTROLS
Scale
NTS
Drawn
DP
Checked
WR
Authorised
Date
-.7.14
Date
-.7.14
Date
I E U
Middle Reach. Ridley Hill
Kingswear. Devon TQ6 0BY.
Tel/Fax 01803 752 851/852
info@integratedenergyutilities.co.uk

| BUILDING CONNECTION & ADAPTATION ARRANGEMENTS | | | | | |
|---|---|---|---|---|---|
| **TYPE** | **MAIN FEATURE** | **SECONDARY FEATURE** | **EXISTING SCENARIO** | **SPACE HEATING SOLUTION** | **DHW SOLUTION** |
| **2A** | Dwelling Space Heating PHEx [HIU] | Dwelling DHW cylinder | Residential - Dwelling Space Heating via HIU PHEx with dwelling DHW storage cylinders | Building Thermal Substation AND Local Dwelling space heating HIU's | Local dwelling storage cylinders |
| **HEATING PLANT ROOM CONTROL STRATEGY** | **District Heating HX temperature and pressure differential control** - CV1&2 are controlled to maintain HX1 & HX2 secondary temperatures as measured by temperature sensors TS4 & TS5 respectively. The differential pressure across the heat exchangers and control valves is controlled by direct action DPV1. Control Valve CV7 shall by-pass the DHN in the event that DHN flow temperature measured by TS1 falls below 60C. | | | | |
| | **Large Boiler [with separate economizer] control** - Each boiler is fitted with a shunt pump designed for e.g. 15C temperature differential at full load. The pumps are switched on with the boiler and switched off with e.g. 5 minute pump over run. When the boilers 1 & 2 are switched on CV3 is controlled in two stages the first to recirculate to achieve a minimum inlet temperature of 65C as measured by TS9 & TS11 respectively and the second to maintain a system supply temperature of 70C as measured by TS13. The boilers are brought on in stages, if boiler 1 is unable to meet the required system temperature within a time [say 30 minutes] control valve CV3 is opened fully to the system and Boiler 2 is brought into operation and the system supply temperature measured by TS13 controlled by CV4. Economizer pumps P1 & P2 are switched on and off with the respective boiler shunt pumps. | | | | |
| | **Alternative Small Condensing Boiler control** - boiler circulation pump CP1 is controlled to maintain a fixed differential pressure as measured by sensor CDPS1. The pump is switched on when a boiler is switched on. Boiler control valves CCV1-3 open when one boiler is switched on. The boilers will operate under their own control to maintain an outlet temperature. The boilers shall be switched on/off according to the system demand for heat as measured by (70-TS5)*flow rate as measured by M2[l/sec] *4.18 | | | | |
| | **Heat distribution pumps control** - Heat distribution pumps P5 1&2 are controlled by variable speed inverters to maintain a heat distribution system index pressure measured by DPS2 at e.g. 0.6 bar. | | | | |
| **DWELLING CONTROL STRATEGY** | The dwelling primary heating system pressure differential is regulated at 0.2 bar by direct acting DPV. A temperature programmer TP1 switches the heating circulation pump P7 on/off. Pump P7 to be controlled by sensor DPS3 to maintain a circulating pressure differential at 0.2bar. The secondary flow temperature to be controlled by direct acting control valve CV6 to maintain a flow temperature at 65C. All the control and the heat metering equipment shall be included within a purpose made heat interface unit HIU. Radiator thermostatic control valves shall be the low Kv type and preferably have wall mounted controls with an actual temperature scale. Domestic thermostats should be of the TPI type to promote close control. Programmers should preferably include optimum start control functions and be linked to boiler room BMS systems. The dwelling hot water service is by individual storage system a direct acting two port control valve is controlled by a temperature immersion sensor to maintain the cylinder temperature at 60C. | | | | |

# 8. Scenario 2B – Residential, dwelling space heating via PHEx with dwelling DHW PHEx (combined HIU)

## Description

| TYPE | MAIN FEATURE | SECONDARY FEATURE | EXISTING SCENARIO | SPACE HEATING SOLUTION | DHW SOLUTION | METERING SOLUTION |
|---|---|---|---|---|---|---|
| 2B | Dwelling Space Heating PHEx [Combined HIU] | Dwelling DHW PHEx [Combined HIU] | Residential - Dwelling Space Heating via PHEx with dwelling DHW PHEx (combined HIU) | Building Thermal Substation AND Local Dwelling HIU's (Space Heating & DHW) | Local instantaneous via HIU | Block metering AND may have individual dwelling meters in HIU's |



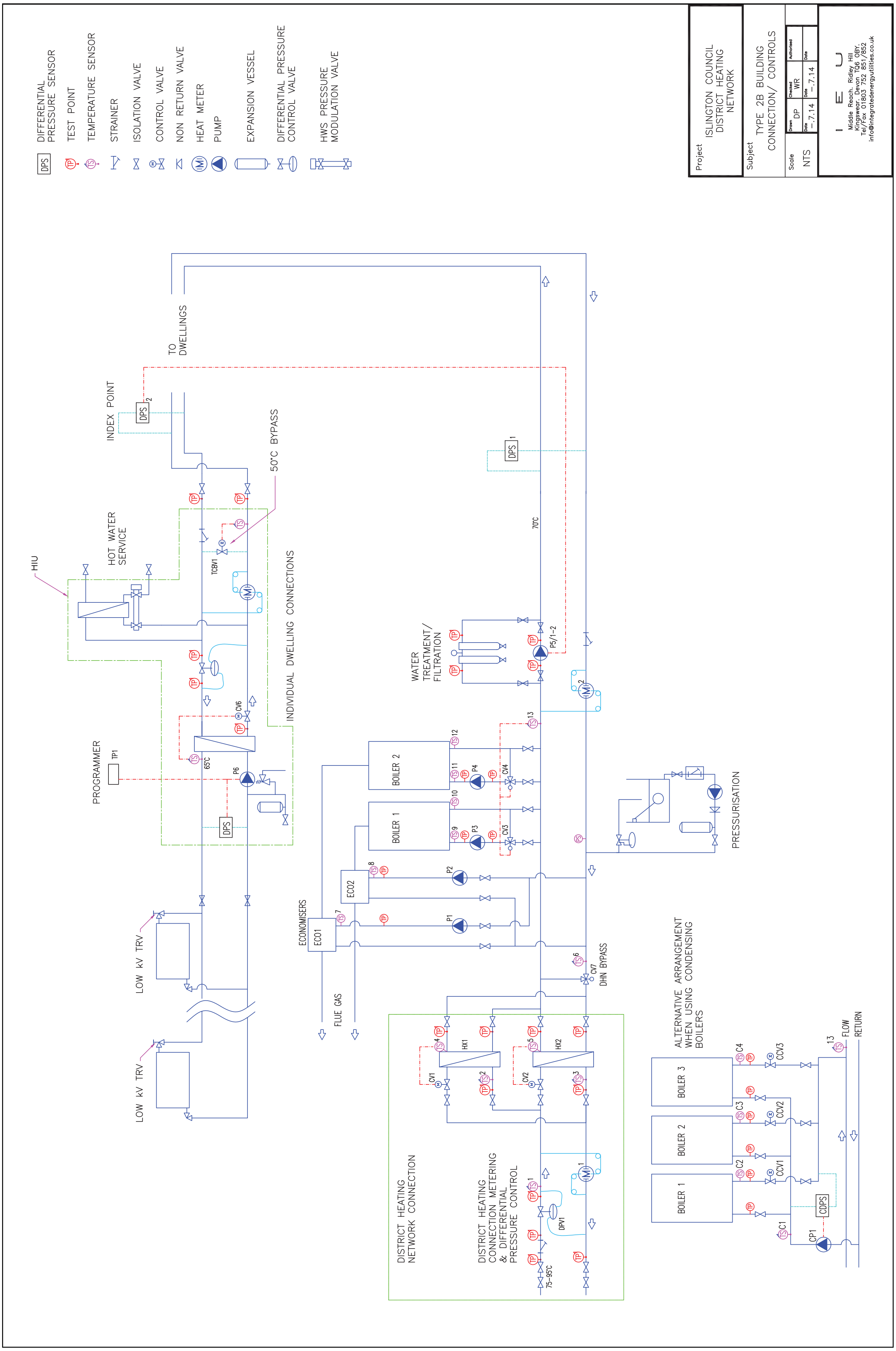

Simplified schematic for illustrative purposes only – see full schematic for detail

## Overview

This represents an alternative solution to 2A, with the critical difference that a dwelling Plate Heat Exhanger (PHEx) is used to provide instantaneous hot water. This scenario might typically be preferred in a new-build private housing context. As with all the scenarios represented in this document, a Building Thermal Substation provides hydraulic separation from the primary distribution network. Boiler plant is retained on the secondary network to provide peak load and standby for this demand only – it cannot currently provide heat back to the primary network. In this case a two-pipe system runs directly to each dwelling. DHW is raised locally from a PHEx, along with space heating from a second PHEx within the HIU. This system is indirect in the sense that there is an HIU incorporating plate heat exchangers within each dwelling.

| Advantages | Disadvantages |
|---|---|
| • From a landlord's perspective separation of responsibility is achieved between landlord and tenant through the use of an HIU containing both 2 PHEx.<br>• Any leaks within the dwelling are automatically contained and limited to the dwelling water quantity.<br>• Buildings with more than 10 dwellings have higher diversity factors for plate heat exchangers than for cylinders. Therefore smaller pipework is required for branches further from the dwelling.<br>• Better flow rates for DHW service.<br>• DHW plate heat exchangers generally provide lower return temperatures than standard cylinders.<br>• Opportunity to use weather compensation control to lower the distribution temperature in milder weather, reducing running costs and promoting low return temperatures. | • The indirectly-connected space heating system raises the return temperatures slightly over directly connected alternatives.<br>• Access may be required within private dwellings to maintain HIUs and private tenants' water system.<br>• Commissioning may be more difficult than in systems proposed for other scenarios. |
| **Do** | **Don't** |
| • Use DHW PHExs with temperature rather than pressure control – these avoid temperature overshoot and therefore reduce the risk of scale buildup.<br>• Use split headers.<br>• Use weather compensation control to lower the distribution temperature in milder weather, reduces running costs and provides low return temperatures.<br>• For larger boilers use separate economiser to achieve condensing operation.<br>• Use modulating distribution pump controlled by differential pressure to maintain temperatures across the boiler.<br>• Use Low Kv TRVs – In combination with DPC valves, radiators then modulate in temperature rather than going hot and cold.<br>• Consider using a Jockey pump to deliver heating energy at low flow rates. | • Use low loss headers.<br>• Use unnecessary bypass arrangements. |

The following provides a recommended schematic pipework layout and control strategy for this scenario. This is a template solution for this scenario; designers can provide alternative solutions but these must be submitted to the Heat Network Operator for review.

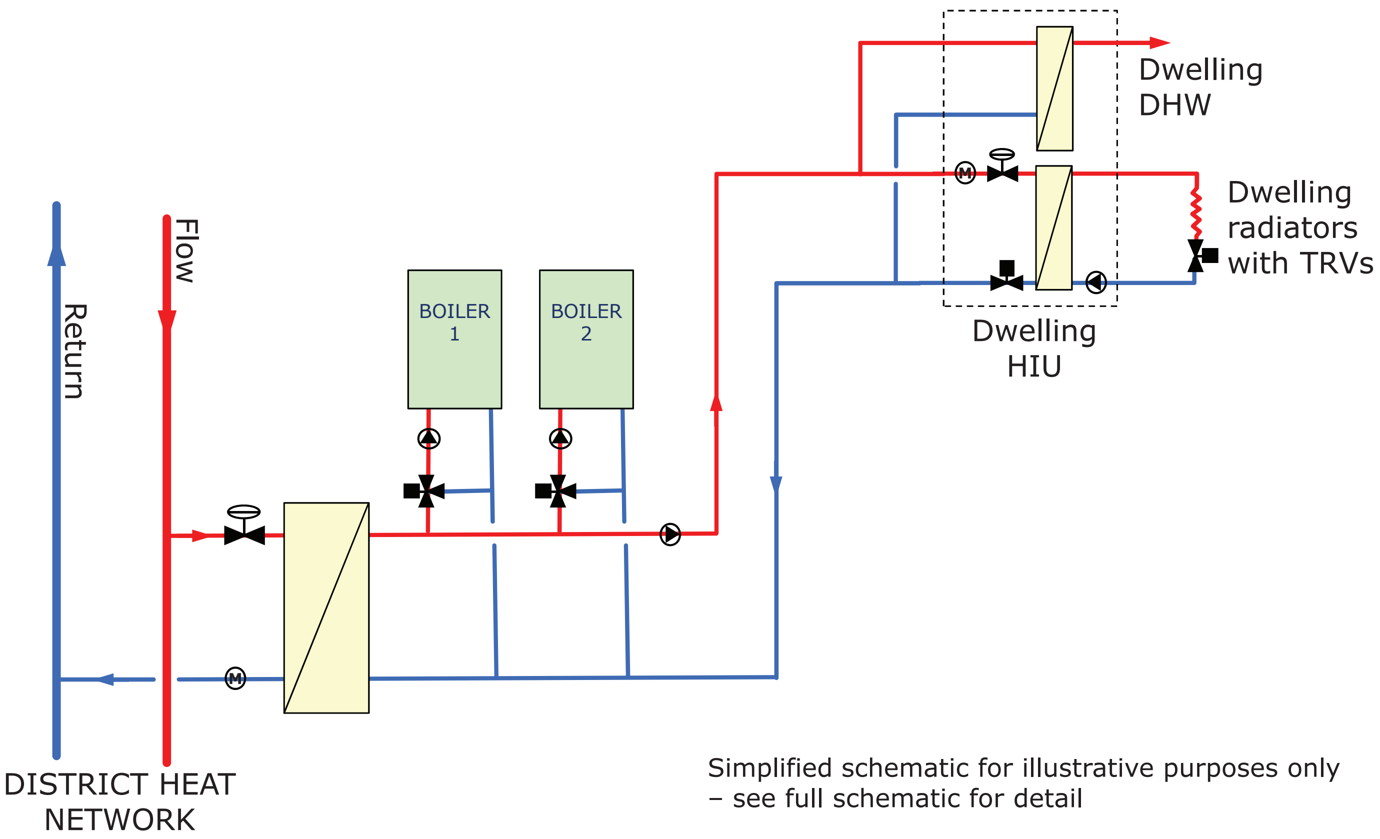


| BUILDING CONNECTION & ADAPTATION ARRANGEMENTS | | | | | |
|---|---|---|---|---|---|
| **TYPE** | **MAIN FEATURE** | **SECONDARY FEATURE** | **EXISTING SCENARIO** | **SPACE HEATING SOLUTION** | **DHW SOLUTION** |
| **2B** | Dwelling Space Heating PHEx [Combined HIU] | Dwelling DHW PHEx [Combined HIU] | Residential - Dwelling Space Heating via PHEx with dwelling DHW PHEx (combined HIU) | Building Thermal Substation AND Local Dwelling HIU's (Space Heating & DHW) | Local instantaneous via HIU |
| **HEATING PLANT ROOM CONTROL STRATEGY** | **District Heating HX temperature and pressure differential control** - CV1&2 are controlled to maintain HX1 & HX2 secondary temperatures as measured by temperature sensors TS4 & TS5 respectively. The differential pressure across the heat exchangers and control valves is controlled by direct action DPS1. Control Valve CV7 shall by-pass the DHN in the event that DHN flow temperature measured by TS1 falls below 60C. | | | | |
| | **Large Boiler [with separate economizer] control** - Each boiler is fitted with a shunt pump designed for e.g. 15C temperature differential at full load. The pumps are switched on with the boiler and switched off with e.g. 5 minute pump over run. When the boilers 1 & 2 are switched on CV3 is controlled in two stages the first to recirculate to achieve a minimum inlet temperature of e.g. 65C as measured by TS9 & TS11 respectively and the second to maintain a system supply temperature of e.g. 70C as measured by TS13. The boilers are brought on in stages, if boiler 1 is unable to meet the required system temperature within a time [say 30 minutes] control valve CV3 is opened fully to the system and Boiler 2 is brought into operation and the system supply temperature measured by TS13 controlled by CV4. Economizer pumps P1 & P2 are switched on and off with the respective boiler shunt pumps. | | | | |
| | **Alternative Small Condensing Boiler control** - boiler circulation pump CP1 is controlled to maintain a fixed differential pressure as measured by sensor CDP1. The pump is switched on when a boiler is switched on. Boiler control valves CCV1-3 open when one boiler is switched on. The boilers will operate under their own control to maintain an outlet temperature. The boilers shall be switched on/off according to the system demand for heat as measured by (70-TS5)*flow rate as measured by M2[l/sec] *4.18 | | | | |
| | **Heat distribution pumps control** - Heat distribution pumps P5 1&2 are controlled by variable speed inverters to maintain a heat distribution system index pressure measured by DPS2 at e.g. 0.6 bar. | | | | |
| **DWELLING CONTROL STRATEGY** | The dwelling primary heating system pressure differential is regulated at 0.2 bar by direct acting DPV. The flow temperature is maintained at a minimum 50C by direct acting thermostically controlled temperature by pass valve TCBV. A temperature programmer TP1 switches the heating circulation pump P7 on/off. Pump P7 to be controlled by sensor DPS3 to maintain a circulating pressure differential at 0.2Bar. The secondary flow temperature to be controlled by direct acting control valve CV6 to maintain a flow temperature at 65C. All the control and the heat meter shall be included within a purpose made heat interface unit HIU. Radiator thermostatic control valves shall be the low Kv type and preferably have wall mounted controls with an actual temperature scale. Domestic thermostats should be of the TPI type to promote close control. Programmers should preferably include optimum start control functions and be linked to boiler room BMS systems. Hot water service is by instantaneous heat exchanger controlled by a direct acting secondary water pressure and temperature control valve. | | | | |

# 9. Scenario 3A – Residential, direct space heating with dwelling DHW cylinder

**Description**

| TYPE | MAIN FEATURE | SECONDARY FEATURE | EXISTING SCENARIO | SPACE HEATING SOLUTION | DHW SOLUTION | METERING SOLUTION |
|---|---|---|---|---|---|---|
| 3A | Direct Space Heating | Dwelling DHW cylinder | Residential - Direct space heating with dwelling DHW cylinder | Building Thermal Substation | Local dwelling storage cylinders | Block metering AND may have individual dwelling meters |




Simplified schematic for illustrative purposes only – see full schematic for detail

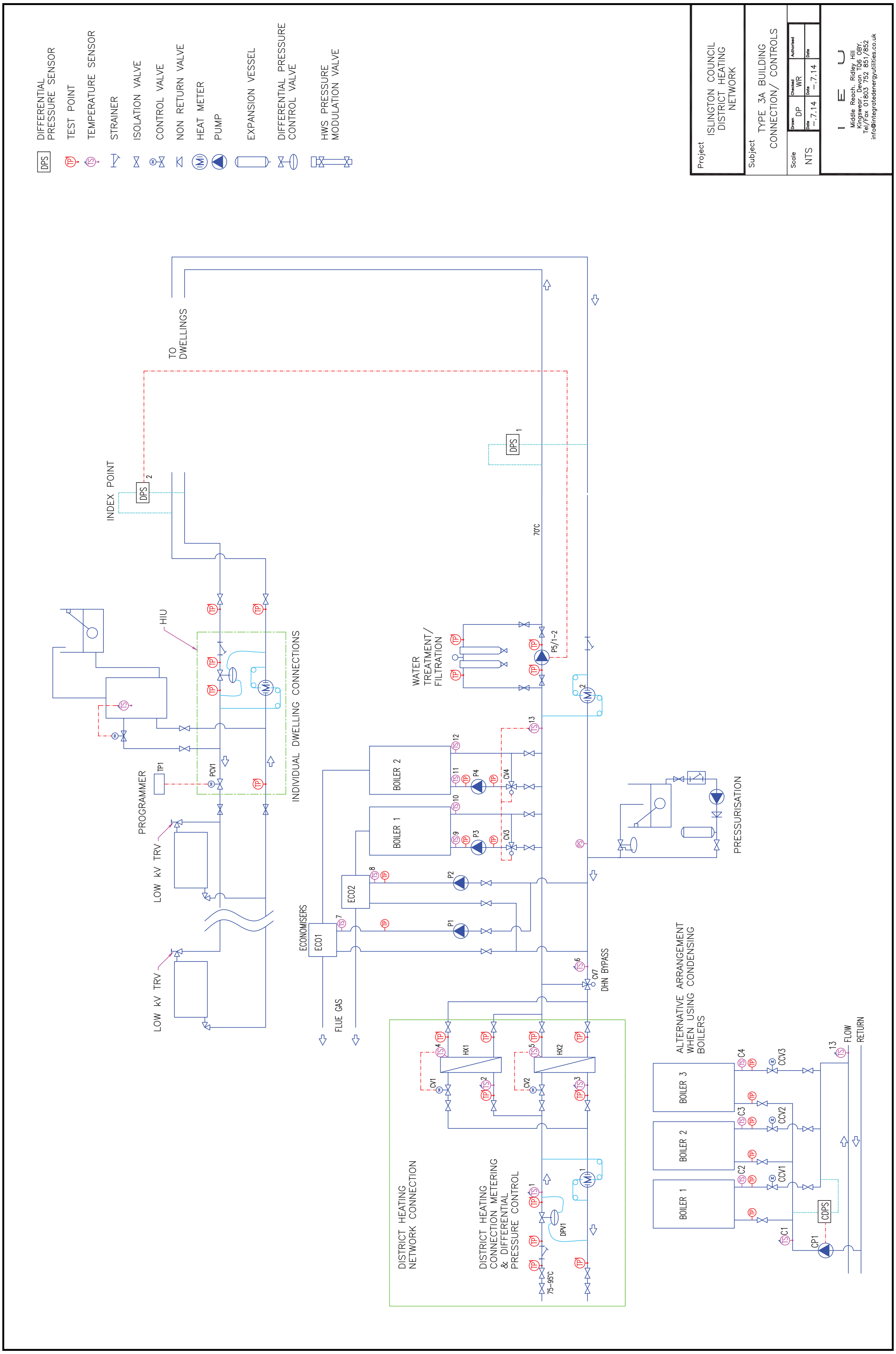
## Overview

This represents the fifth of six solutions to connect a communal residential heating system, with the critical difference from 2A and 2B that space heating is provided directly without the use of a Plate Heat Exchanger (PHEx) in the dwelling. This scenario might typically be found in an existing housing context. As with all the scenarios represented in this document, a Building Thermal Substation provides hydraulic separation from the primary distribution network. Boiler plant is retained on the secondary network to provide peak load and standby for this demand only – it cannot currently provide heat back to the primary network. In this case a two-pipe system runs directly to each dwelling. DHW is raised locally in a cylinder but space heating is provided directly from the primary PHEx (or the boilers). The HIU (if required) does not incorporate plate heat exchangers within each dwelling – only controls, valves and meter. Existing cylinders may use a coil to heat the water, but a local external PHEx may be preferable on dwelling cylinders to achieve low return temperatures.

| Advantages | Disadvantages |
|---|---|
| • The use of DHW cylinders within the dwellings provides backup in case of service interruption.<br>• For a wider discussion of the pros and cons of instantaneous versus stored DHW see Part 1, Section 3.<br>• Direct connection of space heating provides for slightly lower return temperatures. | • DHW cylinders have lower diversity than instantaneous schemes for schemes of 10 dwellings or more and are prone to control problems if sensors become separated from the cylinder.<br>• Additional space requirements for hot water storage. |

| Do | Don't |
|---|---|
| • Provide an appropriate sensor pocket for the DHW cylinder sensor.<br>• Use split headers.<br>• Use weather compensation control to lower the distribution temperature in milder weather, reduces running costs and can help provide low return temperatures.<br>• For larger boilers, use a separate economiser to achieve condensing operation.<br>• Use a modulating distribution pump controlled by differential pressure to maintain temperatures across the boiler.<br>• Use Low Kv TRVs – in combination with DPC valves, radiators then modulate in temperature rather than going hot and cold.<br>• Ensure that any new back-up electric immersion heaters have either a one-hour extension timer or an interlock to stop coincidental operation with the main DHW heating.<br>• Avoid existing electric back-up DHW systems operating at the same time as the main system.<br>• Consider using a Jockey pump to deliver heating energy at low flow rates. | • Use low loss headers.<br>• Use unnecessary bypass arrangements. |

The following provides a recommended schematic pipework layout and control strategy for this scenario. This is a template solution for this scenario; designers can provide alternative solutions but these must be submitted to the Heat Network Operator for review.

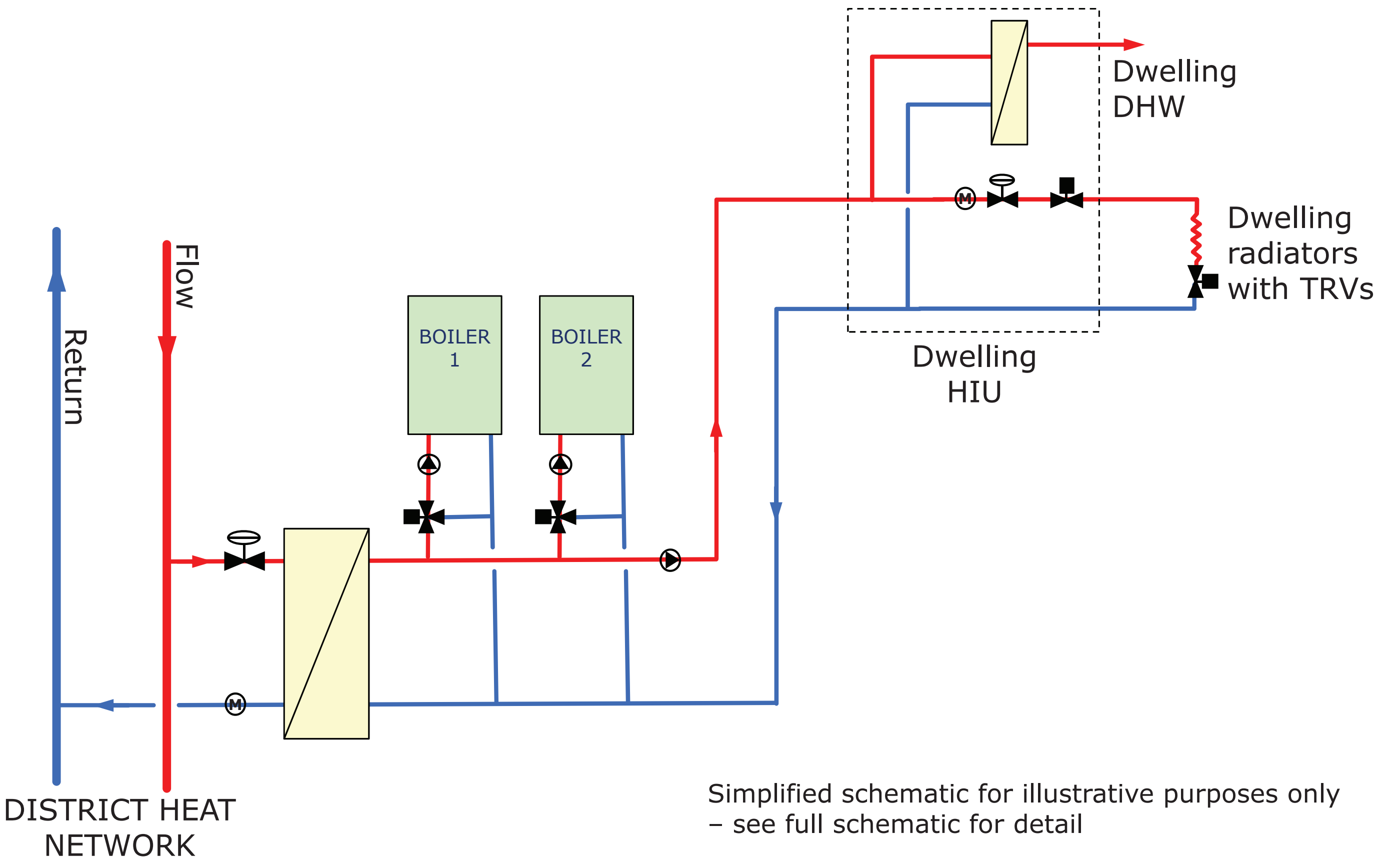


| BUILDING CONNECTION & ADAPTATION ARRANGEMENTS | | | | | |
|---|---|---|---|---|---|
| **TYPE** | **MAIN FEATURE** | **SECONDARY FEATURE** | **EXISTING SCENARIO** | **SPACE HEATING SOLUTION** | **DHW SOLUTION** |
| **3A** | Direct Space Heating | Dwelling DHW cylinder | Residential - Direct space heating with dwelling DHW cylinder | Building Thermal Substation | Local dwelling storage cylinders |
| **HEATING PLANT ROOM CONTROL STRATEGY** | **District Heating HX temperature and pressure differential control** - CV1&2 are controlled to maintain HX1 & HX2 secondary temperatures as measured by temperature sensors TS4 & TS5 respectively. The differential pressure across the heat exchangers and control valves is controlled by direct action DPS1. Control Valve CV7 shall by-pass the DHN in the event that DHN flow temperature measured by TS1 falls below 60C. | | | | |
| | **Large Boiler [with separate economizer] control** - Each boiler is fitted with a shunt pump designed for e.g. 15C temperature differential at full load. The pumps are switched on with the boiler and switched off with e.g. 5 minute pump over run. When the boilers 1 & 2 are switched on CV3 is controlled in two stages the first to recirculate to achieve a minimum inlet temperature of e.g. 65C as measured by TS9 & TS11 respectively and the second to maintain a system supply temperature of e.g. 70C as measured by TS13. The boilers are brought on in stages, if boiler 1 is unable to meet the required system temperature within a time [say 30 minutes] control valve CV3 is opened fully to the system and Boiler 2 is brought into operation and the system supply temperature measured by TS13 controlled by CV4. Economizer pumps P1 & P2 are switched on and off with the respective boiler shunt pumps. | | | | |
| | **Alternative Small Condensing Boiler control** - boiler circulation pump CP1 is controlled to maintain a fixed differential pressure as measured by sensor CDP1. The pump is switched on when a boiler is switched on. Boiler control valves CCV1-3 open when one boiler is switched on. The boilers will operate under their own control to maintain an outlet temperature. The boilers shall be switched on/off according to the system demand for heat as measured by (70-TS5)*flow rate as measured by M2[l/sec] *4.18 | | | | |
| | **Heat Distribution System HX3 temperature control** - CV5 is controlled to maintain HX3 secondary temperatures as measured by temperature sensors TS14. | | | | |
| **DWELLING CONTROL STRATEGY** | The dwelling heating and hot water service system pressure differential is regulated at 0.2 bar by direct acting DPV. A temperature programmer TP1 switches control valve PCV1 on/off. All the control and the heat metering equipment shall be included within a purpose made heat interface unit HIU. Radiator thermostatic control valves shall be the low Kv type and preferably have wall mounted controls with an actual temperature scale. Domestic thermostats should be of the TPI type to promote close control. Programmers should preferably include optimum start control functions and be linked to boiler room BMS systems. The dwelling hot water service is by individual storage system a direct acting two port control valve is controlled by a temperature immersion sensor to maintain the cylinder temperature at 60C. | | | | |

# 10. Scenario 3B – Residential, direct space heating with dwelling DHW PHEx (combined HIU)

## Description

| TYPE | MAIN FEATURE | SECONDARY FEATURE | EXISTING SCENARIO | SPACE HEATING SOLUTION | DHW SOLUTION | METERING SOLUTION |
|---|---|---|---|---|---|---|
| 3B | Direct Space Heating [Combined HIU] | Dwelling DHW PHEx [Combined HIU] | Residential - Direct space heating with dwelling DHW PHEx (Combined HIU) | Building Thermal Substation | Local dwelling instantaneous Plate Heat Exchangers | Block metering AND may have individual dwelling meters in HIU's |




Simplified schematic for illustrative purposes only – see full schematic for detail

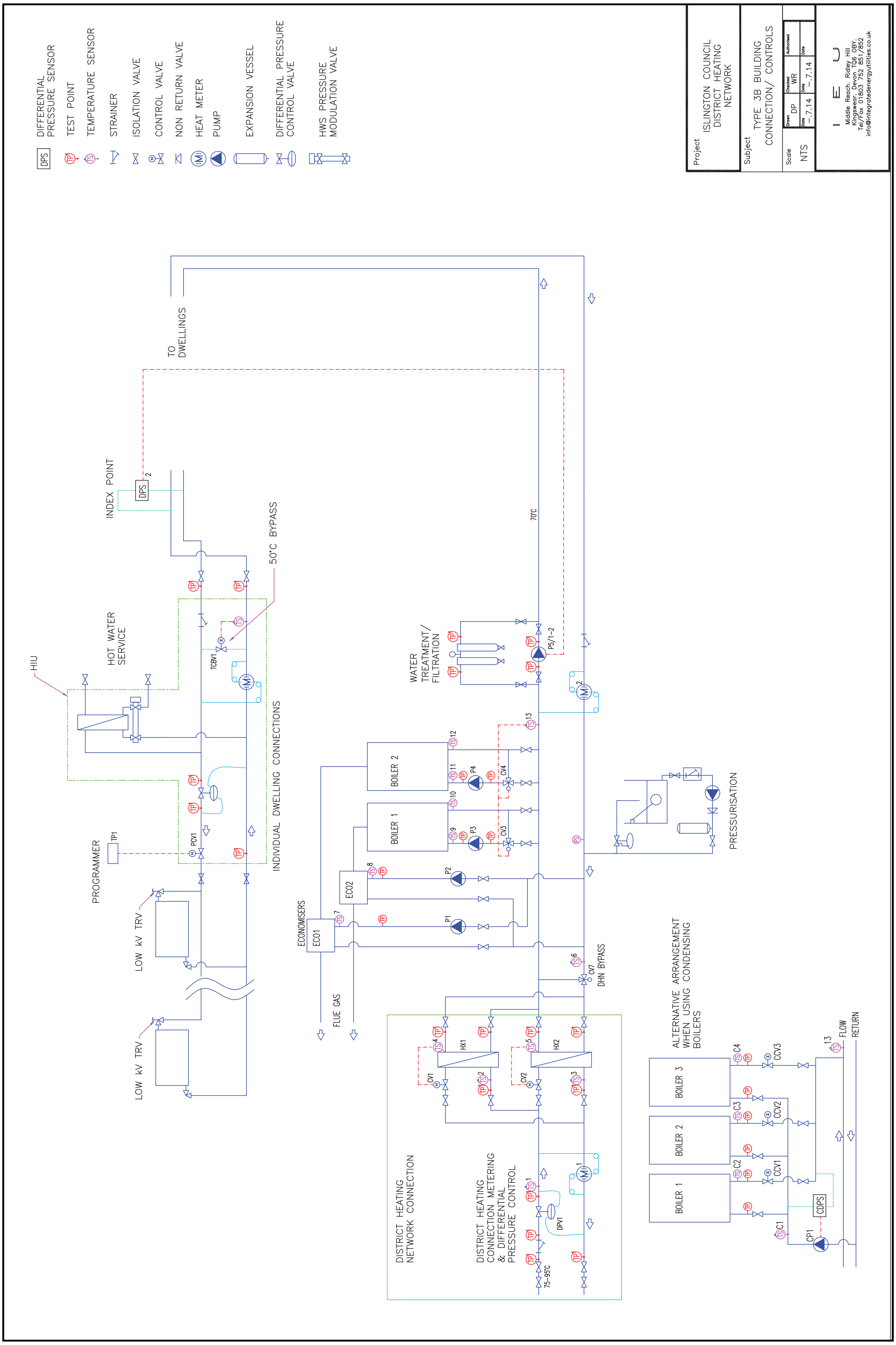
## Overview

This represents an alternative solution to 3A, the critical difference being that a PHEx replaces the DHW in the dwelling. This scenario might typically be found in a new housing context. As with all the scenarios represented in this document, a Building Thermal Substation provides hydraulic separation from the primary distribution network. Boiler plant is retained on the secondary network to provide peak load and standby for this demand only – it cannot currently provide heat back to the primary network. In this case a two-pipe system runs directly to each dwelling. DHW is raised locally from a PHEx and space heating is provided directly from the primary PHEx (or the boilers).

Packaged HIUs provide an ideal solution for this design. These HIUs usually have a thermally actuated valve controlled by a programmer - but with a temperature setting on the programmer effectively providing a set-back temperature below which the dwelling temperature cannot fall.

| Advantages | Disadvantages |
|---|---|
| • Buildings with more than 10 dwellings have higher diversity factors for plate heat exchangers than for cylinders. Therefore smaller pipework is required for branches further from the dwelling.<br>• Minimisation of heat losses in the dwelling due to lower runs of permanently hot pipework.<br>• Better flow rates for DHW service.<br>• This configuration potentially achieves the lowest return water temperatures because of direct connection of space heating and DHW plate heat exchangers, which generally provide lower return temperatures than standard cylinders. | • No electric immersion or hot water storage cylinder backup in case of interruption of the heating system. |
| **Do** | **Don't** |
| • Use DHW PHExs with temperature rather than pressure control – these avoid temperature overshoot and therefore reduce the risk of scale build-up.<br>• Use split headers.<br>• Use weather compensation control to lower the distribution temperature in milder weather, reduces running costs and can help provide low return temperatures.<br>• For larger boilers, use a separate economiser to achieve condensing operation.<br>• Use a modulating distribution pump controlled by differential pressure to maintain temperatures across the boiler.<br>• Use Low Kv TRVs – in combination with DPC valves, radiators then modulate in temperature rather than going hot and cold.<br>• Consider using a Jockey pump to deliver heating energy at low flow rates. | • Use low loss headers.<br>• Use unnecessary bypass arrangements. |

The following provides a recommended schematic pipework layout and control strategy for this scenario. This is a template solution for this scenario; designers can provide alternative solutions but these must be submitted to the Heat Network Operator for review.



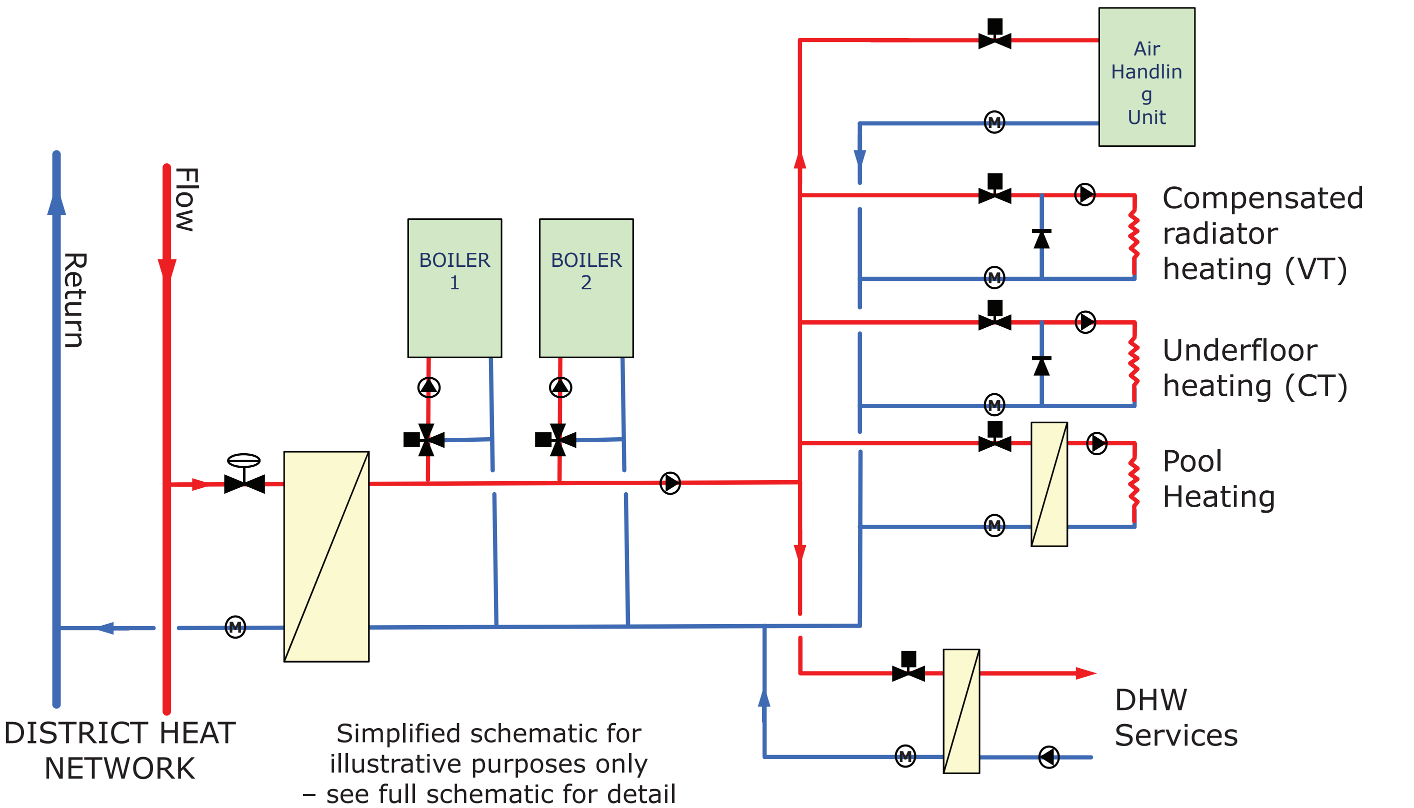
| BUILDING CONNECTION & ADAPTATION ARRANGEMENTS | | | | | |
|---|---|---|---|---|---|
| **TYPE** | **MAIN FEATURE** | **SECONDARY FEATURE** | **EXISTING SCENARIO** | **SPACE HEATING SOLUTION** | **DHW SOLUTION** |
| **3B** | Direct Space Heating [Combined HIU] | Dwelling DHW PHEx [Combined HIU] | Residential - Direct space heating with dwelling DHW PHEx (Combined HIU) | Building Thermal Substation | Local dwelling instantaneous Plate Heat Exchangers |
| **HEATING PLANT ROOM CONTROL STRATEGY** | **District Heating HX temperature and pressure differential control** - CV1&2 are controlled to maintain HX1 & HX2 secondary temperatures as measured by temperature sensors TS4 & TS5 respectively. The differential pressure across the heat exchangers and control valves is controlled by direct action DPS1. Control Valve CV7 shall by-pass the DHN in the event that DHN flow temperature measured by TS1 falls below 60C.<br><br>**Large Boiler [with separate economizer] control** - Each boiler is fitted with a shunt pump designed for e.g. 15C temperature differential at full load. The pumps are switched on with the boiler and switched off with e.g. 5 minute pump over run. When the boilers 1 & 2 are switched on CV3 is controlled in two stages the first to recirculate to achieve a minimum inlet temperature of e.g. 65C as measured by TS9 & TS11 respectively and the second to maintain a system supply temperature of 70C as measured by TS13. The boilers are brought on in stages, if boiler 1 is unable to meet the required system temperature within a time [say 30 minutes] control valve CV3 is opened fully to the system and Boiler 2 is brought into operation and the system supply temperature measured by TS13 controlled by CV4. Economizer pumps P1 & P2 are switched on and off with the respective boiler shunt pumps.<br><br>**Alternative Small Condensing Boiler control** - boiler circulation pump CP1 is controlled to maintain a fixed differential pressure as measured by sensor CDP1. The pump is switched on when a boiler is switched on. Boiler control valves CCV1-3 open when one boiler is switched on. The boilers will operate under their own control to maintain an outlet temperature. The boilers shall be switched on/off according to the system demand for heat as measured by (70-TS5)*flow rate as measured by M2[l/sec] *4.18<br><br>**Heat distribution pumps control** - Heat distribution pumps P5 1&2 are controlled by variable speed inverters to maintain a heat distribution system index pressure measured by DPS2 at e.g. 0.6 bar. | | | | |
| **DWELLING CONTROL STRATEGY** | The dwelling heating system pressure differential is regulated at 0.2 bar by direct acting DPV. The flow temperature is maintained at a minimum 50C by direct acting thermostatically controlled temperature by pass valve TCBV. A temperature programmer TP1 switches the heating circulation valve on/off. All the control and the heat meter shall be included within a purpose made heat interface unit HIU. Radiator thermostatic control valves shall be the low Kv type and preferably have wall mounted controls with an actual temperature scale. Domestic thermostats should be of the TPI type to promote close control. Programmers should preferably include optimum start control functions and be linked to boiler room BMS systems. Hot water service is by instantaneous heat exchanger controlled by a direct acting secondary water pressure and temperature control valve. | | | | |

# 11. Scenario 4 – Non Residential, direct Non-domestic heating and centralised DHW

## Description

Commercial heating systems – i.e. central boilers and Building Thermal Substation supplying various constant temperature (CT), variable temperature (VT) and low temperature (LT) end users and central DHW calorifiers. This is similar to scenario 1B, but with tertiary solutions for CT, VT and LT.

| TYPE | MAIN FEATURE | SECONDARY FEATURE | EXISTING SCENARIO | SPACE HEATING SOLUTION | DHW SOLUTION | METERING SOLUTION |
|---|---|---|---|---|---|---|
| 4 | Direct Space Heating | Centralised DHW PHEx | Non Residential - direct commercial space heating and centralised DHW | Building Thermal Substation but with tertiary solutions for CT, VT and LT | DHW Thermal substation | Block metering only |



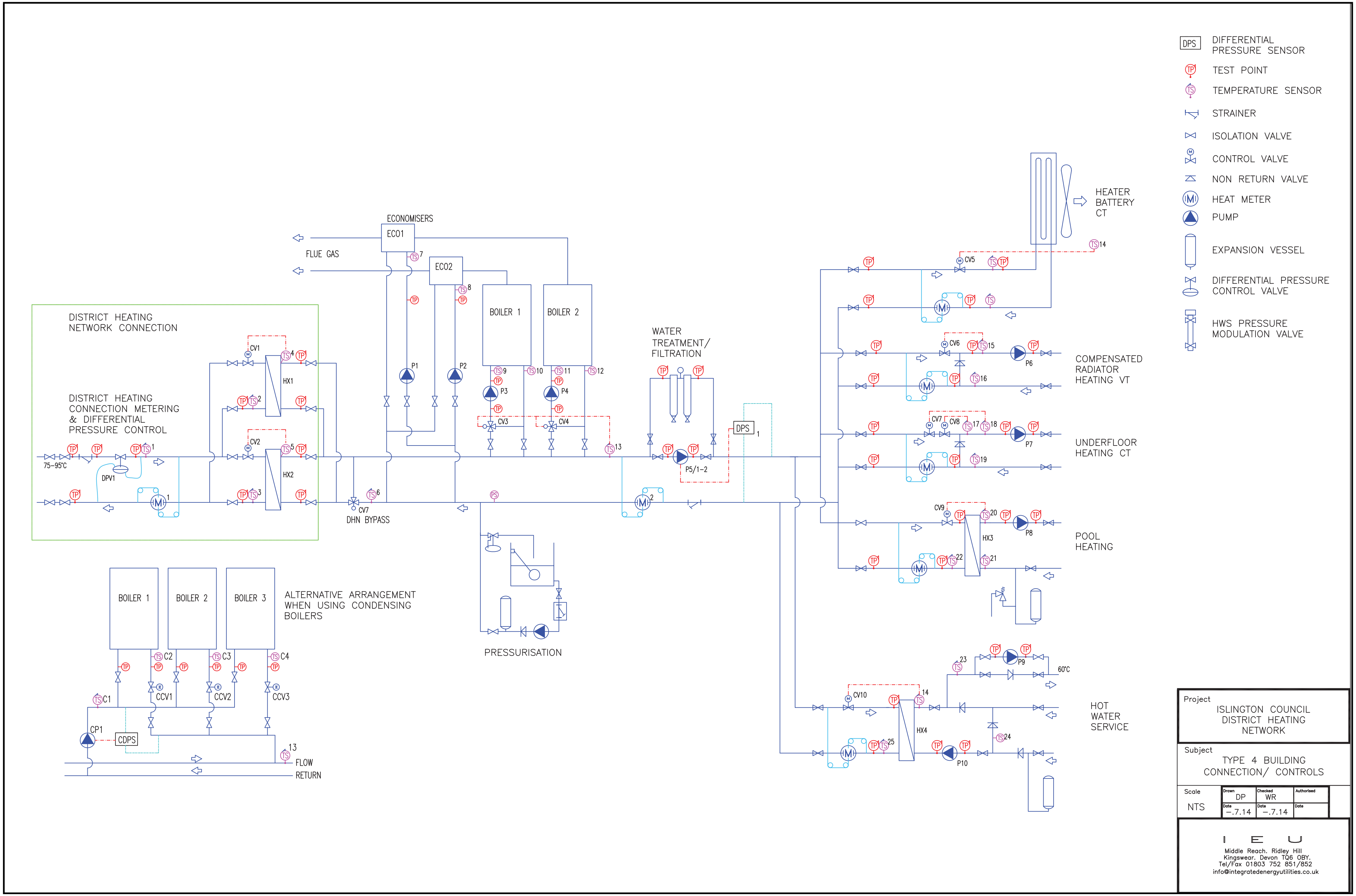
## Overview

Commercial heating systems are by their nature diverse. This scenario represents a generic solution to the types of variable, constant and low temperature loads (fan coil units, compensated radiator circuits, underfloor heating, pool heating and hot water service) that might be seen in commercial systems.

As with all the scenarios represented in this document, a Building Thermal Substation provides hydraulic separation from the primary distribution network. Boiler plant is retained on the secondary network to provide peak load and standby for this demand only – it cannot currently provide heat back to the primary network.

| Do | Don’t |
|---|---|
| • Use split headers.<br>• Use a 2 port injection valve for weather compensation rather than a 3 port valve. It has better regulating characteristics than 3 port valve.<br>• For larger boilers, use a separate economiser to achieve condensing operation.<br>• Use a modulating distribution pump controlled by differential pressure to maintain temperatures across the boiler.<br>• Use Low Kv TRVs – in combination with DPC valves, radiators then modulate in temperature rather than going hot and cold.<br>• Where possible on variable temperature circuits, use weather compensation control to lower the distribution temperature in milder weather, reduces running costs and can promote low return temperatures.<br>• Consider using a Jockey pump to deliver heating energy at low flow rates. | • Use low loss headers.<br>• Use 3 port injection valves for weather compensation. 3 port valves don’t cope well with pressure.<br>• Use fan convectors or sill line heaters / trench heaters where practicable – they require a high water flow. |

The following provides a recommended schematic pipework layout and control strategy for this scenario. This is a template solution for this scenario; designers can provide alternative solutions but these must be submitted to the Heat Network Operator for review.


DIFFERENTIAL PRESSURE SENSOR
TEST POINT
TEMPERATURE SENSOR
STRAINER
ISOLATION VALVE
CONTROL VALVE
NON RETURN VALVE
HEAT METER
PUMP
EXPANSION VESSEL
DIFFERENTIAL PRESSURE CONTROL VALVE
HWS PRESSURE MODULATION VALVE
DISTRICT HEATING NETWORK CONNECTION
DISTRICT HEATING CONNECTION METERING & DIFFERENTIAL PRESSURE CONTROL
75–95°C
DPV1
HX1
HX2
CV1
CV2
DHN BYPASS
FLUE GAS
ECONOMISERS
ECO1
ECO2
BOILER 1
BOILER 2
P1
P2
P3
P4
CV3
CV4
WATER TREATMENT/ FILTRATION
P5/1–2
DPS
PRESSURISATION
ALTERNATIVE ARRANGEMENT WHEN USING CONDENSING BOILERS
BOILER 3
CCV1
CCV2
CCV3
CP1
CDPS
FLOW
RETURN
HEATER BATTERY CT
COMPENSATED RADIATOR HEATING VT
UNDERFLOOR HEATING CT
POOL HEATING
HOT WATER SERVICE
HX3
HX4
CV5
CV6
CV7
CV8
CV9
CV10
P6
P7
P8
P9
P10
60°C
Project
ISLINGTON COUNCIL DISTRICT HEATING NETWORK
Subject
TYPE 4 BUILDING CONNECTION/ CONTROLS
Scale
NTS
Drawn
DP
Checked
WR
Authorised
Date
–.7.14
Date
–.7.14
Date
I E U
Middle Reach, Ridley Hill
Kingswear, Devon TQ6 0BY.
Tel/Fax 01803 752 851/852
info@integratedenergyutilities.co.uk

| BUILDING CONNECTION & ADAPTATION ARRANGEMENTS | | | | | |
|---|---|---|---|---|---|
| **TYPE** | **MAIN FEATURE** | **SECONDARY FEATURE** | **EXISTING SCENARIO** | **SPACE HEATING SOLUTION** | **DHW SOLUTION** |
| **4** | Direct Space Heating | Centralised DHW PHEx | Non Residential - Direct commercial space heating and centralised DHW | Building Thermal Substation but with tertiary solutions for CT, VT and LT | DHW Thermal substation |
| **HEATING PLANT ROOM CONTROL STRATEGY** | **District Heating HX temperature and pressure differential control** - CV1&2 are controlled to maintain HX1 & HX2 secondary temperatures as measured by temperature sensors TS4 & TS5 respectively. The differential pressure across the heat exchangers and control valves is controlled by direct action DPS1. Control Valve CV7 shall by-pass the DHN in the event that DHN flow temperature measured by TS1 falls below 60C. | | | | |
| | **Large Boiler [with separate economizer] control** - Each boiler is fitted with a shunt pump designed for e.g. 15C temperature differential at full load. The pumps are switched on with the boiler and switched off with e.g. 5 minute pump over run. When the boilers 1 & 2 are switched on CV3 is controlled in two stages the first to recirculate to achieve a minimum inlet temperature of e.g. 65C as measured by TS9 & TS11 respectively and the second to maintain a system supply temperature of 70C as measured by TS13. The boilers are brought on in stages, if boiler 1 is unable to meet the required system temperature within a time [say 30 minutes] control valve CV3 is opened fully to the system and Boiler 2 is brought into operation and the system supply temperature measured by TS13 controlled by CV4. Economizer pumps P1 & P2 are switched on and off with the respective boiler shunt pumps. [All controls to be linked to boiler room BMS systems] | | | | |
| | **Alternative Small Condensing Boiler control** - boiler circulation pump CP1 is controlled to maintain a fixed differential pressure as measured by sensor CDP1. The pump is switched on when a boiler is switched on. Boiler control valves CCV1-3 open when one boiler is switched on. The boilers will operate under their own control to maintain an outlet temperature. The boilers shall be switched on/off according to the system demand for heat as measured by (70-TS5)*flow rate as measured by M2[l/sec] *4.18. [All controls to be linked to boiler room BMS systems] | | | | |
| | **Heat distribution system pumps control** - Pumps P5 1&2 are controlled by variable speed inverters to maintain a fixed differential pressure e.g. 1 bar, as measured by DPS1 | | | | |
| | **Constant flow temperature air heating circuit** - CV5 is controlled to maintain leaving air temperature as measured by TS14 | | | | |
| | **Compensated temperature radiator circuit** - CV6 is controlled to maintain compensated flow temperature as measured by TS15 | | | | |
| | **Underfloor heating circuit** - CV7 is controlled to maintain fixed flow temperature as measured by TS18. CV8 will close and trip when the flow temperature measured by TS17 exceeds the system temperature high limit. | | | | |
| | **Pool heating circuit** - CV9 is controlled to maintain fixed HX3 flow temperature as measured by TS20. | | | | |
| | **Hot Water Service heating control** - CV10 is controlled to maintain a hot water HX4 secondary outlet temperature of e.g. 65C, as measured by temperature sensor TS24. | | | | |

# 12. Alternative boiler arrangements

## 12.1 Condensing boilers

If condensing boilers are being employed. the alternative arrangement shown in Figure 11.1 should be considered. The use of bypasses should be minimised – where instantaneous heat exchangers are used, the standby flow will normally result in a sufficient bypass flow. Fixed bypasses should not be used.

Any bypasses installed should be temperature controlled, so that the bypass only operates when flow temperatures are below a minimum set point. Minimum flow bypasses to prevent pumps from operating at zero flow should be installed across the pump, and appropriately controlled to open only at low flows, and to recirculate the required volumes around the pump only.

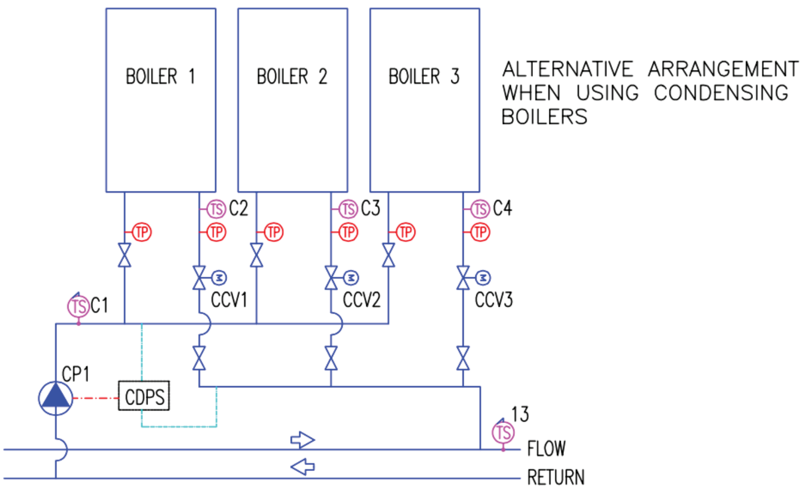



**Figure 11.1 Alternative solution when using condensing boilers**

## 12.2 Larger boilers

If larger boilers are being employed (perhaps above 1000kW total output), the alternative arrangement shown in Figure 11.2 should be considered.

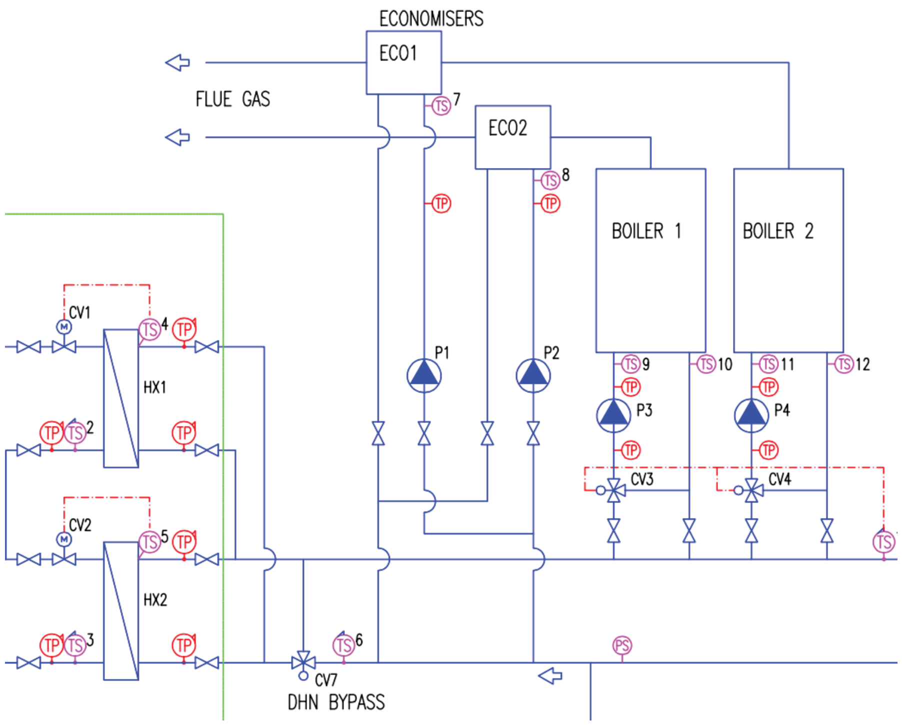



**Figure 11.2 Alternative solution when using larger boilers**

# 13. Technical specifications

The following sets out technical specification recommendations for connections to district heating networks in Islington. Connections to all district heating schemes should follow the minimum standards set out in the CIBSE/ADE CP1 Heat Networks Code of Practice.[4] Where possible, connections should also aim to achieve best practice requirements set out in the Code of Practice. All new-build and retrofit designs must meet the current Building Regulations in particular the requirements set out in Part 1 and the supporting Domestic and Non-Domestic Building Services Compliance Guides.

Works undertaken in making a connection should follow the "Plan of Work" shown in the Code of Practice[5] to ensure that all stages of the process meet the minimum requirements. Where possible and appropriate, a trained heat network professional should be used to oversee the process.

[4] CIBSE/ADE CP1 Heat Networks Code of Practice - raising standards for heat supply (2015)
[5] CIBSE/ADE CP1 Heat Networks Code of Practice - raising standards for heat supply (2015)

## 13.1 Sizing of plant and network

It is essential to avoid oversizing plant and pipework in order to enhance efficiency and minimise heat losses. Designers are often naturally cautious and this can give rise to conservative designs that are more costly and have lower performance.

**Space heating load estimation**

**Existing buildings** – peak demands should be assessed by the customer from a combination of data on fuel use (accounting for system efficiency), existing boiler use and building simulation modelling or other calculation of heat losses as appropriate. This assessment should be supported by the Heat Network Operator, who may be able to use data from monitoring demands at similar buildings to assist.

Space heating consumption for each month should be estimated by the customer (in conjunction with the heat network operator) from fuel or heat meter readings, together with a degree day analysis to produce heat consumption figures for each month for an average year taking into account of the location of the building, the required internal space temperature and an appropriate baseline temperature for the building. Sample dwelling types should be used where necessary to determine peak heat demands and annual consumptions for space heating and hot water, and then extrapolated for the whole area/load. Where possible, existing buildings should be monitored for a year prior to connection in order to determine the actual heating demand.

**New non-domestic buildings** – heat demand should be estimated using modelling software and by using the guidance in CIBSE Guide F,[6] TM46, [7] TM54[8] or other appropriate methodologies. Where available this should include other sources of benchmark data obtained from similar operational schemes.

**New dwellings** – heat demand should be estimated using standard design calculation methodologies like SAP, based on the proposed fabric standards.

**Domestic Hot Water load estimation**

The peak demands for the domestic hot water service, and where instantaneous hot water heat exchangers are used, should be diversified using one of the diversity curves in Figure 12.1.

The widely used diversity curve from the Danish standard DS439,[9] as shown in CIBSE/ADE CP1 Heat Networks Code of Practice, is derived from the following equation (shown overleaf):

[6] Energy Efficiency in Buildings - CIBSE Guide F (CIBSE) (2012)
[7] Energy Benchmarks – CIBSE TM46 (CIBSE) (2008)
[8] TM54 - Evaluating Operational Energy Performance of Buildings at the Design Stage (CIBSE) (2013)
[9] Dansk Standard DS 439: Code of Practice for domestic water supply installations (2009)

$P_{max} = 1.19 * N + 18.8 * N^{0.5} + 17.6$ (kW)

Where:

- Pmax is the total heat rate required for DHW production for the group of dwellings
- N is the number of 'normal' dwellings

Putting N=1 shows the heat rate for a single dwelling as 37.5kW which is fairly typical. However, the diversity factors will be similar if larger DHW heat exchangers are used. For 1,000 dwellings the diversified heat demand reduces to 1.8kW per dwelling.

Alternatively, where the designer has access to measured demand data from sites of a similar type, a diversity factor derived from such measurements may be used.

CIBSE/ADE CP1[10] provides more detail on the definition of the term 'normal' dwelling.

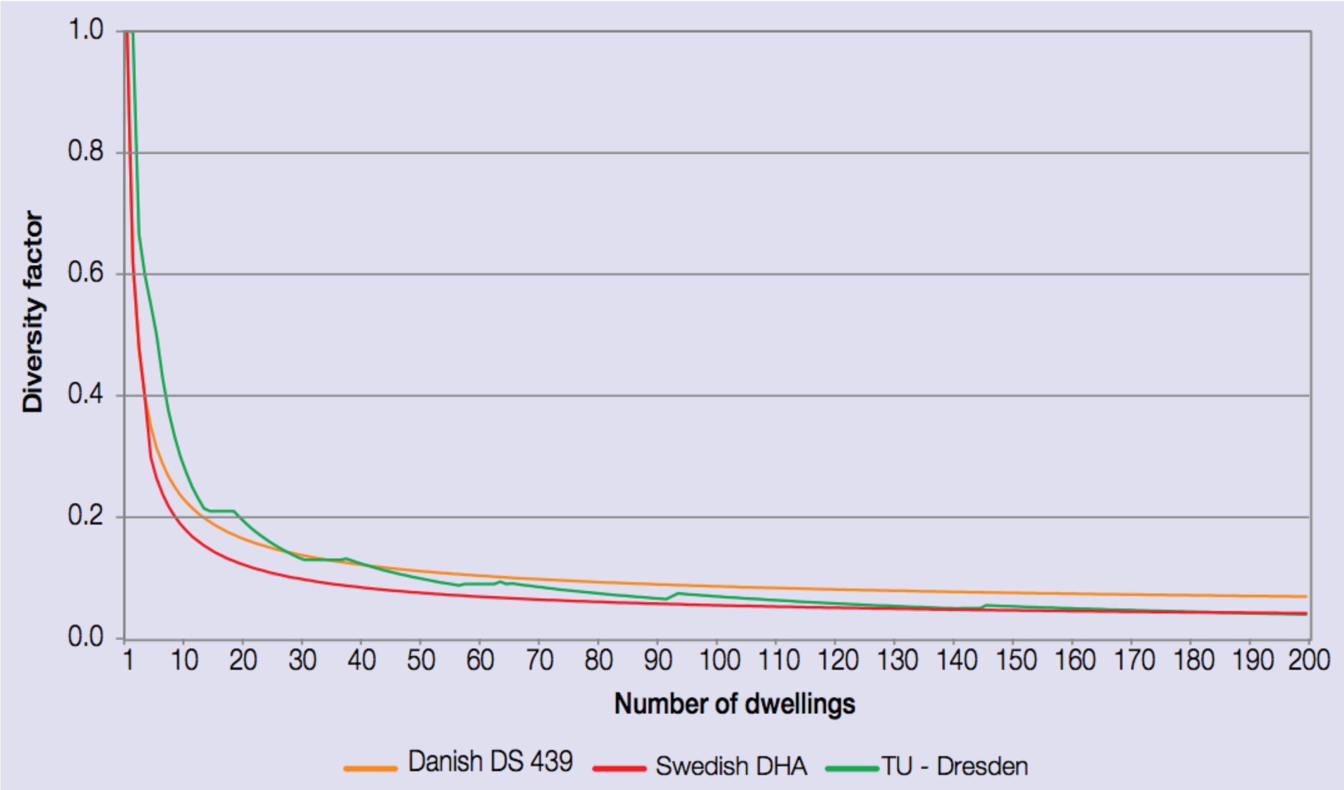



**Figure 12.1 – Diversity factors for instantaneous domestic hot water systems for dwellings (with acknowledgement to SAV Ltd)**

Note: For new residential buildings with more than 200 average-size dwellings, diversified demand has been typically found to be less than 3kW per dwelling for space heating and 2kW per dwelling for DHW heating. If calculations indicate otherwise then a further review should be carried out to check on the assumptions used.

[10] CIBSE/ADE CP1 Heat Networks Code of Practice – raising standards for heat supply (2015)

## 13.2 Pipework design

When designing the heat distribution system within a building, the primary aim should be to minimise the length of pipework. In blocks of flats this will typically require more vertical risers so that the use of horizontal distribution pipework within corridors is minimised.

Where new secondary systems are to be installed, these should be designed for low temperature operation, maximum temperatures of 70°C flow with 40°C return from space heating circuits and 25°C from instantaneous DHW heat exchangers.

The use of bypasses should be minimised – where instantaneous heat exchangers are used, the standby flow will normally result in a sufficient bypass flow. Fixed bypasses should not be used and any bypasses should be temperature controlled so that the bypass only operates when flow temperatures are below a minimum set point.

Bypass flows within the dwelling Hydraulic Interface Unit (HIU) to maintain the DHW instantaneous heat exchanger in readiness should be temperature controlled so that return temperatures are at least 5°C below the outlet (tap) water set-point.

The risk of overheating in summer should be assessed and alternative pipe routes should be selected to minimise this or additional insulation should be specified.

Where the heat network runs in corridors, a calculation of all internal gains including pipe heat losses should be carried out and suitable provision made for ventilation of these corridors to avoid unacceptable internal temperatures in summer. Best practice would be to avoid the use of any distribution pipework in corridors and using shared risers and hence minimise branch lengths into dwellings. Also, controllable ventilation should be provided to risers so that heat losses provide useful heat gain in winter but would be vented outside the building in summer to limit overheating as far as possible.

Pipework routes should be selected to minimise the length of the network to reduce both capital costs and heat losses. Routes should provide a minimum separation distance of 0.6m from adjacent services to reduce the risk of third party damage to either the heat mains or other utilities. Heating pipework should not be run adjacent or below cold water pipework.

Existing utility service plans should be reviewed and routes should be selected to avoid major known existing utility services or areas where services are known to be congested.

Routes through service areas of the connected buildings should be identified to reduce the costs associated with any buried network. Where pipework needs to be routed externally, discussions with the Planning Department (especially where running pipework along the side of a building) and Highways Department in the local authority and other utility companies should be held at an early stage, to identify constraints and opportunities to co-ordinate the heat network installation with other works that may be planned, e.g. re-surfacing of roads, other utility works etc.

Please note that when connecting to Bunhill Heat and Power, the Islington Heat Network Operator (IHNO) will install pipework up to the District Heating thermal substation.

An initial pipe-sizing calculation should be carried out using the guidelines on typical flow velocities for steel pipes in Table 12.1.

| Pipe size ID (mm) (for EN253 pipe) | Typical velocity (m/s) |
|---|---|
| 54.5 | 0.85 |
| 107.1 | 1.2 |
| 160.3 | 1.6 |
| 210.1 | 1.9 |
| 263.0 | 2.2 |
| 312.7 | 2.5 |

**Table 12.1 Recommended flow velocities for steel pipes**

Where pipe systems other than steel are to be used, the designer should verify that a minimum 30 year warranty is available for the operating temperatures and pressures that are expected.

Before completing a heat network connection feasibility study, please contact the heat network operator to discuss estimated connection costs.

Leak detection – a surveillance system in accordance with EN 14419[11] should be specified for steel pipe systems. Isolating valves for residents' emergency use should be located within the property immediately after the service enters the property (or just outside) so that these can be easily shut off by the resident in the event of a leak within the property.

[11] BS EN 14419 District heating pipes. Preinsulated bonded pipe systems for directly buried hot water networks. Surveillance systems (2009)

## 13.3 Pipework insulation specifications

Achieving low heat losses from district heating is essential in achieving a low-carbon, cost-effective system. This applies to the heat network itself and to pipework and storage vessels inside the building.

There is evidence that network losses in some schemes are relatively high, especially for distribution systems within newly-constructed apartment blocks. High heat losses will lead to higher carbon emissions, higher operating costs and a higher risk of overheating so designers need to consider ways to reduce the heat losses as far as practical.

All pipework, both buried and external, should meet the insulation standards set out in BS EN 253 (2009),[12] BS EN 15632:2[13] and 3 (2010)[14] and BS EN 15632:4 (2009),[15] or BS EN 15698:1 (2009).[16]

Steel pipe to EN 253 is typically available with three different insulation thicknesses (Series 1, 2 or 3). Some manufacturers of pre-insulated polymer pipes offer pipes with an increased thickness of insulation. Figure 12.2 shows indicative heat losses from insulated pipes and the relative performance of series 1-3.

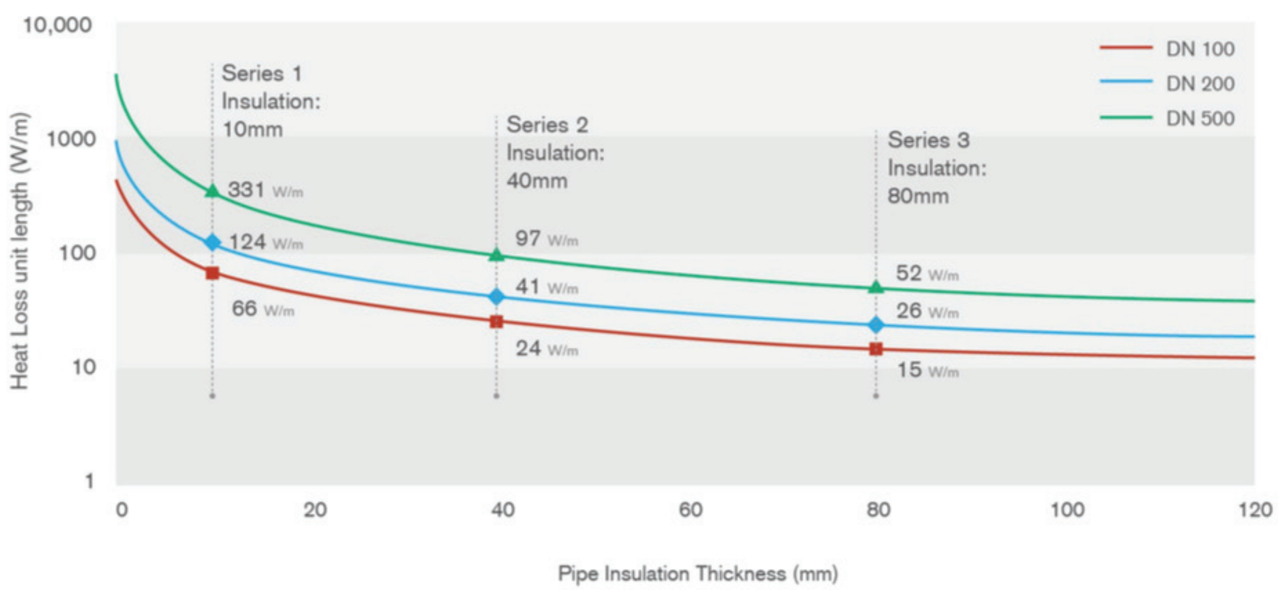



**Figure 12.2 Indicative heat losses from insulated pipes and relative performance of series 1-3 (courtesy of GLA District Heating Manual for London)**[17]

[12] BS EN 253: District heating pipes. Preinsulated bonded pipe systems for directly buried hot water networks. Pipe assembly of steel service pipe, polyurethane thermal insulation and outer casing of polyethylene (2009+A1:2013)

[13] BS EN 15632-2(2010)+A1(2014) District heating pipes - Pre-insulated flexible pipe systems. Bonded plastic service pipes. Requirements and test methods

[14] BS EN 15632-3(2010)+A1(2014) District heating pipes - Pre-insulated flexible pipe systems. Non bonded system with plastic service pipes; requirements and test methods

[15] BS EN 15632-4(2009) District heating pipes - Pre-insulated flexible pipe systems. Bonded system with metal service pipes; requirements and test methods

[16] BS EN 15698-1(2009) District heating pipes - Pre-insulated bonded twin pipe systems for directly buried hot water networks. Twin pipe assembly of steel service pipe, polyurethane thermal insulation and outer casing of polyethylene

[17] District Heating Manual for London (GLA) (2013)

The following sets out minimum standards of pipework insulation for Islington district heating connections.[18] These are based on parameters that are specific to Islington and may need to be adjusted for other locations.

External above-ground pipework – the economic thicknesses of mineral wool and phenolic foam for external above-ground pipework are laid out in tables 12.2 and 12.3. The tables show the optimum thickness for each pipe size, for low and high surface finish emissivity, 95 °C, 75 °C and 55 °C fluid temperature and for exposed and sheltered external conditions

| Pipe size | Economic thickness of insulation for mineral wool (mm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 95°C Fluid temperature | | | | 75°C Fluid temperature | | | | 55°C Fluid temperature | | | |
| | Exposed | | Sheltered | | Exposed | | Sheltered | | Exposed | | Sheltered | |
| | High | Low | High | Low | High | Low | High | Low | High | Low | High | Low |
| 15 to 40 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 50 to 250 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 |

**Table 12.2 Economic thickness of external above-ground pipework insulation using mineral wool**

| Pipe size | Economic thickness of insulation for phenolic foam (mm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 95°C Fluid temperature | | | | 75°C Fluid temperature | | | | 55°C Fluid temperature | | | |
| | Exposed | | Sheltered | | Exposed | | Sheltered | | Exposed | | Sheltered | |
| | High | Low | High | Low | High | Low | High | Low | High | Low | High | Low |
| 15 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 35 | 50 | 35 | 50 |
| 20 to 300 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |

**Table 12.3 Economic thickness of external above-ground pipework insulation using phenolic foam**

Internal pipework – the economic thicknesses of mineral wool and phenolic foam for internal pipework are laid out in tables 12.4 and 12.5. The tables show the optimum thickness for each pipe size, for low and high surface finish emissivity as well as for 95 °C, 75 °C and 55 °C fluid temperatures and for 15 °C and 20 °C internal air temperatures.

| Pipe size | Economic thickness of insulation for mineral wool (mm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 95°C Flow temperature | | | | 75°C Flow temperature | | | | 55°C Flow temperature | | | |
| | 15°C internal temperature | | 20°C internal temperature | | 15°C internal temperature | | 20°C internal temperature | | 15°C internal temperature | | 20°C internal temperature | |
| | High | Low | High | Low | High | Low | High | Low | High | Low | High | Low |
| 15 to 40 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 50 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 50 | 50 | 50 | 50 |
| 65 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 50 | 50 |
| 80 to 250 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 |

**Table 12.4 Economic thickness of internal insulation using mineral wool**

[18] Pipe work Standards for District Heating Connections and Bunhill Phase 2 (Aecom) (2014)

| Pipe size | Economic thickness of insulation for phenolic foam (mm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 95°C Flow temperature | | | | 75°C Flow temperature | | | | 55°C Flow temperature | | | |
| | 15°C internal temperature | | 20°C internal temperature | | 15°C internal temperature | | 20°C internal temperature | | 15°C internal temperature | | 20°C internal temperature | |
| | High | Low | High | Low | High | Low | High | Low | High | Low | High | Low |
| 15 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 35 | 50 | 35 | 50 |
| 20 to 25 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 35 | 50 |
| 32 to 300 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |

**Table 12.5 Economic thickness of internal insulation using phenolic foam**

Buried pipework – the economic level of insulation for pre-insulated buried pipework is presented in Table 12.6 for 95/75 °C and 75/55 °C flow and return temperatures through rigid, flexible and twin pipework. This refers to the insulation series, for example 3 & 2 refers to series 3 on the flow and series 2 on the return.

| Pipe size | Rigid | | Twin | |
|---|---|---|---|---|
| | 95-75°C | 75-55°C | 95-75°C | 75-55°C |
| 25 | 3&3 | 3&3 | 2&2 | 1&1 |
| 32 | 3&2 | 2&2 | 3&3 | 2&2 |
| 40 | 3&2 | 3&3 | 3&3 | 3&3 |
| 50 | 3&3 | 3&2 | 3&3 | 3&3 |
| 65 | 3&2 | 3&2 | 3&3 | 3&3 |
| 80 | 3&3 | 3&3 | 3&3 | 2&2 |
| 100 | 3&3 | 3&3 | 2&2 | 2&2 |
| 125 | 3&3 | 3&2 | 3&3 | 2&2 |
| 150 | 3&3 | 3&3 | 3&3 | 3&3 |
| 200 | 3&3 | 3&3 | | |
| 250 | 3&3 | 3&3 | | |
| 300 | 3&2 | 2&2 | | |

| Pipe size | Flexible |
|---|---|
| | 75-55°C |
| 25 | 3&3 |
| 32 | 3&3 |
| 40 | 2&2 |
| 50 | 2&2 |
| 63 | 2&2 |
| 75 | 2&2 |

**Table 12.6 Economic level of buried pipework insulation for rigid, flexible and twin pipe configurations**

If a steel carrier pipe is used for any buried sections, the designer should specify pre-insulated pipe systems that comply with EN 253 and associated EN standards and the design should be developed in accordance with EN 13941.[19]

The risk of overheating in summer should be assessed, and additional insulation to that given above should be specified if necessary, or alternative pipe routes selected.

[19] BS EN 13941: Design and installation of preinsulated bonded pipe systems for district heating (2009+A1:2010)

**Flanges and Valve insulation**

It is essential to insulate flanges, valves and other pipeline ancillaries. Very often they are left uninsulated and create a channel for significant heat losses, which could also become safety hazards under certain circumstances.

All valves and fittings should be insulated and the insulation should be continuous and close fitting at all joints. Pipe supports should use rigid low conductivity inserts to maintain the insulation quality at the support.

Where appropriate, a protective metal split casing, filled with insulating material of the same thermal performance as the insulation on the adjoining pipework should be fitted around the valve.

Alternatively, flexible insulation jackets manufactured from aluminised glass cloth, with a minimum of 50mm mineral wool infill should be used. Although these do not provide the same level of insulation as the previous case, they are easily fitted and removable for maintenance purposes.

## 13.4 Plant room specifications

Plant rooms should comply with current Building Regulations[20] and HSE health and safety requirements.

Plant room design should provide sufficient access around plant and equipment to enable safe maintenance to be carried out. This is usually a minimum of 1.1m around the plant and should include access/egress and handling of equipment/parts associated with any repair/replacement works.[21]
In particular, sufficient space should be allowed for maintenance access and for future replacement of building thermal substations and HIUs.

The design should locate valve chambers and other facilities across the heat network requiring access (including surveillance system monitoring terminals) in suitable locations so that safe operation and maintenance can be carried out.

Adequate access and other provisions should be made to enable safe replacement of plant in the future, including doorways, stairs and corridors. A plant replacement strategy report should be produced during the design stage.

Large bodied strainers with fine mesh should be specified to reduce the risk of dirt accumulating on valves and heat exchangers.

Plant layout – new developments, where the detailed connection arrangement to a heat network is unknown (including connection ready), will require physical space to be allotted for installation of heat exchangers and any other equipment required to allow connection. Table 12.7 indicates the space required as dictated by the site's heat demand. The figures are the packaged district heating thermal substation dimensions only (delivered pre-constructed on a skid) and do not include access space as detailed above. Sizes are indicative and space requirements should be considered on an individual site and system design basis which the Heat Network Operator can advise on.

| Output (kW) | 250 | 500 | 800 | 1000 | 1500 | 2000 | 3000 |
|---|---|---|---|---|---|---|---|
| Height (mm) | 2000 | 2500 | 2500 | 2500 | 2500 | 2500 | 2500 |
| Approximate dry weight (kg) | 725 | 1050 | 1300 | 1725 | 1800 | 1925 | 2000 |
| Number of heat exchangers | 1 | 1 | 1 | 2 | 2 | 2 | 2 |
| Length (mm) | 1500 | 2250 | 2250 | 2750 | 2750 | 3000 | 3000 |
| Width (mm) | 500 | 750 | 750 | 1500 | 1500 | 1500 | 1500 |

**Table 12.7 Plant room spacing requirements (thermal substation only)**[22]

[20] http://www.planningportal.gov.uk/buildingregulations/7 Energy Benchmarks – CIBSE TM46 (CIBSE) (2008)
[21] BSRIA Rules of Thumb – Guidelines for building services BG 9/2011 (BSRIA) (2011)
[22] Environmental Design Planning Guidance – Tackling fuel poverty, enhancing quality of life and environment for all (Islington Council) (2012)

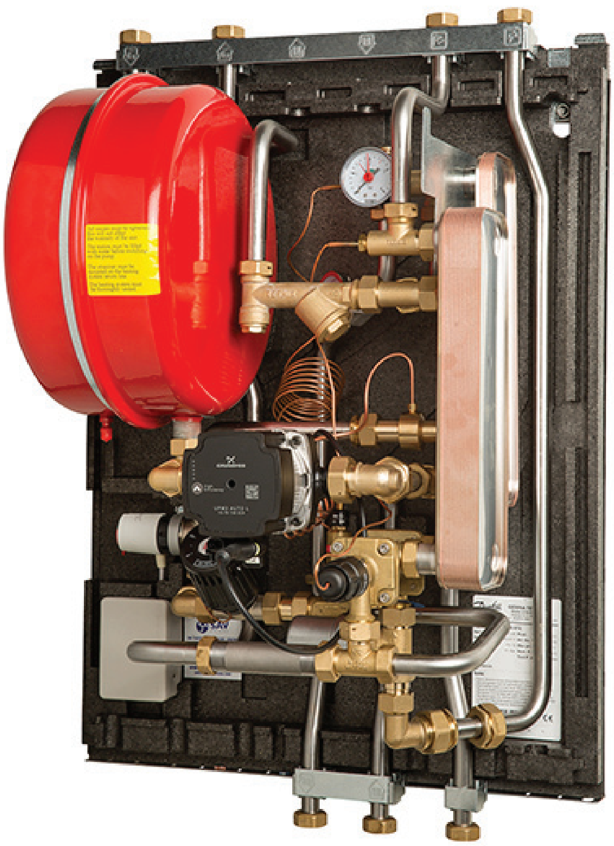
Designs should provide suitable power supplies (including for use when carrying out maintenance), lighting, ventilation, water supply and drainage facilities. Drainage facilities are strongly recommended to be gravity-based (rather than pumped) and able to manage discharge from a full bore pipe failure within the plant room. Plant rooms should include provision for the requirements shown in Table 12.8 to ensure they can interface with the area-wide district heat network.

| **Item** | Minimum specification requirements. |
|---|---|
| **ROOM ILLUMINATION** | Minimum light level: 150 lux. |
| **ELECTRICAL CONNECTION (for maintenance)** | III 380 V to earth / 32 A. |
| **ELECTRICAL SUPPLY (Control box)** | 220 V AC (+/- 5%), 50 Hz (+/- 3%)<br><br>Thermo-magnetic protection recommended 16A curve C (the box incorporates a thermomagnetic protection of 10A curve C in the supply). |
| **WATER SUPPLY** | Nominal Diameter DN 25. |
| **WATER DISCHARGE** | Provide wastewater discharge line in the plant room and a sump to collect condensation from heat exchangers. |
| **CONCRETE STANDS** | Provide concrete stands for heat exchangers and pumps (if present). |
| **VENTILATION** | Mechanical and continuous, with a minimum of three air changes per hour. |
| **HEALTH & SAFETY** | Plan showing evacuation route in case of fire, located in a visible place.<br><br>The plant room should not have elements of risk to health and safety (sharp metallic objects, holes in roof or floor without protection). |
| **LAYOUT & DIMENSIONS** | As described for the relevant packaged substation unit in Table 12.7. |

**Table 12.8 Minimum plant room specifications** [23]

[23] Environmental Design Planning Guidance – Tackling fuel poverty, enhancing quality of life and environment for all (Islington Council) (2012)

## 13.5 Heat Interface Unit specification (where appropriate)



In general, there will be an indirect connection used with either individual Heat Interface Units (HIUs) at each dwelling or a main indirect thermal substation supplying a whole building/block.

Whenever there is a hydraulic break in a system, there will be an increase in return temperature, which will increase heat losses and reduce the temperature differences on the primary network, leading to higher costs (for a fixed flow temperature). Where apartment blocks are connected, it could be considered to be best practice to have either an indirect connection at the dwelling or at the entry to the building, but not both. However, where there are high tower blocks, static pressures need to be considered and a further hydraulic pressure break may be needed, as shown in scenario 1A.

The location of the HIU within dwellings should be such that it can be removed and replaced without major disruption and changes to walls, fixtures or fittings. Where an HIU is installed in a cupboard, consideration should be given to providing high and low level ventilation openings if any equipment is affected by high ambient temperatures.

Residential schemes should be designed so that the HIU or isolation valves are accessible from outside the dwelling to enable maintenance to be carried out, although all user controls and meter displays should be internal to the dwelling.

Where indirect connection is used, the heat exchanger should be sized with an approach temperature (primary return temperature to secondary return temperature) of less than 3 °C unless this is demonstrated as impractical.

Pipework, heat exchangers and other components within a HIU should be insulated to reduce heat losses and unwanted heat gains, insulation should be continuous between the supply pipework and the HIU.

Dwelling HIUs should be selected to deliver the required design performance, and test results should be available to substantiate this, particularly with regard to the temperature control of domestic hot water under a range of pressure differences and draw-off rates. The CIBSE/ADE Heat Networks Code of Practice (CP1) indicates that best practice would include testing the HIU performance against established standards, such as the Swedish standard F103-7 (2009).[24] Guidance on HIU selection, design and installation is also available from BSRIA.[25]

[24] Svensk Fjärrwärme (2009) F:103-7e: Certification of district heating substations (Stockholm: Swedish District Heating Association)
[25] Heat interface Units – BSRIA Guide (2015)

## 13.6 Pump specification/requirements

The use of variable flow control principles is an important part of achieving a well-performing district heating system. Using variable flow control systems will result in lower flow rates and lower return temperatures at part-load. Variable speed pumps are used and should be controlled to maintain a minimum pressure difference at the extremities of the network. This important control principle will reduce heat losses and pumping energy.

Control valves should be two-port, so that a variable volume control principle is established.

Any secondary domestic scale pumps should be selected to provide a low-pressure difference, approximately 0.25bar, across the radiator circuit to assist in setting the correct flow rates to each radiator.

The use of variable speed pumps for the dwelling radiator circuit isolated by a PHEx is recommended as best practice to reduce electricity use and the need for high bypass flows. This is shown in the domestic circuits of scenarios 2A and 2B.

## 13.7 Ensuring low secondary return temperatures

Achieving consistently low return temperatures and keeping flow temperatures low is key to a well-performing district heating scheme. For a given flow temperature, a low design return temperature will reduce peak flow rates, leading to smaller pipes and lower costs. Maintaining low return temperatures under part-load and low-load conditions is important to keep heat losses and pumping energy low. If the design return temperatures are not maintained in operation, the heat network capacity will be reduced. Achieving low return temperatures starts by correct selection and balancing of radiators and other heat emitters within the building, which is the responsibility of the building owner and designer and not the heat network operator.

Designers should strive for low return temperatures in building heating systems to enhance operational efficiency. Connections should be optimised to maximise the efficiency of central and distributed plant, whether CHP, boilers or heat pumps. In particular, low return temperatures enhance the efficiency of condensing boilers (see Section 11.1).

As indicated by the Heat Networks Code of Practice, for new building services systems (in existing or new buildings), temperatures for the heating and hot water service circuits should be optimised but should comply with the limits given in Table 12.9 unless this is demonstrated as impractical.

**Table 6** Preferred operating temperatures for new building services systems

| Circuit | Flow temperature / °C | Return temperature / °C |
|---|---|---|
| Radiators | Max 70 | Max 40 |
| Fan-coil units | Max 60 | Max 40 |
| Air handling unit | Max 70 | Max 40 |
| Underfloor heating | See Note 1 | See Note 1 |
| Domestic hot water service (DHWS) instantaneous heat exchanger on load | See Note 2 | Max 25 °C for 10 °C cold feed temperature |
| DHWS cylinder with indirect coil | See Note 3 | Max 45 °C when heating up from cold at 10 °C |
| DHWS calorifier with external plate heat exchanger | See Note 4 | Max 25 °C for 10 °C cold feed temperature |

Note 1: Underfloor heating systems will typically operate with floor temperatures below 35 °C and typically flow temperatures of 45 °C which is advantageous for heat networks, as this will result in low return temperatures.

Note 2: A minimum flow temperature of 65 °C is typical and will be determined by the required hot water delivery temperature, which is typically set to 55 °C. Lower hot water delivery temperatures may be acceptable, provided the volume of water is small and the legionella risk can be controlled and this may allow the use of lower flow temperatures.

Note 3: Hot water storage involves a legionella risk and the stored temperature is normally above 55 °C. For acceptable heat up times a minimum flow temperature of 70 °C is typical.

Note 4: A central hot water calorifier would normally be designed to store water at 60 °C and with a minimum recirculation temperature of 55 °C. Typically a flow temperature of 70 °C or higher would be needed.

Note 5: Where direct connection is used, the radiators shall be sized in accordance with this table. However, in operation, a higher flow temperature may be used to suit the network design, provided that radiator return temperatures shall be less than 40 °C.

In all cases, the variation of flow temperature across the network needs to be considered especially for the summer low flow condition where temperature drops can be significant. The temperatures given in this table are at the consumption point and higher flow temperatures will be needed at the energy centre supply point.

**Table 12.9 – Preferred operating temperatures for new building services systems**

Where boilers are being retained within the building for use at times of high demand, the connection design should ensure that the heat supplied from the heat network is prioritised and the boilers used only when required to supplement this. This may be achieved by connecting the heat network supply either in series with the boilers, i.e. into the return circuit or in parallel. The parallel connection requires the flow into the boilers to be controlled so that the supply from the heat network is maximised.

### 13.7.1 Space heating

Flow temperatures for the space heating circuit should be selected so that flow rates to individual radiators or fan-coil units (FCUs) can be set up accurately to achieve the design return temperature. For new dwellings, with low space heating demands, flow temperatures of 50°C to 60°C are likely to be needed with a return temperature of 40°C otherwise the flow rate may be too low.

In new heating systems, the radiator pipework should be sized to provide a sufficiently rapid response of the radiator circuit and micro-bore pipework should be considered for low flow rate systems.

A common feature of all six residential scenarios in sections 4-9 is that the space heating is controlled by a differential pressure sensor. The sensor will maintain a constant head across the radiator, which means that with the correct thermostatic radiator valves (TRV) selected, the radiators will modulate in temperature rather than turning on and off. This provides more accurate control of radiator and room temperature. Low Kv TRVs, which have a high resistance to flow, are required on each radiator.

Pre-settable thermostatic radiator valves designed for low flow rates should be used. These valves are designed with integral adjustable apertures enabling a flow rate to be set for a given pressure difference. As these openings are very small, a fine mesh strainer should be incorporated into the circuit - particularly important for direct connection systems.

Room temperature control should be provided by TRVs, fitted to all radiators in the circuit, which will reduce volume flow rates and hence return temperatures under part-load. All TRVs should show a scale based on temperature rather than arbitrary numbering.

Best practice would include the use of heating systems with return temperatures below 40°C. The lowest return temperatures are usually obtained from radiators which are connected as ‘top entry and opposite bottom exit’.

The use of wall mounted thermostats connected to radiator valves should be considered (particularly in new-build properties) as shown in Figure 12.3. This ensures the thermostat measures the room air temperature, not the temperature adjacent to the radiator.

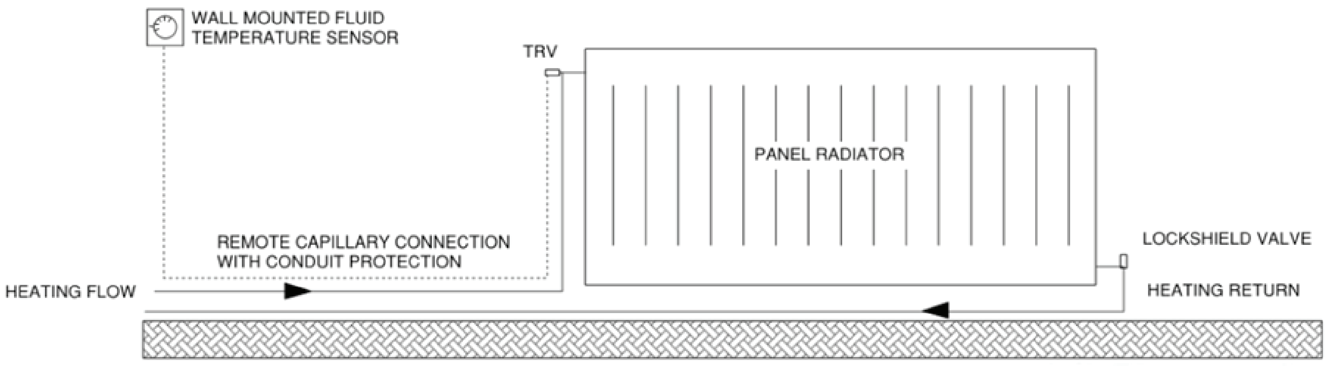



**Figure 12.3 Wall mounted thermostats connected to radiator valves**

Return temperature limiter controls should be considered for applications where towel rails are the secondary source of heating and where keeping the towel rail warm, disregarding the room temperature, is a priority. These limiters ensure the towel rail is always warm by measuring the temperature on the return, which can then be adjusted independent of the room temperature.

In order to promote steady operation and close control of room temperatures, all electronic room thermostats should be TPI-based. TPI (Time Proportional & Integral) control is a form of on/off control using an advanced energy saving algorithm.

In commercial buildings, TRVs, where used, should be specified to be limited to a suitable maximum design temperature (e.g. 22°C). Appropriate tamper proof fittings should be provided to prevent adjustment other than by the facilities management staff.

### 13.7.2 Domestic Hot Water

Dwelling cylinder coils should be selected to deliver lower return temperatures or use an external plate heat exchanger (PHEx). Existing dwelling cylinders may use a coil to heat the water but a local PHEx may be preferable to supply cylinders, to achieve low return temperatures. This choice may in part depend on water hardness.

Where possible, centralised DHW storage heating should use an external plate heat exchanger (controlled with a two-port valve) rather than a coil within the storage vessel. Best practice would be to use a two-stage heating system where the return from the space heating circuit is used to pre-heat the cold feed to the DHW. Both these approaches usually result in a lower return temperature on the district heating circuit.

## 13.8 Building Management Systems (BMS)

Heat Networks generally use Building Management Systems to control and monitor networks and the buildings connected to them. To ensure connectivity, consistency and simplicity across monitoring systems it is recommended that the designer liaise with the Heat Network Operator to ensure controls proposals and systems are compatible with each other.

Usually a read-only communication link is installed between the district heating control panels and the boiler room control panels. This may include the facility to request a temperature set-point from the district heating control panel/substation by the boiler panel.

The IHNO would appreciate the ability to monitor all heating and hot water systems controlled by a connecting boiler room control panel in order to assist with ongoing fault analysis. This is also to ensure ongoing high efficiency and low return temperatures back to the district heating scheme.

For systems not operated by the IHNO it is recommended that you discuss the best approach to allow connectivity with the heat network operator.

## 13.9 Metering arrangements

Heat metering is an important part of any district heating system in order to monitor performance and determine payment. Individual dwelling heat meters are a requirement under the Energy Efficiency Directive (EED)[26] for all new buildings and for buildings undergoing major refurbishment. This has been implemented in the UK through the Heat Network (Metering and Billing) Regulations.[27] Building-level meters are also a requirement under the EED for all multi-apartment/multi-purpose buildings connected to a heat network. All other premises served by a heat network must undertake cost effectiveness and technical feasibility assessments for the installation of individual dwelling meters or heat cost allocators. Metering should follow the requirements set out in CP1 the CIBSE/ADE Heat Networks Code of Practice and where possible should also comply with the Heat Trust Scheme.[28]

A full CIBSE TM39[29] sub-metering strategy should be developed for the building in order to set out where the meters are located, what they measure and how they will be read, e.g. through an Automatic Meter Reading System or BMS. This strategy should set out how the sub meters collectively provide a clear picture of energy consumption for the facilities manager. This is a requirement for new buildings and works in existing buildings under the Building Regulations.

[26] EU Energy Efficiency Directive 2012/27/EU
[27] The Heat Network (Metering and Billing) Regulations SI 3120 (2014)
[28] The Heat Trust Scheme (http://www.heattrust.org) (2015)
[29] Building Energy Metering – CIBSE TM39 (CIBSE) (2009)


Heat meters should be in accordance with the Measuring Instruments Directive (MID)[30] and should be Class 2 accuracy. Heat meters should be of the type with no moving parts in the water flow measurement – they should be ultrasonic to ensure high accuracy and minimise pressure drops in the system. The energy metering system must include a flow meter, two temperature sensors and a standalone integrator unit complete with battery backup. The integrator should have non-volatile memory backup with a Modbus (or equivalent) communication system for monitoring and billing purposes.

The meter installation should follow the manufacturer's recommendations in terms of orientation, the minimum length of straight pipe before and after the meter and ensuring that it is possible to easily access the meter and integrator for maintenance, calibration and taking readings. Further guidance is available from B&ES.[31]

The minimum static pressure stated by the heat meter manufacturer should be met at all times for each meter and this requirement should be taken into account in the overall hydraulic design. If cavitation occurs, this can severely impact the accuracy of the meter.

A strainer should be fitted upstream of the meter with a mesh size as advised by the manufacturer.

Dwellings heat meters should be installed in a tamper proof enclosure to reduce the potential for fraud and/or should be fitted with security seals.

Meters should be connected to a full Automatic Meter Reading (AMR) system to record and report:

- heat delivered to the building
- heat delivered to the building space heating & DHW separately (if possible)
- heat delivered to each dwelling (if possible)

Direct data readings should be obtained using M-bus communications or other proven AMR technology. Heat meters that provide data via pulsed outputs are not normally recommended for use with AMR systems.

[30] Measuring Instruments Directive (2004/22/EC)
[31] Guide to Good Practice: Heat Metering SUS01 (2015)

## 13.10 Commissioning

Written commissioning procedures should be produced for each type of heating circuit, building on the commissioning plan established during the design stage and based on CIBSE Commissioning Code M[32] and other guidance. A copy of all commissioning documentation should be provided to the heat network operator.

All operatives involved in commissioning should receive training in the importance of achieving low return temperatures.

A commissioning record sheet should be used to enter the return temperatures from the space heating circuits after the system has been running in constant operation for over 30 minutes.

The pipework installation must be checked to ensure it is complete, and all components are correctly positioned, correctly installed, easily accessible, properly identified (NB: refer to CIBSE Code W[33] for more comprehensive and detailed installation check-lists).

Check the system has been filled, thoroughly vented and pressure tested in accordance with B&ES TR6[34] Pressure Testing of Pipework. Ensure the system has been flushed and chemically cleaned in accordance with BSRIA Guide BG29/2012[35] and BG50/2013.[36] Check the pumps and associated variable speed drives are installed, inspected and tested in accordance with the manufacturer's instructions and are ready to operate.

Dwelling HIUs should be commissioned in accordance with the HHIC Commissioning Checklist for HIUs.[37] The total flow to the radiator circuit should be adjusted to the design conditions using the controls at the HIU – this may be a variable speed pump, a balancing valve or an adjustable differential pressure control valve for direct connection systems. Where possible, check on the average temperature difference achieved across any circuit can be established by the use of a heat meter that records volume and energy.

The controls systems for building connections should be fully checked prior to commissioning including a point-to-point check that sensors are correctly addressed and that all sensors are working correctly.

All measured data and set points on valves etc. should be recorded on the commissioning record sheet and a copy provided to the heat network operator.

requirement for new buildings and works in existing buildings under the Building Regulations.

[32] CIBSE Commissioning Code M: Commissioning Management (2003)
[33] CIBSE Commissioning Code W: Water Distribution Systems (2010)
[34] TR6 Guide to Good Practice - Site Pressure Testing of Pipework B&ES (2006)
[35] BSRIA Pre-Commission Cleaning of Pipework Systems (BG 29/2012)
[36] BSRIA Water Treatment for Closed Heating and Cooling Systems (BG50/2013)
[37] The Heating and Hot Water Industry Council (HHIC) Commissioning Checklist for HIUs

### 13.10.1 Commissioning metering

An initial check prior to commissioning should be carried out to ensure that the installation has been carried out in accordance with EN1434,[38] manufacturers' instructions and the MID, particularly in relation to meter location, orientation and sensor installation as appropriate for the specific meter.

The correct reporting of kWh from each meter through the Automatic Meter Reading (AMR) system should be demonstrated and these readings must be repeatable.

The meter should be monitored for a short period on load to establish that flow rate and temperatures are being recorded and that the data received by the AMR is credible. A hand calculation check should be carried out to prove that the conversion to kWh from the flow rate and temperature measurements is correct.

A reconciliation calculation should be carried out between the central plant meters, main building meters and dwelling meters, from which system losses can be estimated. These should be compared to expected values based on the design.

A meter register should be prepared and maintained detailing:

- What the meter is measuring
- meter serial numbers
- postal address of the properties
- communications addresses for the AMR
- dates commissioned
- initial readings
- dates of last calibration

All physical meters should be clearly labelled with a meter code, serial number and what is being measured e.g space heating for dwellings.

A full check should be carried out to establish that the installed meters are in line with the CIBSE TM39 metering strategy diagram. A signed-off copy of the metering strategy and meter schedule should be provided to the heat network operator.

A final follow-up visit to the property should be carried out to ensure that the customer understands how to operate the heating system and the metering and billing or pre-payment process. Best practice would involve recording and storage of data for an extended period. Outputs from the AMR could be displayed on the web, including the average percentage heat loss from the network. This could also include information on the central plant inputs, outputs and efficiency.

[38] BS EN 1434-1 Heat meters. General requirements (2007)

## 13.11 Handover and providing information

In order to encourage good energy efficient operation, it is essential to ensure correct handover procedures are followed. A key part of this is to provide the operations team with all the necessary information about the heat network including O&M manuals, log books and metering strategies. A copy of all handover documentation should be provided to the heat network operator.

Appropriate customer instructions should be developed and distributed to customers at handover, supplemented by customer training if necessary. An information pack should be provided to the customer detailing the function of the heating system, its controls, heat meter and the pre-payment system if used. It should also comply with the requirements of the Heat Trust Scheme.[39] The pack should be written to be visually attractive and easy to understand and not a collection of manufacturers' leaflets. It should contain a list of FAQs and suitable answers.

Handover procedures should follow those laid down by CIBSE and BSRIA and the Heat Networks Code of Practice. A full O&M manual should be provided for the heat network, including controls strategies and commissioning records. This should include any information that is specific to operation of the plant in relation to the district heating, e.g. procedures in case the building needs to operate solely on the local boiler plant.

A building logbook based on CIBSE TM31[40] should be put in place for each main building and central heat interface plant room. This should include clear instructions on how to operate the building efficiently, as well as the CIBSE TM39 sub-metering strategies, floor areas, recent changes to the building etc. This is a requirement for new buildings and works in existing buildings under the Building Regulations. Copies of the final building logbook and metering strategy should be provided to the heat network operator.

## 13.12 Operation and maintenance

All buildings connected to a heat network should be operated and maintained according to the Heat Networks Code of Practice.[41]

Building operators and facilities managers should ensure that their system operates as designed and take, and act on, advice provided by the heat network operator to achieve this.

The building heating and hot water systems should be operated and maintained to minimise return temperatures whilst still providing an effective heat supply.

The Islington Heat Network Operator will aim to work closely with building operators to monitor customers' heat consumption, and where significant divergence from typical trends are seen, investigations will be undertaken to ensure the system is performing correctly and heat meter is operating correctly.

[39] The Heat Trust Scheme (http://www.heattrust.org) (2015)
[40] Building Log Book Toolkit – CIBSE TM31 (CIBSE) (2006)
[41] CIBSE/ADE CP1 Heat Networks Code of Practice - raising standards for heat supply (2015)

# 14. Appendix A – Glossary of terms

The definitions given here relate specifically to the context of heat networks. Terms may have broader or alternative meanings in other contexts.

| | |
|---|---|
| **Automatic meter reading (AMR)** | A system where heat meters are monitored and data on energy use recorded and stored at intervals and then communicated to a heat meter operator so that bills can be produced without the need for manually reading the meters. |
| **Building Management System (BMS)** | A computer-based system for remote control and monitoring of building services used for interactive energy management. |
| **Building information modelling (BIM)** | BIM can be described as value creating collaboration through the entire life-cycle of an asset, underpinned by the creation, collation and exchange of shared 3D models and intelligent, structured data attached to them. |
| **Building thermal substation** | A main heat exchanger between the district heating network and the building heating/DHWS systems. |
| **Calorific value (CV)** | The heat energy available from a fuel when it is completely burnt, expressed as heat energy units per unit of weight or volume of the fuel. The gross or higher calorific value (GCV/HCV) is the total heat energy available when all the products of combustion are cooled to standard conditions and the heat released from the condensation of water vapour is included. The net or lower calorific value (NCV/LCV) is the total heat energy released from combustion excluding the latent heat of the water vapour from condensation of the products of combustion. |
| **CO, carbon monoxide; CO2, carbon dioxide.** | Oxides of carbon produced by fuel combustion. CO represents incomplete combustion and can be burnt to CO2, which is the product of complete combustion. |
| **Combined Heat and Power (CHP)** | The combined production of heat and power (usually in the form of hot water and electricity). This is often an engine driving a generator, but can sometimes be a turbine-driven system. |

| | |
|---|---|
| **Construction (Design and Management) Regulations** | The Construction (Design and Management) Regulations (2015) came into force on 6th April 2015; they replace the CDM Regulations (2007). The key aim is to integrate health and safety into the management of a project and to encourage everyone involved, to work together. The principles of CDM (in 2015) apply to all construction projects; however, notification applies where work: will last more than 30 days, or will involve more than four persons working on site at any time, or will involve more than 500 person days. CDM Regulations identify task functions of the client, designers, the CDM principal designer, principal contractor and contractors that must be carried out by nominated bodies. |
| **Control of Substances Hazardous to Health (COSSH)** | COSSH are the Regulations that require employers to control the use of substances that can be hazardous to health. |
| **Demand; maximum demand; demand profile** | The rate at which energy is required, expressed in kW or MW. It is usually related to a time period, typically half an hour, e.g. 1 kWh used over half an hour is a demand rate of 2 kW. Maximum demand is the highest half-hourly rate at which electricity is required during a month or year. Peak load or peak demand are the terms usually used for heat energy. A graph of demand rate over a typical day, for example, is the demand profile. |
| **Energy service company (ESCo)** | A company offering a total energy supply service that takes responsibility for provision, financing, operation and maintenance of energy facilities. Energy services contracts may be worded to define the outcome of the service provided, temperatures and light levels, rather than how much energy is to be supplied. |
| **Heat exchanger** | A device in which heat is transferred from one fluid stream to another without mixing. There must obviously be a temperature difference between the streams for heat exchange to occur. They are characterised by the method of construction or operation, e.g. shell-and-tube, plate heat exchanger (PHEx), rotary. |
| **Heat meter** | Device that measures thermal energy provided by a source or delivered to a sink, by measuring the flow rate of the heat transfer fluid and the change in its temperature ($\Delta T$) between the outflow and return legs of the system. It is typically used in industrial plants for measuring boiler output and heat taken by process, and for district heating systems to measure the heat delivered to consumers. |
| **Heat network** | The pipework carrying heat from the central heat source to individual buildings. |

| | |
|---|---|
| **Heat Trust** | A major initiative to protect the interests of householders and micro businesses connected to heat networks. See www.heattrust.org for more information. |
| **High temperature hot water (HTHW)** | Pressurised hot water at 120°C and above used for space and/or process heating. |
| **Hydraulic/Heat Interface Unit (HIU)** | An integrated solution for delivering and recording the heat consumed by an individual dwelling served from a heat network. The HIU consists of a pre-fabricated assembly of components that form the interface between the heat network and the dwelling's heating system. It may include a plate heat exchanger for the production of hot water and a heat exchanger to separate the two circuits together with control valves and a heat meter. |
| **Low temperature hot water (LTHW)** | Hot water at up to 95°C used for space heating and low temperature process. |
| **Low/zero carbon (LZC) technology** | Includes renewable technologies like photovoltaics, solar water heating, biomass but also includes low carbon technologies like CHP and heat pumps |
| **Maximum demand** | Maximum power, measured in kW or kVA, supplied to a customer by a supply/distribution company, equal to twice the largest number of kWh or kVAh consumed during any half-hour in a specified period (usually a month). Charges for maximum demand usually vary seasonally. |
| **Measurement Instruments Directive (MID)** | The EU Directive which governs the standards for metering of energy including heat. |
| **Medium Temperature Hot Water (MTHW)** | Pressurised hot water at 95°C to 120°C used for space heating and process. |
| **Particulate** | Particles of solid matter, usually of very small size, derived from the fuel either directly or as a result of incomplete combustion and considered deleterious emissions. |
| **Thermal storage** | Storage of heat, typically, in an insulated tank as hot water to provide a buffer against peak demand. The water may be pressurised to allow it to be kept at a higher temperature. |