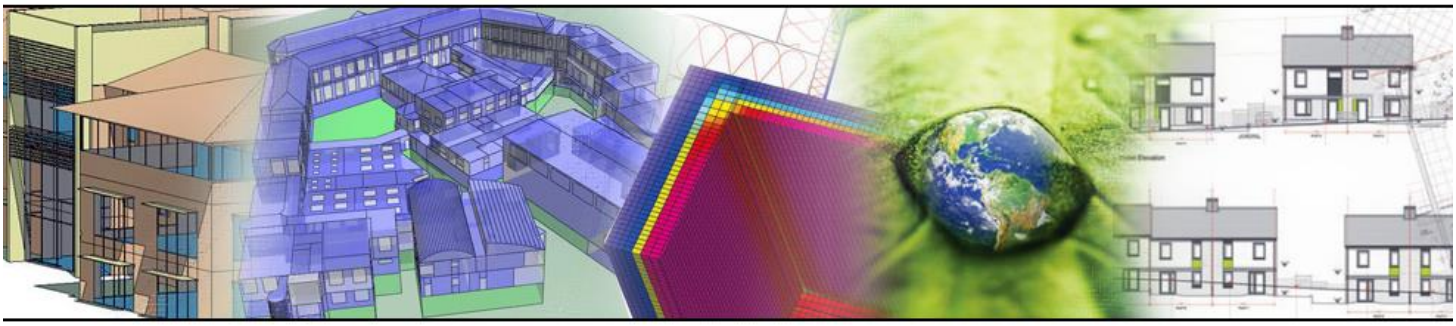

Carbon Reduction Measures

Pre-commencement of super structure – Block C
Condition 37

Former Nestlé Factory, Nestles Avenue, Hayes UB3 4RF

Stroma Reference: 03-24-OP-B475 C371
Date: 10/12/2025
Prepared for: Barratt London

1. Introduction

This report has been prepared for Barratt London Ltd, by Stroma Built Environment, a construction consultancy specialising in sustainability, energy conservation and the application of renewable energy technologies. It has been prepared to discharge Condition 37 of the planning approval which states:

Prior to the commencement of any superstructure works for each residential phase of development, full details of the carbon reduction measures that conform to the energy strategy (Energy Statements, Sep 2017, ESC54738 Issue 4) shall be submitted and approved in writing by the Local Planning Authority. These shall include:

> *1 - Full details of the baseline energy and carbon performance of each phase of the development*
> *2 - Full details of the passive energy savings measures (Be Lean - London Plan)*
> *3 - Full details of the combined heat and power systems including:*
> > *a - full plans and specifications of the technology*
> > *b - the phasing of the installation of the network which includes the delivery of main necessary energy centre in phase one*
> > *c - the input and output (annual KgCO2 and KwHr) of the CHP system*
> > *d - the onsite network connection*
> > *e - the future proofing for offsite connections*
> > *f - monitoring, reporting and maintenance regimes.*
> *4 - Full details and specifications, including relevant plans and elevations of any additional low or zero carbon technology to be utilised in the site.*

The development must proceed in accordance with the approved details unless otherwise agreed in writing with the Local Planning Authority.

This report relates specifically to Block C.

The results take into account a change to the external wall U-value which was necessitated by the ban on combustible materials in buildings above 18m[1]. To counteract the increased emissions, detailed thermal modelling has been carried out on the most significant thermal junctions and the design of these elements has been optimised to minimise linear thermal bridging. In addition, highly efficient gas boilers and combined heat and power systems will contribute further to the overall CO_2 reductions.

[1] *Unlike the original energy statement, every unit within phase two has been assessed in the calculation of these results.*

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7. APPENDIX 1 ..... ERROR! BOOKMARK NOT DEFINED.

2. Quality Management

Prepared by		Checked by
Nicola Griggs		Rob Waiting BSc (hons) MSc
Energy Assessor		Principal Sustainability Consultant
Date: 10/12/2025		**Date:** 10/12/2025
File reference:	03-24-OP-B475 C371	

Version	Status	Date	Change Summary
C371	First Issue	10/12/2025	-

3. Baseline energy and carbon performance

3.1. Introduction

This summary sets out the key measures and carbon dioxide emissions targets proposed for the development in the three stages of the London Plan 2016 energy hierarchy in order to address Part 1 of Condition 37 which requires:

1 - Full details of the baseline energy and carbon performance of each phase of the development

The London Plan 2016 sets targets for and requires evaluations of regulated energy use – i.e. energy related to building services such as heating and lighting. Other energy use is classed as unregulated and covers energy used by the building occupants, for, in the case of dwellings, cooking and appliances. This energy cannot be influenced by the applicant as it solely dependent on the occupant's behaviour. Unregulated emissions have been calculated according to the Building Research Establishment's Domestic Energy Model (BREDEM 2012)

3.2. Key Results

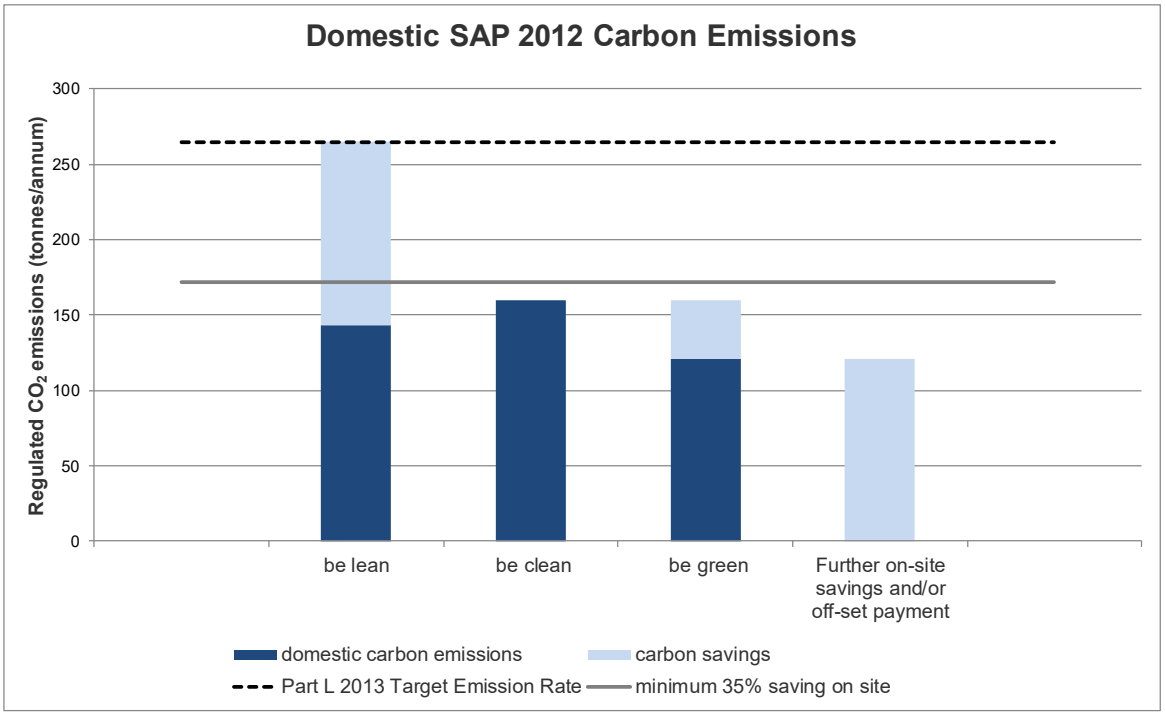
Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	*Unregulated*
Baseline: Part L 2013 of the Building Regulations Compliant Development	***264.7***	***290.97***
After energy demand reduction (be lean)	***143.0***	***290.97***
After heat network connection (be clean)	***160.1***	***290.97***
After renewable energy (be green)	***120.6***	***290.97***

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	*Percentage*
Be lean: savings from energy demand reduction	***121.7***	***46%***
Be clean: savings from heat network	***-17.1***	***-6%***
Be green: savings from renewable energy	***39.5***	***15%***
Cumulative on-site savings	***144.1***	***54%***

Graph 1: Domestic energy hierarchy targets



4. Passive energy savings measures

The development proposals include the provision of the following energy efficiency measures:

- Optimally sized windows that achieve good daylight levels but avoid excessive solar gain in summer and heat loss in winter;
- Insulation in walls, floors and roofs that meet or exceed the performance levels listed for the reference case in SAP2012 Table R1. These are as follows:

Element	Part-L Limiting value	Proposed U-value	% improvement
Heat loss floors	0.25 W/m^{2}K	0.11 to 0.13 W/m^{2}K	48 to 56%
External walls	0.30 W/m^{2}K	0.17 W/m^{2}K	43%
Main roofs	0.20 W/m^{2}K	0.08 to 0.12 W/m^{2}K	40 to 60%
Windows	2.00 W/m^{2}K	1.10 W/m^{2}K	45%
Air leakage rate	10 m^3/hm^2	2.0 m^3/hm^2	80%

- Careful design to reduce the effect of non-repeating thermal bridges including the use of high-performance thermal breaks where appropriate;
- All lighting, both in individual apartments and in the communal areas will use lamps with a luminous efficacy of at least 75 lamp-lumens/watt (equivalent to an "A" rating);
- All common area lighting will have automatic controls with occupancy and daylight sensors;
- Any white goods that are supplied (fridges, freezers, washer dryers and dishwashers) will be models that are "best practice" for energy consumption; and
- Mechanical ventilation systems which will be installed in every apartment and the systems used will exceed Energy Savings Trust "best practice" guidelines.

These measures will enable the dwellings to achieve compliance with the current Building Regulations, Part L1A: 2013 prior to the addition of low and zero carbon technologies.

The most significant change in the passive energy saving measures from the Energy Statement (ESC54738 Issue 4) is the increase in the external wall U-value from 0.15 W/m^{2}K to 0.17 W/m^{2}K. This is due to a change in the insulation that is to be used as a result of the ban on combustible materials in buildings over 18m high. To mitigate the increased emissions resulting from the higher U-value detailed thermal modelling has been carried out on the most significant thermal junctions and the design of these elements has been optimised to minimise linear thermal bridging. In addition, highly efficient gas boilers and combined heat and power systems will contribute further to the overall CO_2 reductions.

5. Combined Heat and Power systems

5.1. Plans and specifications

In line with the energy strategy, a low NOx E230 CHP unit is proposed. Full plans and specifications of the CHP system are included in Appendix 1

5.2. Phasing of the installation

The MEP Performance specification (FNF-SITE-SP-200-0001) details the following phasing for the installation:

Phase 1 – Installation of 2No. Boilers, all primary & Secondary Pipework with Blanked off connections left for future connection of the rest of the boilers & CHP, flushing bypasses shall be installed, and the contractor shall ensure that all pipework has circulation through it for water quality purposes.

Phase 2 – Boilers 3-4 commissioned and brought online.

Phase 3 – When the development reaches 60%, the remaining boilers and CHP units shall be installed.

All flues & pipework shall be installed during the first phase of the works, with blanked off sections left for future connection to the Plant. Due to the complex nature of installing Thermal Stores, these shall also be installed under Phase 1.

The phasing plan of the development can be found in Appendix 1

5.3. Input and output of the CHP system

For technical details of the CHP, please see Appendix 1

5.4. Onsite network connection

A layout for the site heat mains is included in Appendix 1.

All the apartments and all the non-residential spaces will be connected to the network. The network will serve only the main residential part of the site as covered by this report. It will not be extended to serve the Class B and Data Centre buildings as the heat demand in these buildings will be low, and a separate heating and cooling system, using air source heat pumps in the variable refrigerant flow (VRF) format, is proposed.

A further material consideration on a large and extensive site such as this is the need to demonstrate that the planned construction phasing has taken account of the need to ensure that the site heat mains are installed and the Energy Centre is built and commissioned before the first occupations will take place. This has been taken fully into account and the Phasing Plan and the Heat Mains Layout Plan, both included in Appendix 1, show how this will work.

The Energy Centre, attached to the western flank of Block D1, is part of Phase 1. This means that the Energy Centre can be constructed and the plant and flues installed and commissioned to coincide with the initial completions in Phase 1. The site heat mains, routed through Sandow Square, will be installed at an early stage as part of the permanent landscaping construction works and connected to the Phase 1 substations or temporarily capped as necessary.

5.5. Future proofing for offsite connections

While it is not feasible to connect to an existing district heating network, the communal heating system will be designed to permit a future connection to such a network should one extend into the locality in the future, and appropriate provision is being made within the Energy Centre. In order to facilitate this, the energy centre has been positioned at the edge of the site. A plan of the Energy Centre is included in Appendix 1

5.6. Monitoring, reporting and maintenance regimes

The Energy Centre MEP Services Particular Performance Specification (FNF-SITE-SP-200-001) gives full details of the monitoring, and reporting regimes but are summarised below.
Each apartment on the site shall have a heat unit incorporating a heat flow meter on secondary LTHW circuits. These shall be used alongside the primary heat meter located in each building for billing purposes, energy sub-metering and the control of the circuit flow rate.

The Energy Centre gas and heat consumption shall be measured via BMS connections to new pulse meters. In addition, electricity consumption for all major loads shall be monitored from pulse output meters installed on sub main supplies to each mechanical plant motor control panel.

The BMS shall contain an energy monitoring graphical display, which shall indicate the following information:-

- Heat consumption at each heat unit in kWhr (week to date, month to date, year to date).
- Energy Centre electrical energy consumption in kWhr (week to date, month to date, year to date).
- Gas energy consumption in kWhr (week to date, month to date, year to date).
- Energy Centre water consumption in litres (week to date, month to date, year to date).
- LTHW flow rate per circuit (max / min / average flow rate in week to date, month to date and year to date)
- Heat Demand in kW at any given time.

The BMS shall include all controls required to provide the full control and correct operation of the heating strategy described below. The main panel shall be capable of reading information relayed from all of the individual block panels.

Facilities shall be provided within the BMS controls installation for the future compilation of monitoring trends and historical information. A graphical front end shall be used to provide the primary control interface for the BMS, with graphics created for each system and control element. A security password system shall be incorporated to automatically prohibit commands from unauthorised people, with access levels hierarchically arranged such that a minimum level can be set to "read only" and at the highest level to access all information. 25% spare points capacity shall be provided for future extension to control / monitor any future installations.

The Applicant proposes to develop the detailed design of the communal plant, and then subsequently operate the systems in conjunction with an ESCo partner: they have a proven track record in this regard and already have some 6,000 apartments that are part of existing completed residential and mixed-use schemes ranging in size from 200 to over 700 apartments that are serviced in this way. All equipment will be maintained in line with the manufacturer's guidance and best practices.

6. Low or zero carbon technology

This phase has an allowance for a substantial array of photovoltaic panels in line with the energy strategy. A total of 110.2 kWp is proposed for this phase which is equivalent to 462.4 m^2 of roof area. This figure is based on good industry practice regarding the ratio of roof area to active panel area, and consequently we are confident that it can be delivered. Appendix 1 shows the indicative layout of the photovoltaic array. Full details of the PV array are subject to specialist design.

7. Appendix 1

Indicative drawings

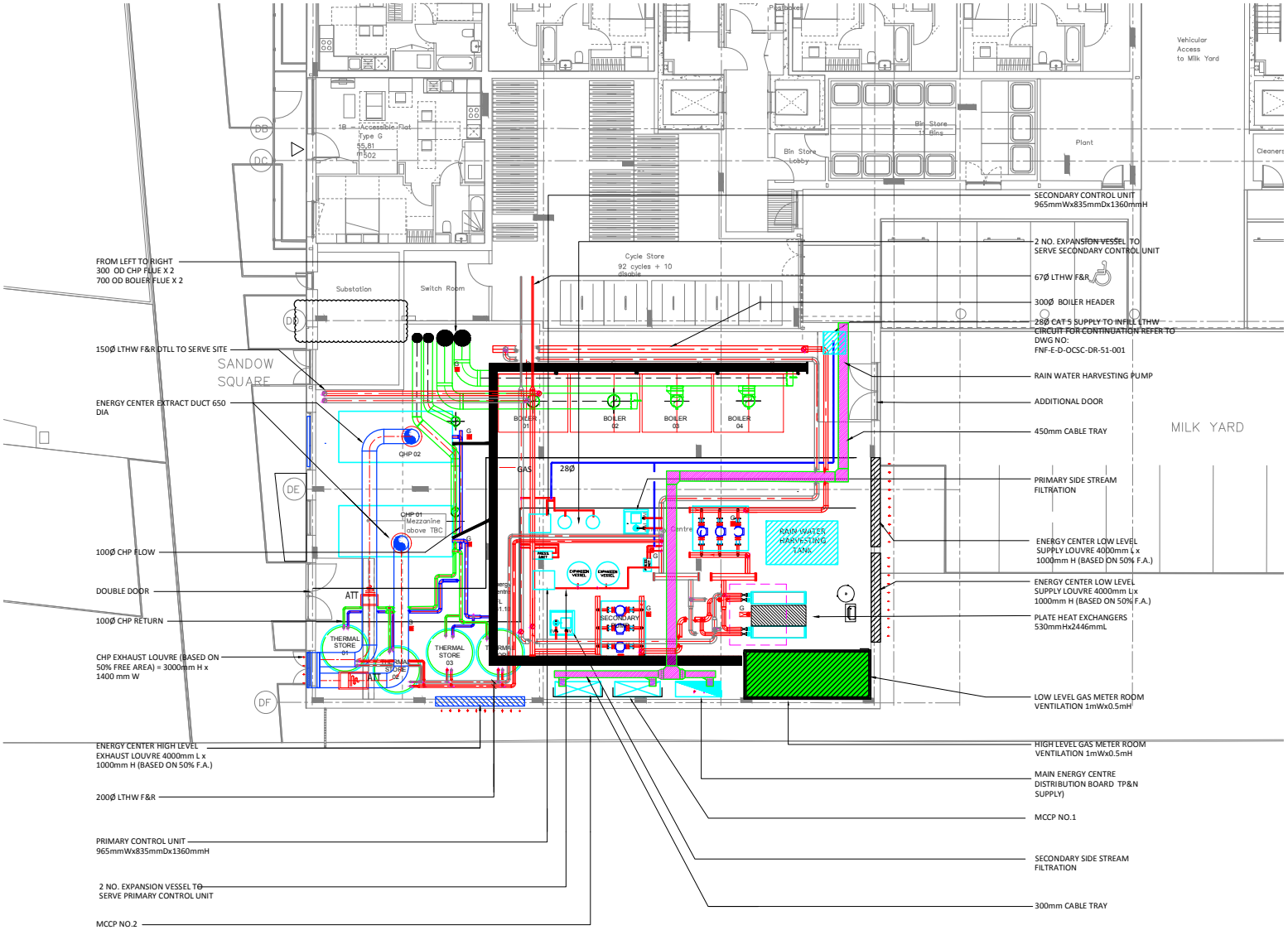
Energy Centre – Schedule of mechanical plant – CHP 01 + 02
Energy Centre general arrangement
Energy Centre Schematic
Site Heat Mains Layout – Sheet 1
Site Heat Mains Layout – Sheet 2
Site Heat Mains Layout – Sheet 2
Phasing Plan
Block C Roof plans – PV layouts
Energy Centre MEP Services Particular Performance Specification

Schedule FNF-M-D-OCSC-SCH-50-0002 Combined Heat and Power (CHP) plant

Reference No	Components	Technical Details	Comments
CHP. 01 & CHP.02	Model	E230	
	Size (length x width x height)	4100mm x 1950mm x 2295mm	
	Weight	5500kg	
	Weight w/Enclosure	7000kg	
	Fuel Type:	Natural Gas	
	Electrical Output:	228 kW	
	Thermal Output:	357 kW	
	Max Water In/Out Temperatures	80°C/90°C	
	Max Water Flow Rate	8.79 l/s	Assuming Cp = 4.2kJkg.K and ρ = 968.55kg/m3
	Max Test Pressure	9.75 bar	
	Exhaust Outlet Temperature	120°C	
	Exhaust Connection Size	200mm	
	Exhaust Max Allowable Backpressure	3710 Pa	
	Exhaust Flange Type	PN10	
	Min/Max Gas Pressure mbar:	20 /55	
	Gas connection	50 N.S. PN16 flanged	
	Engine Details		
	Fuel Type	Natural Gas	
	Min. Methane Number	70	
	Cylinders	12	
	Speed	1500 rpm	
	Aftercooler	No	
	Ventilation Details		
	Connection Size	500mm	
	Ventilation Rate	2.39m3/s	
	Maximum Air Inlet Temperature	30°C	
	Maximum Air Outlet Temperature	45°C	
	Alternator		
	Rating	350kVA	
	Voltage	400V	
	Phase	3	
	Frequency	50Hz	
	Generator		
	Manufacturer	Stamford	
	Model	HCI444E-311	
	Type	Synchronous	
	Power Factor	PF 0.8	
	Current Per Phase @ 0.8PF	407	
	CHP Protection Device	400A/Ph	
	Efficiency:	94.3%	
	Noise Data		
	Enclosure SPL @ 1m SN/LN	70dBA/65dBA	

Notes:

1. The CHP unit shall be manufactured by ENER-G (telephone +44 161 745 7450) or equal and approved.
2. The engine coolant system shall be hydraulically separate from the building heating.
3. The unit shall be complete with integral controls including BMS and boiler module cascade interfaces, mechanical, electrical, thermal and motor generator protection, synchroniing, modulation and performance monitoring of the CHP system.



NOTES:

1. ALL LEVELS & PLANT CONFIGURATION/CORDINATION TO BE UNDERTAKEN BY THE MECHANICAL, ELECTRICAL & PUBLIC HEALTH CONTRACTORS TO PRODUCE A FINAL WORKING INSTALLATION MODEL.
2. THE INSTALLATION SHALL BE CARRIED OUT IN ACCORDANCE WITH ACCORDANCE WITH SPECIFICATION & SCHEDULES OF PLANT & EQUIPMENT TO PROVIDE A COMPLETE WORKING SYSTEM IN ACCORDANCE WITH THE DESIGN.
3. THE DOMESTIC WATER SERVICES SHALL BE WRAS APPROVED & COMPLIANT WITH THE WATER BYE LAWS.
4. RISER LTHW PIPEWORK SIZES AS HEAVY GRADE STEEL
5. THE CONTRACTOR SHALL INCLUDE FOR ALL NECESSARY OFFSETS TO AVOID OTHER SERVICES.
6. VENTS TO BE FITTED AT ALL HIGH POINTS
7. ALL PIPEWORK TO BE INSULATED IN ACCORDANCE WITH SPECIFICATION.
8. CS, DVR,CV & METER SIZES SHALL BE SIZED TO SUIIT FLOW AND MEASURING SIGNAL REQUIREMENTS
9. INTUMESCENT FIRE BARRIER PUTTY TO BE FITTED BETWEEN PIPE INSULATION & PIPE SLEEVES ON ALL PIPEWORK PASSING THROUGH WALLS & FLOORS
10. FOR SCHEDULES OF EQUIPMENT SEE SPECIFICATION.
11. THE COMPLETE INSTALLATION TO BE CO-ORDINATED WITH ALL OTHER SERVICES.
12. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE CURRENT ARCHITECTS LAYOUT.
13. THE CONTRACTOR SHALL INCLUDE FOR ALL FINAL CONNECTIONS TO EXISTING DRAINAGE.
14. ALL PENETRATIONS OF FIRE COMPARTMENT TO BE SLEEVED TO MAINTAIN THE FIRE COMPARTMENT INTEGRITY.
15. ALL CONCEALED PIPEWORK TO BE INSULATED IN ACCORDANCE WITH THE MECHANICAL SERVICE SPECIFICATION & DRAWING.
16. ALL ENERGY CENTER LOUVRES ARE TO BE FIRE SMOKE RESISTANT DAMPER/INTUMESCENT AIR TRANSFER GRILLES.
17. FINAL FLUE DESIGN TO BE COMPLETED BY SPECIALIST

- FOR SETTING OUT REFER TO ARCHITECT'S DRAWINGS.
- THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER ARCHITECTURAL AND ENGINEERING DRAWINGS AND ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS.
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Rev No.	Date	Revision Note	Drn by	Chkd by
P01	22.01.18	FOR INFORMATION	J.C.	S.T.
P02	08.06.18	TENDER ISSUE	J.C.	J.C.
P03	23.07.18	TENDER ISSUE	J.D.	J.C.
T01	14.01.19	TENDER ISSUE	J.D.	J.S.

Rev No.	Date	Revision Note	Drn by	Chkd by

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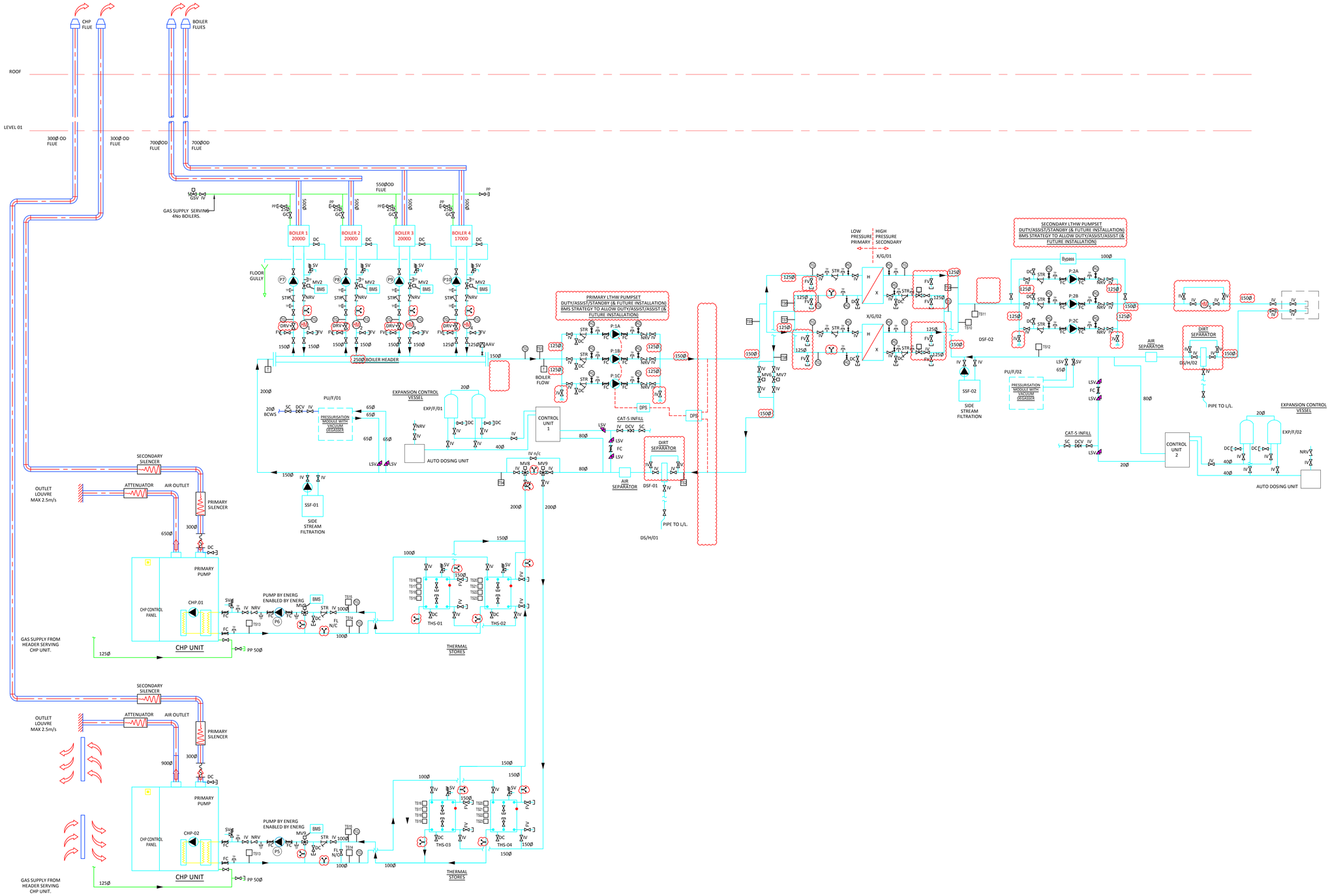
Client: BARRATT LONDON
Project: FORMER NESTLE FACTORY

Title: BLOCK D
ENERGY CENTRE

PROJECT	DISCIPLINE	ZONE	COMPANY	TYPE	NUMBER	REVISION
FNF	M	D	OCSC	DR	50-001	T01

Date: 22.02.17 Scale: 1:100 @ A1 Drn by: J.C. Chkd by: S.T. Aprvd by: J.F.



LEGEND:

- ISOLATION VALVE
- ISOLATION VALVE WITH CURRENT SWITCH
- GLOBE VALVE
- 2 PORT MOTORISED VALVE
- 3 PORT MOTORISED VALVE
- 3 PORT GATE VALVE
- 4 PORT GATE VALVE
- DEAD WEIGHT FIRE VALVE
- SLAM SHUT VALVE
- DOUBLE REGULATOR VALVE
- FIXED ORIFICE DOUBLE REGULATING VALVE
- BUTTERFLY VALVE
- PRESSURE RELIEF VALVE
- PRESSURE REDUCING VALVE
- DRAIN COCK
- NON RETURN VALVE/CHECK VALVE
- AIR VALVE & VENT
- THERMOSTATIC RADIATOR VALVE
- LOCK SHIELD VALVE
- GATE ANGLE - 2 PORT
- CONTROL ANGLE - 2 PORT
- STRAINER
- AIR ADMITTANCE VALVE
- PRESSURE INDEPENDANT CONTROL VALVE
- HEAT METER
- TEMP SENSOR (BMS)
- COMMISSIONING STATION

NOTES:

1. THE CONTRACTOR SHALL INCLUDE FOR ALL NECESSARY OFFSETS TO AVOID OTHER SERVICES.
2. ALL PIPEWORK TO BE INSULATED IN ACCORDANCE WITH SPECIFICATION.
3. INTUMESCENT FIRE BARRIER PUTTY TO BE FITTED BETWEEN PIPE INSULATION & PIPE SLEEVES ON ALL PIPEWORK PASSING THROUGH WALLS & FLOORS
4. FOR SCHEDULES OF EQUIPMENT SEE SPECIFICATION.
5. THE COMPLETE INSTALLATION TO BE CO-ORDINATED WITH ALL OTHER SERVICES.
6. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE CURRENT ARCHITECTS LAYOUT.
7. THE CONTRACTOR SHALL INCLUDE FOR ALL FINAL CONNECTIONS TO EXISTING DRAINAGE.
8. ALL PENETRATIONS OF FIRE COMPARTMENT TO BE SLEEVED TO MAINTAIN THE FIRE COMPARTMENT INTEGRITY.
9. ALL CONCEALED PIPEWORK TO BE INSULATED IN ACCORDANCE WITH THE MECHANICAL SERVICE SPECIFICATION & DRAWING.
10. FLUSHING BYPASS ON BOILERS ACHIEVED BY INTERCONNECTING FLEXIBLE HOSES ON BOILER PIPEWORK
11. FLUE TO EXTEND 3m ABOVE THE HIGHEST POINT ON BLOCK D ROOF.
12. ALL ENERGY CENTER LOUVRES ARE TO BE FIRE SMOKE RESISTANT DAMPER/INTUMESCENT AIR TRANSFER GRILLES
13. PUMPS FOR SIDE STREAM FILTRATION TO BE SUPPLIED BY MANUFACTURER

Rev No.	Date	Revision Note	Drn by	Chkd by
P01	22.01.18	FOR INFORMATION	J.C.	S.T.
P02	08.06.18	ADDED PUMP REFERENCES & MINOR MODS	L.C.B.	S.T.
P03	20.07.18	TENDER ISSUE	J.D.	J.C.
P04	03.12.18	TENDER ISSUE	C.W.	S.T.

Rev No.	Date	Revision Note	Drn by	Chkd by

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Client: BARRATT LONDON
Project: FORMER NESTLE FACTORY

Title: BLOCDK D
ENERGY CENTRE SCHEMATIC

PROJECT	DISCIPLINE	ZONE	COMPANY	TYPE	NUMBER	REVISION
FNF	M	D	OCSC	SC	50-001	P04

Date: 22.02.17 Scale: 1:100 @ A1 Drn by: J.C. Chkd by: S.T. Aprvd by: J.F.

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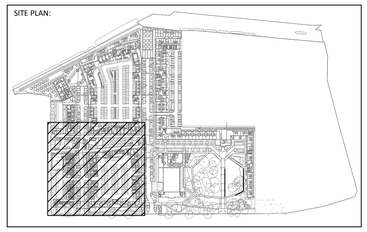
5. NOTE THIS DRAWING SHALL NOT BE USED FOR SETTING OUT PURPOSES.
6. MAINS GAS WORKS SHALL BE CARRIED OUT BY THE GAS UTILITY CONTRACTOR
7. MAINS COLD WATER PIPEWORK SHALL BE LAID BY THE WATER CONTRACTOR
8. ALL EXCAVATIONS SHALL BE CARRIED OUT BY THE SUB-CONTRACTOR INCLUSIVE OF GAS, WATER, POWER AND TELECOMS
9. CONTRACTOR TO ENSURE THAT ALL BT OPENREACH DUCTS AND CHAMBERS ARE INSTALLED IN ACCORDANCE WITH THE OPENREACH DEVELOPERS GUIDE.
10. THE CONTRACTOR SHALL ENSURE THAT THE INSTALLATION IS IN ACCORDANCE WITH THE NJUG REQUIREMENTS.
11. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ARCHITECTS DRAIWNG
12. ALL DIMENSIONS SHOWN ARE THE INTERNAL DIMENSIONS OF THE PRE INSULATED PIPEWORK

SITE PLAN:



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Rev No.	Date	Revision Note	Drn by	Chkd by

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OCSC O'CONNOR SUTTON CRONIN Multidisciplinary Consulting Engineers

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Client: BARRATT LONDON
Project: FORMER NESTLE FACTORY, HAYES

Title: PROPOSED SITE-WIDE
INCOMING SERVICES LAYOUT (1 OF 3)

PROJECT	DISCIPLINE	ZONE	ORIGINATOR	TYPE	NUMBER	REVISION
FNF	N	SITE	OCSC	GA	51-004	T03

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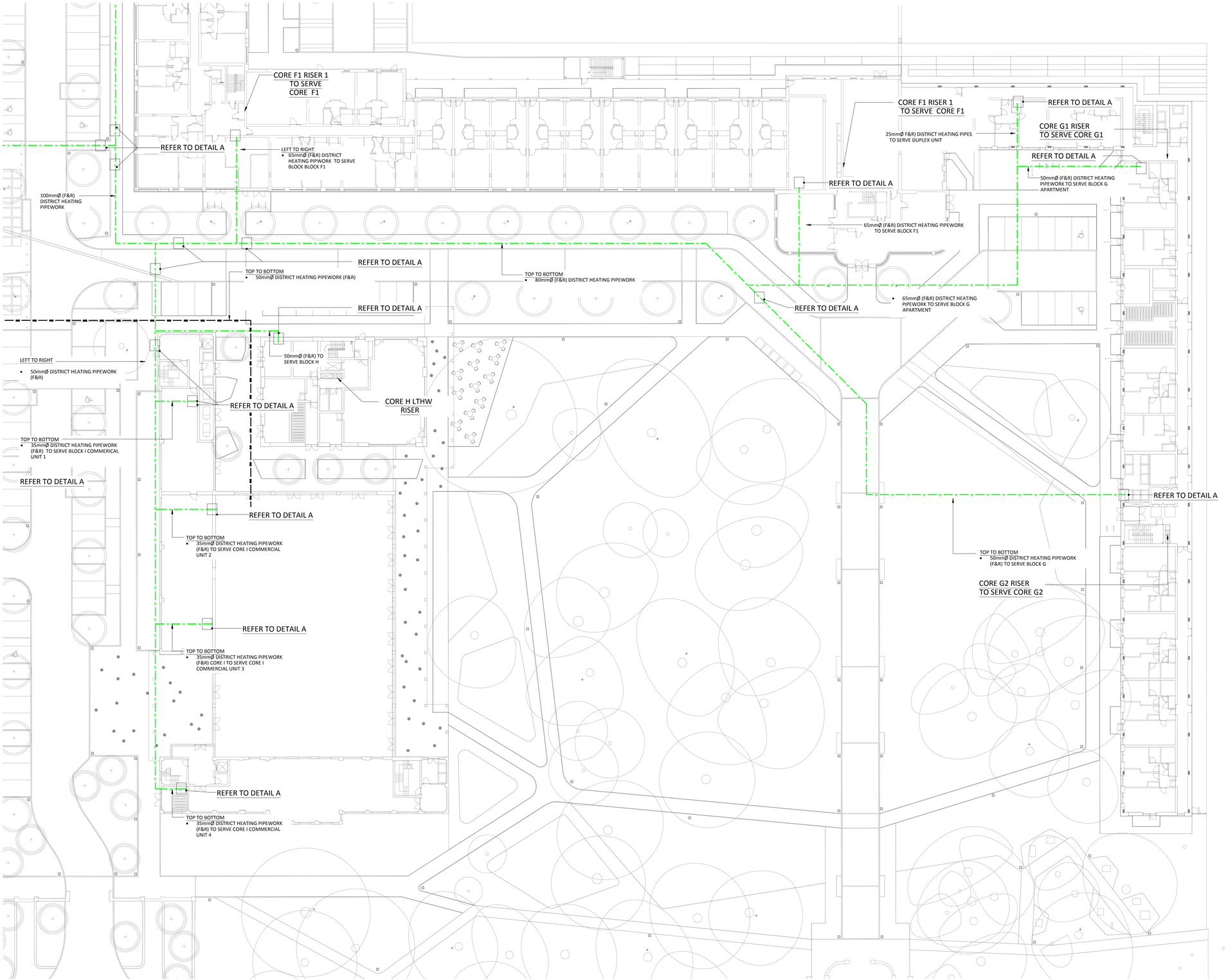

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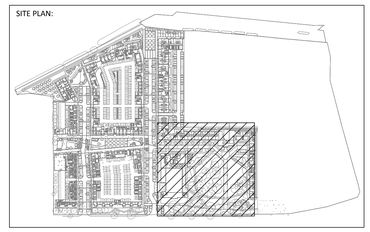
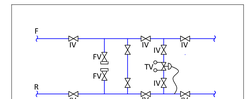
12. ALL DIMENSIONS SHOWN ARE THE INTERNAL DIMENSIONS OF THE PRE INSULATED PIPEWORK

SITE PLAN:





DETAIL 'A' – FUTURE BRANCH TERMINATION WITH FLUSHING LOOP

- FOR SETTING OUT REFER TO ARCHITECT'S DRAWINGS.
- THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER ARCHITECTURAL AND ENGINEERING DRAWINGS AND ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS.
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Rev No.	Date	Revision Note	Drn by	Chkd by
P01	08.06.18	ISSUED FOR COMMENT	J.D.	S.B.
T01	12.07.18	FOR INFORMATION	J.D.	J.C.
T02	30.07.18	TENDER ISSUE	J.D.	J.C.
T03	19.11.18	PIPE SIZES UPDATED IN LINE WITH SWEDISH STANDARD DESIGN GUIDANCE	J.D.	J.S.

Rev No.	Date	Revision Note	Drn by	Chkd by

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Multidisciplinary Consulting Engineers

Dublin | London | Belfast | Galway | Cork

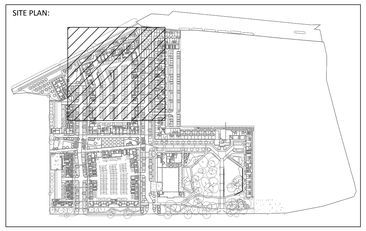
Client: BARRATT LONDON
Project: FORMER NESTLE FACTORY, HAYES

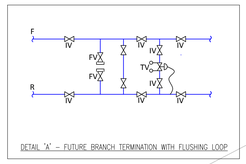
Title: PROPOSED SITE-WIDE
INCOMING SERVICES LAYOUT (2 OF 3)

PROJECT	DISCIPLINE	ZONE	ORIGINATOR	TYPE	NUMBER	REVISION
FNF	N	SITE	OCSC	GA	51-005	T03

Date: 31.01.18 Scale: 1:200 @ A0 Drn by: J.D. Chkd by: S.B. Aprvd by: J.S.

SITE PLAN:





DETAIL 'A' – FUTURE BRANCH TERMINATION WITH FLUSHING LOOP

BLOCK E CORE 1
TO SERVE E1

REFER TO DETAIL A

LEFT TO RIGHT
- 65mmØ (F&R) DISTRICT HEATING PIPEWORK

BLOCK E CORE 2
TO SERVE E2 AND E3

REFER TO DETAIL A

TOP TO BOTTOM
- 50mmØ (F&R) DISTRICT HEATING PIPEWORK

REFER TO DETAIL A

LEFT TO RIGHT
- 100mmØ (F&R) DISTRICT HEATING PIPEWORK

DN

CORE F3 RISER TO
SERVE CORE
F3 & F4

REFER TO DETAIL A

TOP TO BOTTOM
- 2no. 65mmØ (F&R) DISTRICT HEATING PIPES

LEFT TO RIGHT
- 2no. 65mmØ BOOSTED COLD WATER SUPPLY

CORE F2 RISER 2
TO SERVE
CORE F2

REFER TO DETAIL A

TOP TO BOTTOM
- 2no. 50mmØ (F&R) DISTRICT HEATING PIPES

REFER TO DETAIL A

CORE F2 RISER 1
TO SERVE
CORE F2

TOP TO BOTTOM
- 2no. 65mmØ (F&R) DISTRICT HEATING PIPES

LEFT TO RIGHT
- 2no. 80mmØ (F&R) DISTRICT HEATING PIPES

GENERAL NOTES

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Rev No.	Date	Revision Note	Drn by	Chkd by

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Project: FORMER NESTLE FACTORY, HAYES

Title: PROPOSED SITE-WIDE
INCOMING SERVICES LAYOUT (3 OF 3)

PROJECT	DISCIPLINE	ZONE	ORIGINATOR	TYPE	NUMBER	REVISION
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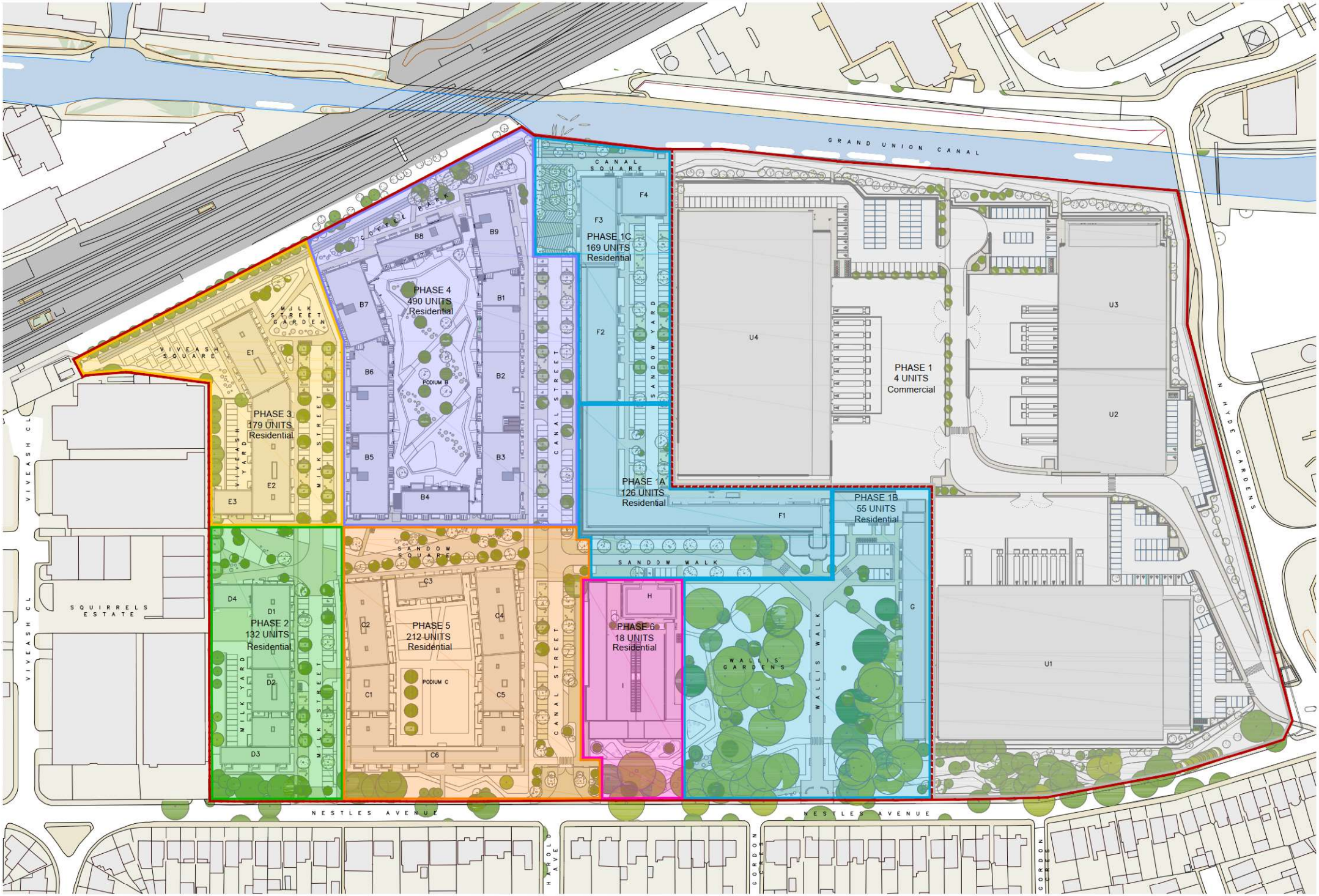
Date: 31.01.18 Scale: 1:200 @ A0 Drn by: J.D. Chkd by: S.B. Aprvd by: J.S.



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SEGRO

PHASE 1 COMMERCIAL AND RESIDENTIAL TO COMMENCE AT THE SAME TIME
PHASE 1 - COMMERCIAL - 4 UNITS
PHASE 1 (A, B, C) - RESIDENTIAL - 350 UNITS
PHASE 2 - RESIDENTIAL - 132UNITS
PHASE 3 - RESIDENTIAL - 179 UNITS
PHASE 4 - RESIDENTIAL - 490 UNITS
PHASE 5 - RESIDENTIAL - 212 UNITS
PHASE 6 - RESIDENTIAL - 18 UNITS
RED LINE - WHOLE SITE
RED LINE -LIMIT BETWEEN RESIDENTIAL AND COMMERCIAL AREA

DATE REV DESCRIPTION CHK
CONSULTANTS DWG NOS

MAKOWER ARCHITECTS
24–26 Great Suffolk Street
Borough, London SE1 0UE

FORMER NESTLE FACTORY, HAYES
MASTERPLAN - Phasing

MP 701

SCALE 1:500@A0 0 5 10 20
ISSUE D1

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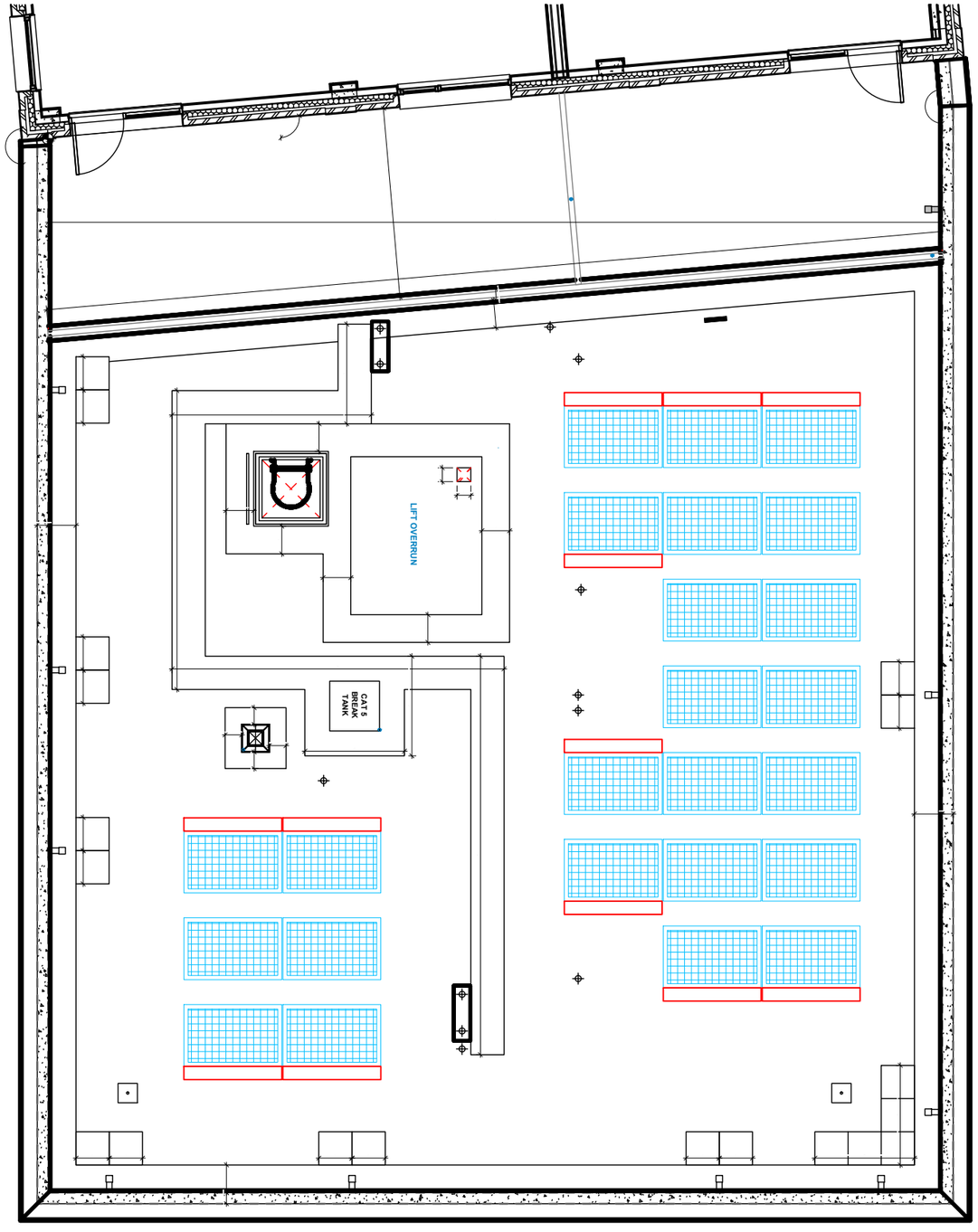
-C1-RF-DR-PV-90001

Title: Nestle Block C1 - PV Layout

Rev: P01



SOLAR PV DESIGN - ELEVATIONAL TREATMENT MAY VARY

SOLAR PV ARRANGEMENT
BARRATT HOMES WEST LONDON
NESTLE - BLOCK C
BLOCK C1
SITE ID: 2258PV

DC CABLE

T TIGO - PANEL OPTIMISER

ENPHASE - MICRO INVERTER

DRAWN BY:	EG
DATE:	15/05/25
CHECKED BY:	EC2
DATE:	15/05/25
REVISION:	R1

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DY11 7SL

BLOCK C1 - 24 X 405W PANELS - 9.72KWP/8621.64KWH

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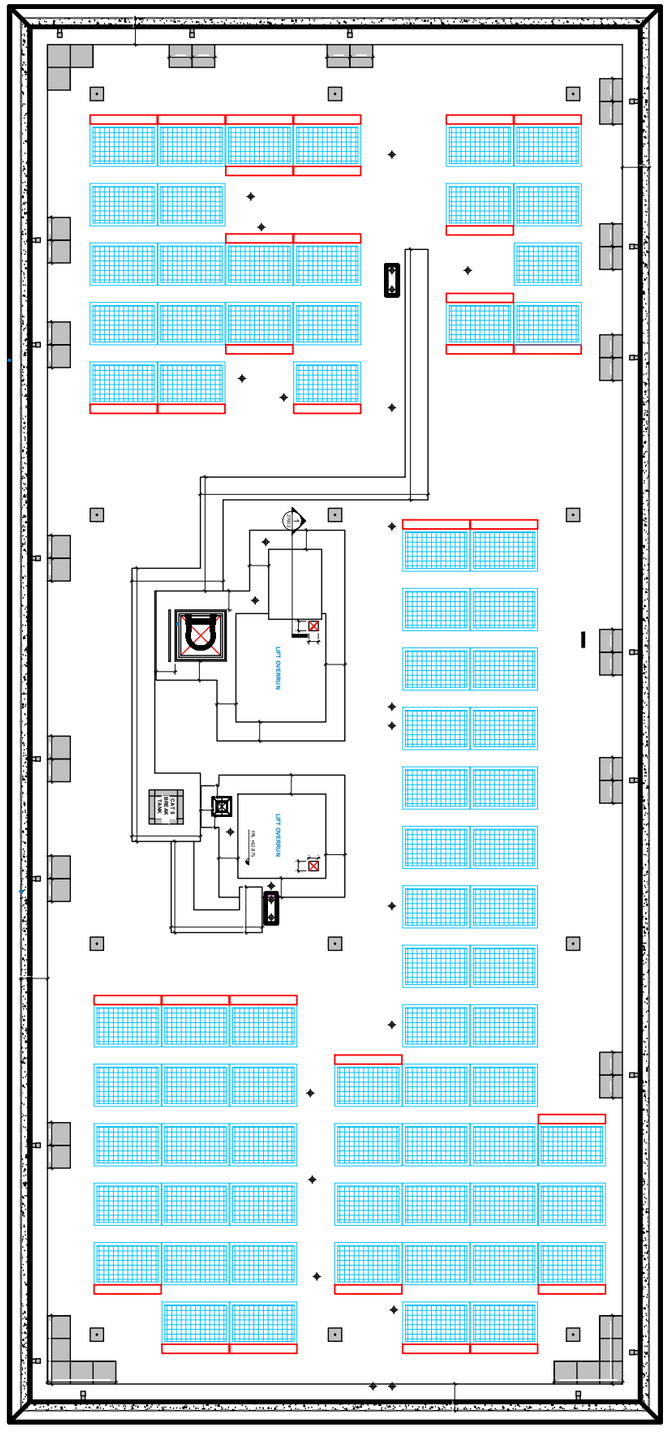
H7946-EC2-C2-RF-DR-PV-90001

Title: Nestle Block C2 - PV Layout

Rev: P01



BLOCK C2 - 76 X 405W PANELS - 30.78KWP/27394.2KWH

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SOLAR PV ARRANGEMENT
BARRATT HOMES WEST LONDON
NESTLE - BLOCK C
BLOCK C2
SITE ID: 2258PV

DC CABLE

T TIGO - PANEL OPTIMISER

ENPHASE - MICRO INVERTER

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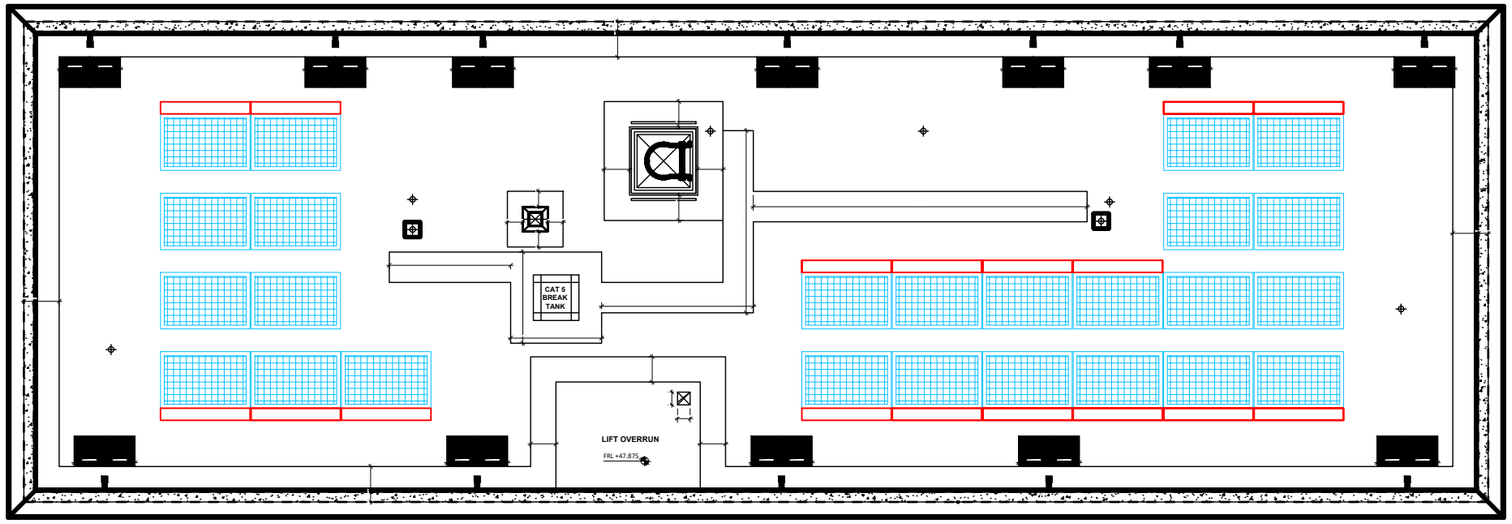
H7946-EC2-C3-RF-DR-PV-90001

Title: Nestle Block C3 - PV Layout

Rev: P01



BLOCK C3 - 25 X 405W PANELS - 10.125KWP/9011.25KWH

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SOLAR PV ARRANGEMENT
BARRATT HOMES WEST LONDON
NESTLE - BLOCK C
BLOCK C3
SITE ID: 2258PV

DC CABLE

TIGO - PANEL OPTIMISER

ENPHASE - MICRO INVERTER

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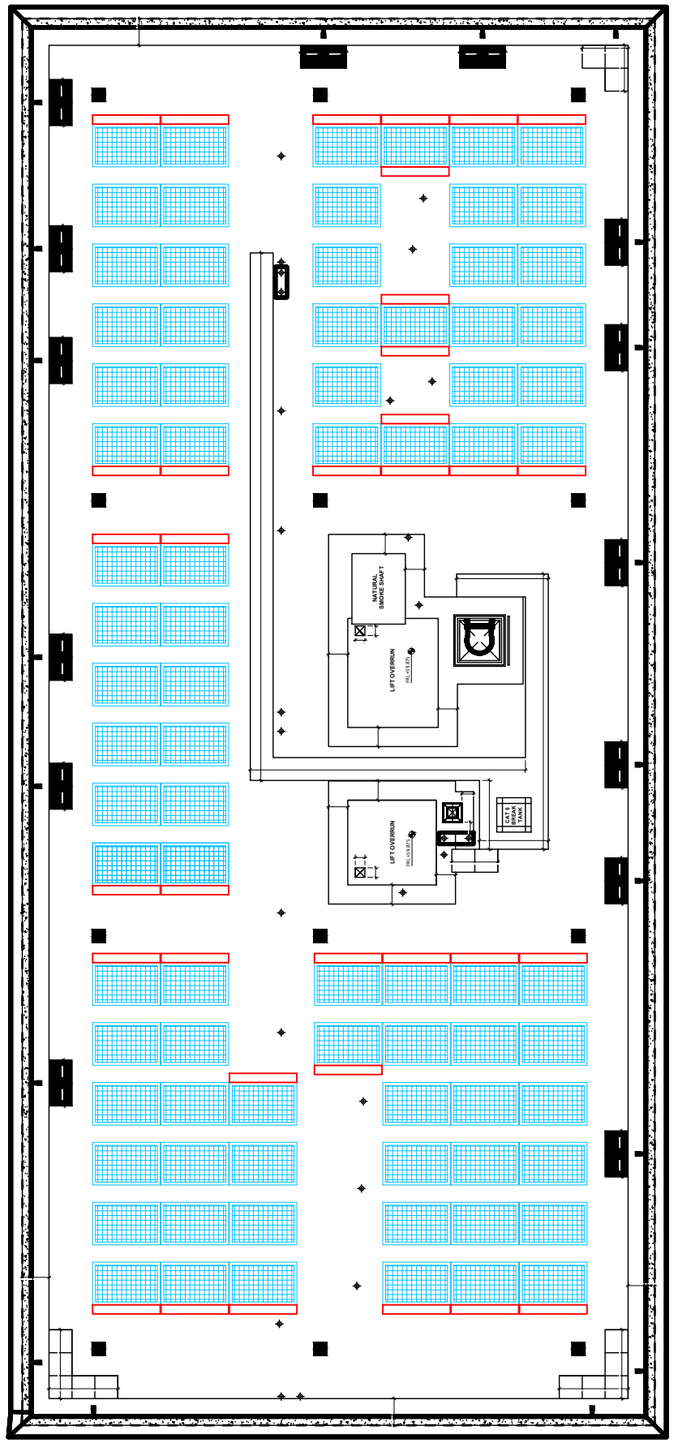
H7946-EC2-C4-RF-DR-PV-90001

Title: Nestle Block C4 - PV Layout

Rev: P01



BLOCK C4 - 81 X 405W PANELS - 32.805KWP/29196.45KWH

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SOLAR PV ARRANGEMENT
BARRATT HOMES WEST LONDON
NESTLE - BLOCK C
BLOCK C4
SITE ID: 2258PV

DC CABLE

T TIGO - PANEL OPTIMISER

ENPHASE - MICRO INVERTER

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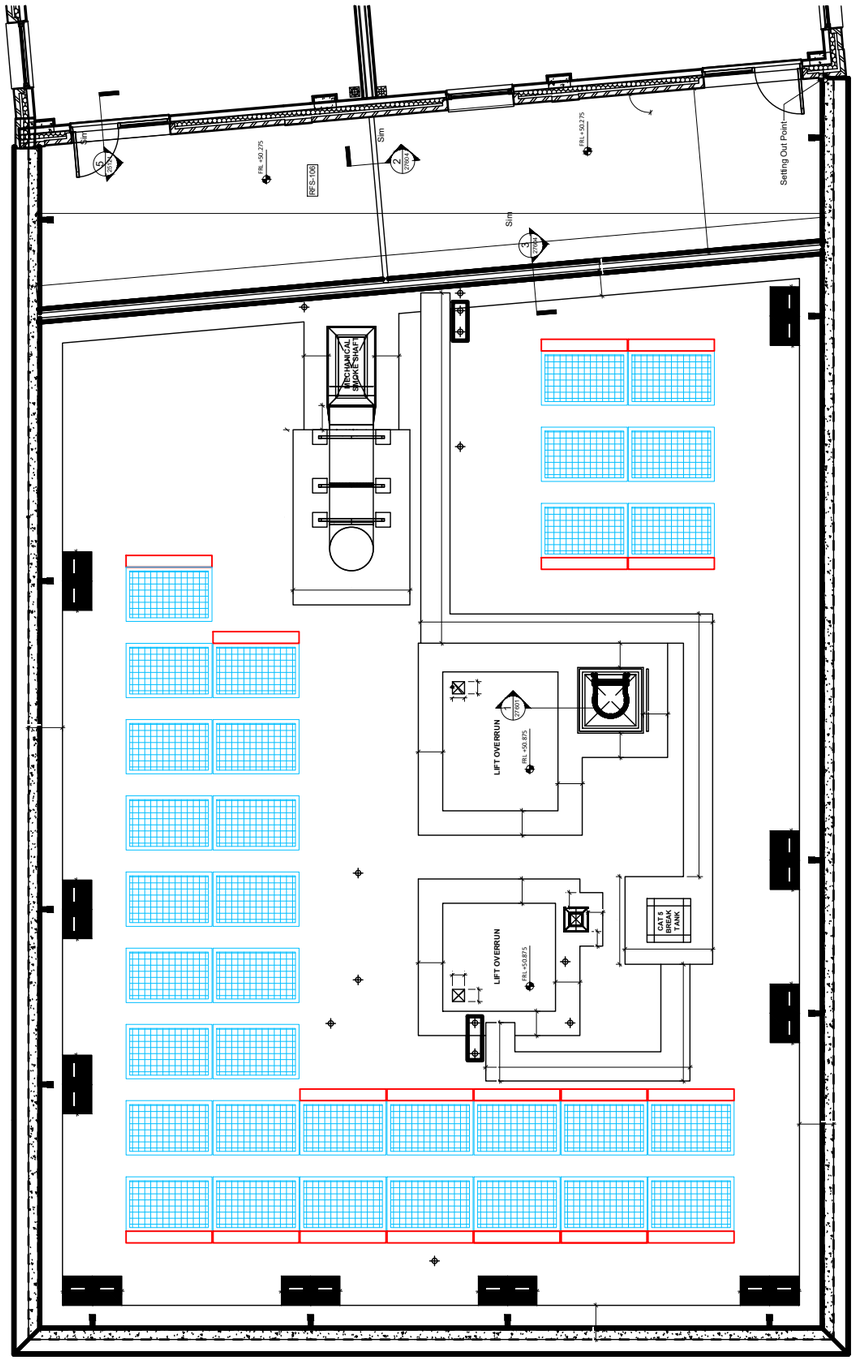
H7946-EC2-C5-RF-DR-PV-90001

Title: Nestle Block C5 - PV Layout

Rev: P01



BLOCK C5 - 33 X 405W PANELS - 13.365KWP/11854.755KWH

SOLAR PV DESIGN - ELEVATIONAL TREATMENT MAY VARY

SOLAR PV ARRANGEMENT
BARRATT HOMES WEST LONDON
NESTLE - BLOCK C
BLOCK C5
SITE ID: 2258PV

DC CABLE

T TIGO - PANEL OPTIMISER

ENPHASE - MICRO INVERTER

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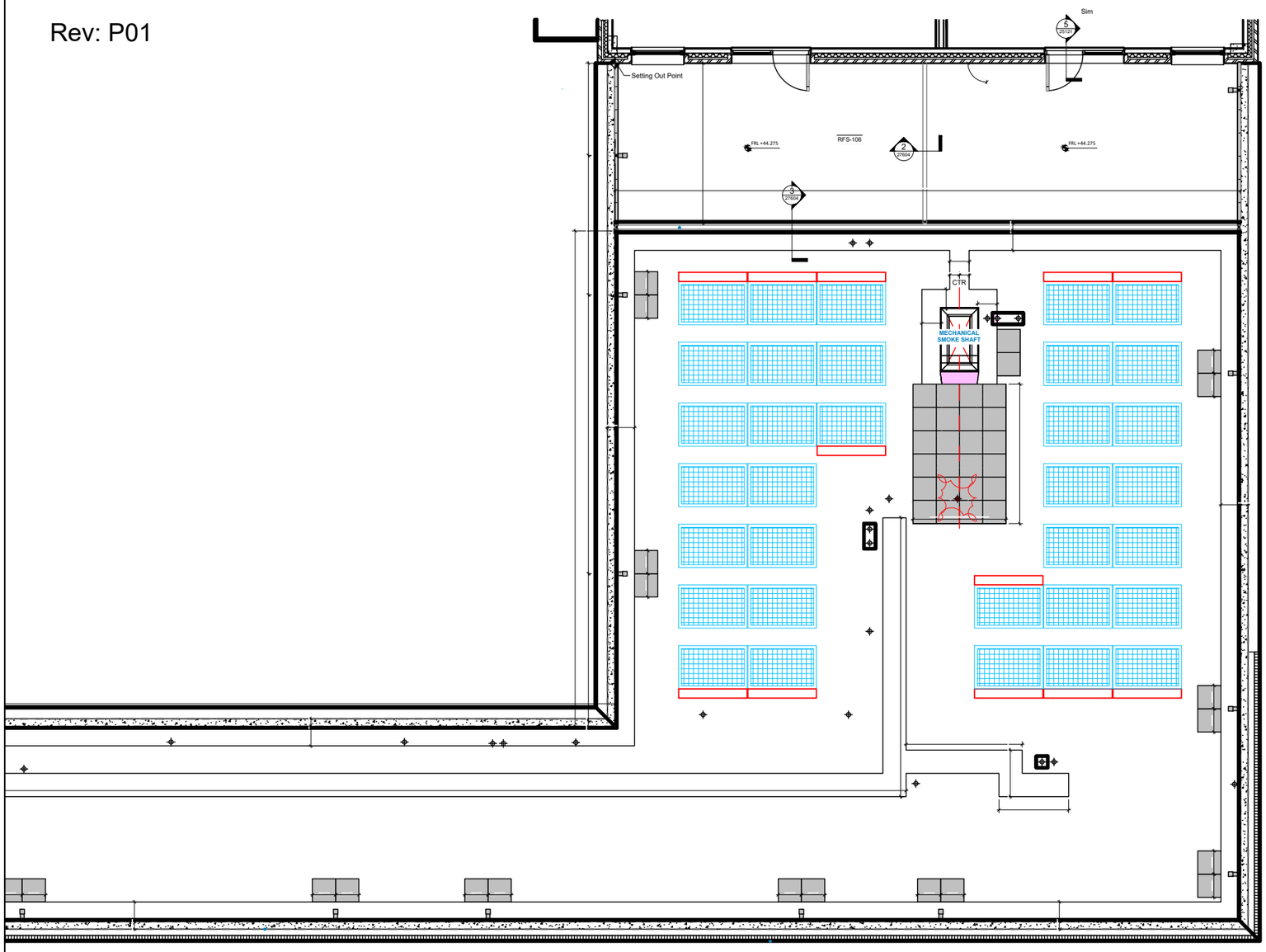
H7946-EC2-C6-RF-DR-PV-90001

Title: Nestle Block C6 - PV Layout

Rev: P01



BLOCK C6 - 33 X 405W PANELS - 13.365KWP/11854.755KWH

SOLAR PV DESIGN -
ELEVATIONAL TREATMENT
MAY VARY

SOLAR PV ARRANGEMENT
BARRATT HOMES WEST LONDON
NESTLE - BLOCK C
BLOCK C6
SITE ID: 2258PV

DC CABLE

T TIGO - PANEL OPTIMISER

ENPHASE - MICRO INVERTER

DRAWN BY:	EG
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FORMER NESTLE FACTORY SITE, HAYES – ENERGY CENTRE MEP SERVICES PARTICULAR PERFORMANCE SPECIFICATION

Prepared for: Barratt London
Prepared by: John Cotter.
Project Reference: Former Nestle Factory Site – Hayes.
Document Reference: FNF-SITE-SP-200-0001

Status	Revision	Issued Date	Prepared By	Approved By	Comments
S2	P01	04.06.18	JC	ST	Issued for information

NOTICE

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1 PROJECT DESCRIPTION

The Former Nestle Factory Site is a new mixed-use residential development, located within Hayes, London. The development comprises of 1381 residential dwellings across multiple phases. The development shall also accommodate approximately 834m2 of commercial building area.

This report intends to outline the performance requirements of the proposed central district heating energy for the development.

Residential (1381 Apartments)

Block	Quantity of Apartments
B	490
C	212
D	132
E	179
F	295
G	55
H	18

Non Residential

Block	m² (GIA)
F	490
H	212
I	132

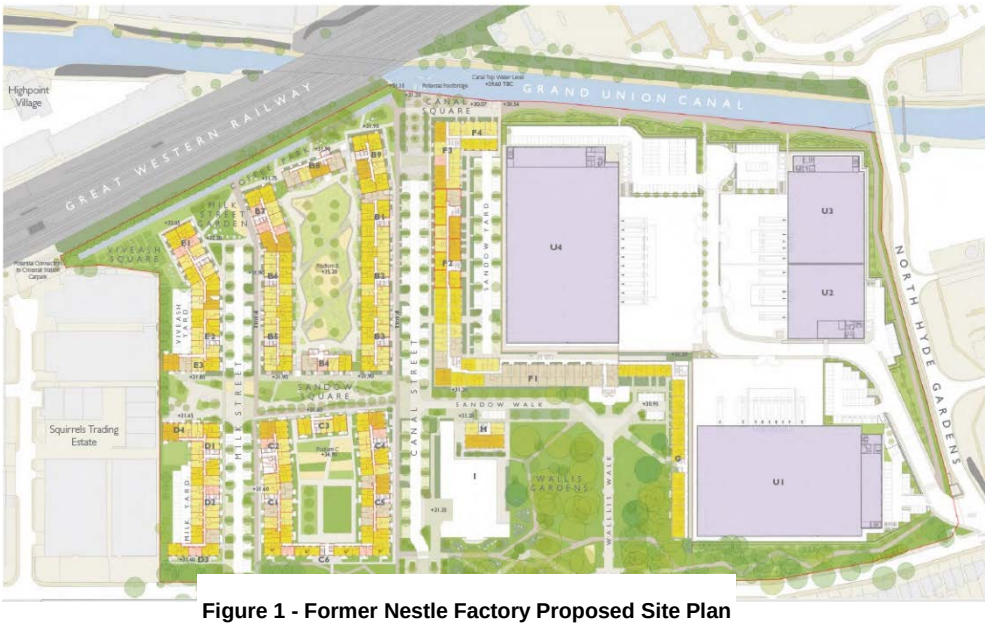

Figure 1 - Former Nestle Factory Proposed Site Plan

2 SCHEDULE OF WORKS

2.1 Introduction

The works comprise of the detailed design, supply and installation of a new Mechanical, Electrical & Public Health Services for the Energy Centre at FNF. The Energy Centre is located in Building D, which is the Central Power House serving the wider development. Refer to the architects drawings and associated documentation for further information.

The Energy Centre is to serve approximately 1381 dwellings, across multiple Blocks, as well as approximately 834m^2 of Commercial Building Area.

The Contractor's Tender will be deemed to include turnkey installations in full compliance with this specification including for the final detailed design, supply, installation, testing and commissioning of the works.

On no account shall an omission from the description relieve the Contractor from his obligation in carrying out the whole of the works described in this specification which shall conform to all relevant standards and requirements.

The Contractor shall allow for the full Energy Centre fit-out within their tender returns. This shall however be broken down into three phases as described below:-

- Phase 1 – Installation of 2No. Boilers, all primary & Secondary Pipework with Blanked off connections left for future connection of the rest of the boilers & CHP, flushing bypasses shall be installed, and the contractor shall ensure that all pipework has circulation through it for water quality purposes.
- Phase 2 – Boilers 3-4 commissioned and brought online.
- Phase 3 – When the development reaches 60%, the remaining boilers and CHP units shall be installed.
- All flues & pipework shall be installed during the first phase of the works, with blanked off sections left for future connection to the Plant. Due to the complex nature of installing Thermal Stores, these shall also be installed under Phase 1.

This Tender shall include for the Energy Centre and all associated buried District Heating Network across the site and into each block.

The Contractor shall include for a DSEAR assessment to be completed prior to Handover.

The Contractors Design Portion (CDP) shall include all works within the energy center, including the BMS systems, fire alarm systems, controls wiring & the Flue System.

This specification shall be read in conjunction with the Architectural Specification and Drawings, the MEP Services Drawings and the Structural Engineers Specification and Drawings.

The contractor shall not handover to the ESCO (as nominated by Barratt Homes) until an agreed period after completion of the permanent energy centre. The contractor shall provide a

2 year maintenance/defects period following completion and operation of the permanent energy centre combined with a full life warranty for all plant used in the preceding period.

During this 2 year period, the contractor shall allow for remote monitoring and call outs for defects.

The contractor shall acquire the buried district heating pipework for site wide, this shall include all relevant valves within pits and chambers constructed by the groundwork's package

2.2 Scope of Contract

The Contract includes the final detailed design supply, delivery to site, off-loading, positioning, installation and commissioning of all items of equipment and materials required for the following works including all skilled and unskilled labour and all incidental items necessary for the full completion of the MEP Services Installation ready for handing over to the Client in working order and in accordance with the agreed programme.

Throughout this specification the word 'Contractor' shall read as meaning MEP Engineering Services Contractor.

The works shall generally comprise, but not be limited to, the following systems and principal equipment in the Energy Centre:-

- New gas services to new boiler plant and combined heat and power (CHP) plant.
- Gas boosting equipment to CHP units.
- Mains cold water supplies.
- Low pressure hot water heating boilers and flues.
- Primary Side Heating Pumps including Boiler Shunt Pumps.
- 2 No. CHP Units and Thermal Stores as detailed.
- Thermal Stores.
- CHP energy meter. 1 Per Unit.
- Boiler Heat Meters & Heat Meter on Main Supply to Site.
- CHP circuit plate heat exchanger.
- CHP circulation pumps, one either side of the plate heat exchanger.
- Secondary Pumps. An allowance has been made for a Jockey pump at 10l/s Vs 200kPa.
- Air & Dirt Separators on primary & secondary systems.
- Side Stream Filtration.
- Culligan Water Treatment.
- Duty/Assist Main Plate Heat Exchangers. Heating substations shall not be used within the Residential Buildings. They shall be used within commercial buildings.
- Energy Centre Supply & Extract Ventilation.
- Pressurisation and degassing equipment for primary and secondary systems.
- Chemical dosing pots for primary and secondary systems.
- Interconnecting pipework, valves and fittings, insulation, trace heating to cold water only, safety installations and all other components required for fully functional systems.
- Labelling and updating existing wall mounted valve schedules and schematics for the energy centre.
- Electrical power and controls installations within the Energy Centre
- The installation of a new LV supply to the Energy Centre to supply the proposed new mechanical equipment.
- Low voltage distribution system
- General power installation
- General lighting installation
- Emergency lighting installation
- Telecommunication system
- Fire detection and alarm system

- Automatic controls and motor control centres with Building Management System (BMS) outstations and integration with the existing BMS. The location of the outstation is still to be confirmed.
- Maintenance spares and tools.
- Builder's work in connection (BWIC).
- Testing, Phased commissioning and training.
- As Installed drawings, maintenance manuals, system demonstration and training
- Equipment warranties and plant maintenance
- The contractor shall include for submitting all anti vibration equipment, inertia basis, and attenuators to the Acoustic Engineer for Approval.

The works covered by this specification, the associated schedules and drawings shall comprise a complete package for the services in the Energy Centre itself and incoming services as required and the full commissioning and certification of the services within the Energy Centre leaving them fully functional and fully operational. The Contractor shall include for returning to the Energy Centre to recommission the system 5 times. This is to incorporate the phasing of the scheme.

2.3 Programme

Commencement and completion of the installation shall be agreed with the Construction Manager and shall be in accordance with the Construction Manager's Programme of Works. The Contractor shall pay particular attention to site access and traffic restrictions, noisy work limitations and permitted working hours, the details for which should be contained within the Construction Managers Conditions of Contract and Preliminaries. Allowance for such factors shall be included within the tender. Claims for lack of knowledge shall not be considered.

2.4 Coordination

Prior to the installation of any equipment the Contractor shall agree with other trades, the location of equipment, routes for cables, trunking, ductwork, pipework etc to ensure adequate coordination on site.

2.5 Design Standards

The works shall be in accordance with relevant Byelaws, Statutory requirements and Regulations. All materials, plant, equipment and workmanship provided, designed and installed shall comply with all relevant EN and British Standards and Local Authority requirements. The General Specification identifies standards applicable to particular services and equipment.

The installation shall be installed in accordance with good current practice and shall comply specifically with the following, however, not limited to:-

- Electricity at Work Regulations
- The Electricity Safety, Quality and Continuity Regulations
- The Electricity Act
- The Building Act
- The Electromagnetic Compatibility Regulations
- Tort and negligence
- All relevant Approved Documents (Building Regulations)
- Health and Safety at Work Act
- BS 7671 Requirements for Electrical Installations
- IET Guidance Notes
- IET On-Site Guide
- BS 9999 Fire safety in the design, management and use of buildings. Code of practice
- BS 9991 Fire safety in the design, management and use of residential buildings. Code of practice
- BS 8519 Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications. Code of practice
- BS 5266 (All relevant parts)
- BS5839 (All relevant parts)
- CIBSE Codes, Technical Memoranda and Guides
- All relevant British Standards/Codes of Practice, whether mentioned or not
- CDM Regulations
- Water Regulations
- Requirements of Statutory Undertakings.
- Building Regulations and associated Approved Documents.
- The Domestic Building Services Compliance Guide and the Domestic Heating Compliance Guide.
- BS 5422 Method for specifying thermal insulation.
- BS 9999 (All relevant parts)
- BS EN 81 Safety rules for the construction and installation of lifts.
- The Water Regulations.
- Gas Safety (Installation and Use) Regulations.
- The F-Gas Regulations.
- Environmental Protection Agency codes of practice, Regulations and requirements.
- Control of Substances Hazardous to Health (COSHH) Regulations.
- Control of Noise at Work Regulations.
- The Building Control Officer's requirements.
- The requirements of the local Fire Brigade and its Fire Prevention Officer(s).
- The Design Guide for the Fire Protection of Buildings by the Loss Prevention Council and any subsequent design guides published by the Fire Protection Association.

- All current Guides, Application Manuals, Technical Memoranda, publications, recommendations and commissioning codes of CIBSE, IGE and IOP.
- Lifetime Homes.
- The Disability Discrimination Act.
- Requirements to achieve a "Secure by Design" Award for Developers where appropriate and relevant to specific circumstances of the installation
- BREEAM Requirements
- Building Services Research and Information Association (BSRIA) Environmental Code of Practice from buildings and their services.
- HVCA Maintenance Guides.
- NHBC Guidelines.
- All current publications and recommendations of the Building Research Establishment.
- All requirements and recommendations of the Environment Agency and all local Water Supply, Drainage and Highways Authorities.
- All Acts of Parliament and statutory instruments governing pollution control and environmental protection.
- Product and/or materials manufacturers' printed guides and recommendations.
- All European Product Directives.
- All requirements and recommendations of the contracted utility supply companies and all Acts of Parliament and statutory instruments governing utility supplies and usage.

2.6 Information to be provided with Tender Submission

The Contractor shall submit with their Tender a brief description of the proposed MEP Services Engineering systems and equipment for comment by the Client, Consultant and Project Manager.

The Contractor shall also provide the following minimum information:-

- Properly completed tender summary sheets
- Schedule of proposed manufacturers for plant and equipment where not uniquely specified
- Proposed programme identifying design and installation periods and key procurement dates

2.7 Information to be provided upon Acceptance of Tender

Prior to commencing works on site, the Contractor shall prepare and submit to the Client detailed working drawings and supporting information of the MEP Services design. The drawings shall include plans, sections and elevations, wiring diagrams, schematic diagrams and details to show the proposed installations accurately reflecting the design specification.

All drawings shall be comprehensively detailed giving dimensions, tolerances, finishes, fixings, builders work, materials etc. Drawings and equipment details to be included as a minimum requirement are:-

- Wiring diagrams for all plant and equipment requiring electrical connections. Where manufacturer's original drawings are used, they shall be specific to the relevant plant

and all references to optional features, other machines of a range etc. shall be deleted. All wiring diagrams shall clearly indicate the wiring which forms part of or is connected to the equipment as delivered.

- Detailed installation drawings of all plant and equipment.
- Installation drawings showing the incoming and external services and the general distribution of services from the main service intake up to and including the point of final connection.
- Any detailed drawings, or manufacturers drawings required prior to, or found necessary during erection, manufacture and progress of the works.
- Detailed drawings of all fabricated items.
- Circuit schedules for all main supply, sub circuits and final circuits.
- Detailed plans, sections and elevations showing all required builders work, including the size and position of all bases, plinths, holding down bolts, holes, chases, trenches etc. in the structure or building fabric related where applicable to the column/building grid lines, steelwork to be built in or attached to the structure.
- Diagrammatic, schematic and wiring diagrams of all automatic control systems, including arrangements and description of operation of the automatic control installation.
- Manufacturers' data/drawings of all equipment, assemblies, components and installation clearly indicating operating characteristics of the equipment.

2.8 Site Visit

The Contractor shall be deemed to have visited the site during the tender period, acquainting themselves fully with local conditions and to obtain all information required to accurately formulate the tender including existing building details and arrangements and site topography.

The Contractor shall liaise with the client to gain access to the property. Any apparent discrepancies or queries shall be referred to the Consulting Engineer for clarification prior to submission of Tender.

Claims for lack of knowledge shall not be considered.

2.9 Installation Requirements

Items requiring regular adjustment or affording isolation facilities, where located in concealed positions shall have removable access covers, tiles, or other suitable provision made to afford ease of access.

All services shall be installed with all aspects of Health and Safety at Work fully considered.

When preparing installation drawings, the Contractor shall have due regard for all aspects of the building design, location of all proposed services and shall make themselves aware of any co-ordination problems which need to be resolved before the installation commences.

All dimensions given on drawings shall be verified by the Contractor on site before the installation commences.

The Trade Contractor shall liaise with the Construction Manager during the Tender process to ensure they are fully aware of the sectional handovers within the development. The Trade Contractor shall be responsible for ensuring the installation is in full compliance with the sectional handovers such that the associated system can have be fully commissioned during each sectional handover and there are no incomplete works which serve finished areas.

The Trade Contractor shall ensure that no closed protocol systems are installed within the development, excluding the fire alarm system.

2.10 Construction (Design and Management) Regulations

The Contractor shall note that this project shall be carried out in accordance with the Health & Safety Executive Construction (Design and Management) Regulations 2015.

The Contractor shall include in the tender for complying with the CDM Regulations 2015.

2.11 Builders Work

The builders work associated with the MEP Installation works shall be executed by the Main Contractor.

The builders work comprises the elements of building work necessary to incorporate the services installation into the building/structure, fabric and finishes including cutting out of all chases, holes, forming openings and trunking sleeves, provision of supports/noggins in walls to accommodate fixing of services equipment and the provision of plywood backboards for the support of ceiling mounted luminaires, smoke detectors, etc.

The Contractor shall be responsible for producing detailed builders work schedule for pricing, drawings and for marking out work required. All making good and painting shall be carried out by the Main Contractor.

2.12 Approved Specialist Sub-Contractors/Manufacturers

This specification (including the schedules included in this specification) details the approved manufacturers/installation contractors for this project. Should the tendering Contractor wish to use any alternatives, details shall be submitted at tender stage, along with any programme or financial incentives to the Client for approval.

The Contractor shall liaise with their selected specialist sub-contractors throughout the installation process, ensuring that the Client's requirements are met in full. In addition, the electrical contractor shall provide and install all power supplies and containment as necessary for these systems.

Orders for all sub-contractors and manufacturers shall be placed to allow sufficient time for lead in times, including any holiday periods, to allow materials and labour to arrive on site in accordance with the main construction programme.

3 BASIS OF DESIGN

3.1 Design Parameters

External Temperatures		
	Winter	-4ºC, 100% RH
	Summer	30ºC db, 21ºC wb
Internal Temperatures	Winter	Summer
Apartments		
Living Room	22°C ± 2°C	Uncontrolled
Bedrooms	18°C ± 2°C	Uncontrolled
Bathrooms and En-Suites	22°C ± 2°C	Uncontrolled
Halls and Lobbies	18°C ± 2°C	Uncontrolled
Kitchens	18°C ± 2°C	Uncontrolled (Note 01)
Utility Room, Cloakroom, WC	21°C ± 2°C	Uncontrolled (Note 02)

Note 01: *Kitchens are designed to the "Living Rooms" conditions where they are part of the same space.*
Note 02: *Temperatures in these spaces are only controlled where large enough to justify a dedicated underfloor heating circuit.*

Heating Services	
Primary Heating flow and return	73/43°C
Secondary Heating flow and return	70/40°C (Note 01)
Primary heating and CHP circuit maximum	90°C
CHP return temperature	30°C
Dwelling heating flow and return	55/45°C

Note 01: Return temperatures from HIUs will be less than shown above under full load conditions so the return to the Energy Centre will vary accordingly.

Heating Pipework Design Criteria	
Maximum Pressure Drop – Buried Network	73/43°C
Maximum Pressure Drop – Internal Network	70/40°C (Note 01)
Water Velocity	
Pipework of 50mm diameter and below	30°C
Pipework of 65mm diameter and above	55/45°C

3.2 Ventilation Design Criteria

All mechanical ventilation rates shall be in accordance with BS 6644.

3.4 Environmental Noise Criteria

The M&E systems will be designed such that levels of M&E noise are achieved to reach the external environmental noise criteria, defined within the Acoustic Report.

Internal Noise Criteria

The M&E systems will be designed such that levels of M&E noise are achieved in the areas defined. This includes noise from M&E systems dedicated to each area, noise intrusion from M&E noise sources (i.e. noise from external plant via windows) and structure borne noise from M&E sources.

The noise level in plant rooms is reduced if necessary to comply with noise levels in adjacent areas.

The rated noise level from any plant, together with any associated ducting, shall be 10 dB(A) or more below the typical minimum measured LA90 level at the nearest noise sensitive premises. The overall criteria to be achieved are as below:

Criteria for testing of emergency plant such as the emergency generator will be 10 dB(A) above the proposed daytime environmental criteria.

5 PIPEWORK SERVICES

Pipework shall generally be installed in accordance with the requirements detailed in the General Specification unless otherwise stated in this document.

Pipework materials shall be as follows. The contractor shall ensure that all piping materials installed comply with the relevant British Standards. Any difference between the material listed below and the materials used for installation must be must be brought to the attention of the engineer for clarification.

Service	Application	Material Specification
Gas	Internal, throughout	Medium and heavy grade black carbon steel pipework conforming to BS EN 10255.
LTHW	Plantrooms	Medium and heavy grade black carbon steel pipework conforming to BS EN 10255.
	Service Risers	Medium and heavy grade black carbon steel pipework conforming to BS EN 10255.
	Horizontal distribution (main runs)	Medium and heavy grade black carbon steel pipework conforming to BS EN 10255.
	Horizontal distribution (corridors)	Medium and heavy grade black carbon steel pipework conforming to BS EN 10255.
	Secondary side of HIUS in apartments	Copper Table X non-arsenical grade in accordance with BS EN 1057 R250 half hard.
	Underfloor heating	Cross linked PE tube with oxygen barrier with 2mm wall thickness or five layer oxygen diffused PB pipework with 2mm wall thickness conforming to BS 7291.
Mains Cold Water	External	ALPE barrier pipe to BS EN 12201
Domestic hot and cold water	Internal, throughout	Copper Table X non-arsenical grade in accordance with BS EN 1057 R250 half hard.
Condensate	Throughout	Copper Table X non-arsenical grade in accordance with BS EN 1057 R250 half hard.
Overflow and warning pipes	Throughout	MUPVC conforming to BS 4514 and BS 5255 with glued joints.
Safety valve discharges	Throughout	Copper Table X non-arsenical grade in accordance with BS EN 1057 R250 half hard. The discharges may be connected to MUPVC downstream subject to the appropriate lengths of copper pipework being fitted upstream in accordance with Regulations.
Above ground foul drainage	Risers and Landlords areas above ground	HDPE with fusion welded joints to EN 1519 installed in accordance with manufacturers recommendations for fixing, jointing and thermal movement.
Rainwater drainage	Throughout	HDPE with fusion welded joints to EN 1519 installed in accordance with manufacturers recommendations for fixing, jointing and thermal movement.

Where medium and heavy grade steel pipework is shown in the table above medium grade steel pipework shall be used except where pipework in installed in inaccessible locations when heavy grade pipework shall be used.

The black carbon steel pipework to BS EN 10255 and pipework fittings for gas services shall be screwed up to and including 40mm and welded or flanged for 50mm and above. All enclosures containing gas pipework shall be ventilated in accordance with the Gas Regulations.

The black carbon steel pipework to BS EN 10255 and pipework fittings for heating water services shall be screwed up to and including 50mm and welded or flanged for 65mm and above.

Welding of black carbon steel pipework shall be carried out in accordance with BS2971 and HVCA Code of Practice TR/5.

Black carbon steel screwed fittings shall be to BS EN 10241, BS EN 10242, BS 143 and 1256. Butt welding pipe fittings shall be to BS EN 10241 and BS EN 10253.

Copper Table X pipework to BS EN 1057 R250 in sizes up to and including 67mm shall be assembled with Yorkshire capillary fittings, having integral lead-free solder rings (YP range). End feed fittings shall not be used. Fittings shall be "lead-free" capillary to BS EN1254. All fittings shall be of metal not subject to dezincification. All flux materials used for soldering shall be WRC approved for use on potable water systems.

Copper Table X pipework to BS EN 1057 R250 in sizes 76mm and above shall be flanged, braze welded or welded. Flanges shall be mild steel with copper alloy centre to BS EN 1092-3. Silver alloy brazing metal shall be to BS EN 1044, Table 3, type 105, and protected against electrolytic action and corrosion. Brazing shall be carried out in accordance with BS EN 12797, BS EN 13134 and BS EN ISO 13585. Welding shall be carried out in accordance with BS EN ISO 9606-3 and BS EN ISO 24373.

ALPE barrier pipe for potable water shall have a pressure rating of 10 bar/SDR11 and jointed with butt or electrofusion fittings of equal pressure rating, or as appropriate to suit any ground contamination.

5.1 Welding

Welding of steel pipes shall be by the oxyacetylene and/or metal-arc methods. Oxy-acetylene welding shall not be used for steel pipework above 100mm or pipe flanges of any size. All welding shall be carried out by certified welders, who shall stamp all welds for identification purposes. Certificates and numbers shall be issued to the Engineer for approval. If requested by the Engineer, samples of the filler rod or electrodes to be used shall be submitted to the Engineer for approval before any work is commenced on site. The Engineer reserves the right to carry 'cutting out' welding tests on up to 5% of the welds on the installations. The Contractor shall include for remaking the joints where cut out without extra charge.

All welded tees, branches, reducers, etc, shall be beveled mitred joints fused by a penetration weld and finished off with a fillet weld of ample dimensions and penetration. All bends and tees

shall be easy-sweep branches made into the pipe except sizes 15mm and 20mm which must be made by drilling. 'Burning-in' will not be permitted on these sizes.

Welded branch connections to mains may be employed where the sizes of the branch is two or more smaller than the sizes of the main. Generally sweep branches shall be made except for tees or headers or where a sweep fitting would cause air to be trapped. Profiled entries into pipework may be cut by flame but the cut edges must be filed smooth and all swarf and cuttings must be removed from the bore of the pipework before the fittings is offered up for welding.

Welded joints shall not occur within two metres of anchor points.

Welding of copper pipework using a bronze technique may be employed, the joints to be formed by swaging and a neat joint made, or by using welding fittings of approved pattern. All traces of flux shall be removed after the weld is formed.

Full protection shall be given to the building fabric and decorations during welding by suitable fireproof mats. Every precaution shall be taken to prevent damage by scorching or fire. The contractor shall produce method statements for all welding operations and these must include the provision of two portable fire extinguishers for use by the welder in an emergency. During all welding or cutting operations the Welder shall be accompanied by a competent assistant.

The Contractor shall include in his tender for the supply of all electric arc welding plant and equipment necessary to complete the contract. The Contractor shall also include for the cost of providing a supply of electricity for welding purposes by the use of mobile generating sets.

5.2 Pipework Accessories

Valves, pipe fittings and other pipework accessories shall be in accordance with the requirements detailed in the General Specification unless otherwise stated in this document.

5.3 Pipework Insulation and Labelling

Pipework insulation shall be in accordance with the requirements detailed in the General Specification unless otherwise stated in this document.

Internal cold water pipework shall be insulated with rigid mineral fibre or CFC free phenolic foam preformed sectional insulation having a minimum density of 80 kg/m3. Pipe fitting insulation shall be moulded mineral wool factory-fabricated to fit standard fittings, bends, tees, elbows and valve body patterns. All insulation shall be securely fixed and finished with reinforced Class 'O' aluminium foil laminate sheeting with integral self-adhesive lap. Overlaps shall be neatly pasted down and vapour sealed. 75mm wide soft aluminium tape shall be applied over joints to maintain integrity of the vapour barrier. Supports shall be provided with rigid hardwood, phenolic or rubber bridges or proprietary inserts around the circumference of the pipe the same thickness as the insulation and the vapour seal continued through the supports. Bends and fittings shall be formed from mitred and trimmed sections cut to ensure that a good contact with the surface to be insulated is made, and that the true shape of the fitting is maintained.

All distribution pipework shall be identified or labelled in accordance with BS 1710 at maximum 3m spacing on straight runs and at all access positions and all branches. Labelling shall be applied directly to the pipe if it is uninsulated or on the outer cover of the insulation as appropriate. All pipes entering dwellings shall be labelled at the point of entry but labelling within dwellings is not required unless otherwise identified in this specification.

The thickness of pipework insulation for all services shall be in accordance with the standards specified in BS 5422. Where trace heating is specified against freezing the application of the insulation shall be strictly in accordance with the requirements of the trace heating manufacturer's instructions. The insulation thicknesses required by BS 5422 shall not be reduced because of the presence of trace heating.

It shall be noted that the thickness of insulation for plastic pipework shall be the same as the next larger steel or copper size unless calculated in accordance with Annex H of BS5422.

6 MAINS COLD WATER

Existing mains cold water services enter the Energy Centre plant room and shall terminate in a CAT 5 tank and booster set.

All equipment, pipework and fittings used in the installations shall be suitable for potable water and be Water Research Council approved.

All stop cocks to isolate incoming water supplies to the plant room shall be located in accessible positions in the room.

The contractor shall flush, chlorinate and refill the whole of the installations to be put into service following their completion. This shall be done prior to handover of any part of the installations. On completion of the works or any part of the works to be handed over prior to final completion, the contractor shall issue chlorination certificates and water services completion certificates. The project, or any part of the project, will not be accepted for handover without these being available.

The Contractor shall be responsible for the installation, chlorination and testing of all water services pipework from a point of connection at the service providers' meter.

7 LOW TEMPERATURE HOT WATER

The contractor shall supply, install, test and commission low temperature hot water (LTHW) heating services in the Energy Centre which is to serve distribution throughout the development. The installations shall comprise boilers, combined heat and power (CHP) plant, CHP buffer, pressurisation units, plate heat exchangers, pumps, dosing pots, air and dirt separation equipment and all other components necessary to provide fully functional systems.

There shall be two six new boilers, run and standby boiler primary pumps and a 2No. CHP units connected to buffer vessels via a primary circulation pump.

The specifications for the main items of equipment are given in the schedules which form part of this document. Valves, pipe fittings and installations shall comply with the General Mechanical and Public Health Services Specification. The contractor shall include all of the heating services pipework within the Energy Centre and Car Park area and cap off pipework leaving the Energy Centre above the door to the plantroom for extension into the Phase 2 building under separately-tendered works.

The CHPs shall operate as the first “boiler” module in the sequence. The sequencing of the gas boilers shall rotate so that all boilers run periodically when there is low-load. The CHP buffer vessel is designed to provide four hours storage of the CHP output during periods of low demand for hot water in summer.

Other than the interface with the other boiler controls and links to the building management system the CHP units shall operate as a ‘stand-alone’ package with automatic control that requires minimal or no supervision.

The contractor shall include condensate drainage installations from the boilers and CHP units to the drain gullies in the Energy Centre as shown on the drawings.

For energy efficiency, the heating systems shall be variable volume provided with sequenced inverter driven pumps, pressure independent differential control valves, pressure sensors etc. There shall be duty/duty/assist pumps for the boiler primary and secondary heating circuits. CHP circuit pumps shall be single pumps. All other pumps shall be twin-head run and standby. The pumps are specified in the schedules which form part of this document.

8 FLUES AND ENERGY CENTRE VENTILATION

The contractor shall allow for the Design, Supply, Installation, & Commissioning of the Flue & Ventilation system for the Energy Centre.

Full details of the flue installation shall be submitted to the designer and Client prior to proceeding.

Full Mechanical Supply & Extract Ventilation shall be installed as detailed on the drawings. The contractor shall include for a 10 step supply & extract fan control system. The fans duty shall be directly linked to the quantity of boilers firing.

All flues and Energy Centre ventilation systems shall be fully tested, witnessed and certified satisfactory prior to the Energy Centre Plant being left in operation.

The contractor shall install condensate drains from all applicable flues and these shall be routed to the drainage gullies in the Energy Centre.

9 GAS SERVICES

A new Gas meter enclosure shall be installed within the Energy Centre as shown on the drawings. The contractor shall include for extending gas services from the meter to each Gas Appliance.

The contractor shall supply, install, test and commission gas services to serve the new boilers and CHP plant as shown on the drawings.

The contractor shall supply, install, test and commission a gas check meter as scheduled and shown on the drawings in the supply to the CHP Units & boilers in accordance with the Building Regulations. This shall provide outputs to the BMS system so that the energy consumption of the equipment can be logged.

Gas isolation valves shall be fitted in easily accessible locations in the branches to each piece of equipment served.

Upon completion of the works the contractor shall purge, refill, recommission and certify the gas services. Gas services shall comply with the Gas Regulations. Suitably qualified and Gas Safe registered personnel shall carry out all works on the gas systems.

On completion of the works or any part of the works to be handed over prior to final completion, the contractor shall issue Gas Safe certification including the Gas Safe Declaration of Safety and Compliance certificates. The certification shall cover the whole of the installations to be handed over including connections and outlets served. The project, or any part of the project, will not be accepted for handover without a satisfactory Gas Safe certification being available.

10 CONTROLS AND ELECTRICAL WORKS ASSOCIATED WITH MECHANICAL SERVICES

10.1 Particular Requirements Energy Centre Controls

The controls specialist shall be Trend approved AES Controls or equal and approved.

The controls specialist shall provide a complete automatic controls installation for the operation of all mechanical installations as described within this document, listed in schedules and as indicated in the drawings. The automatic controls installation shall include not only specified items of mechanical and electrical equipment but also all incidental sundry components, computer programmes, interfaces with other systems, data and documentation necessary for the complete execution and proper operation of the installations, whether or not these sundry components are mentioned in detail.

This fully integrated Building Management System (BMS) shall enable the efficient operation, monitoring and management of the mechanical and electrical services installations within set criteria and varying their criteria as required from the Energy Centre. The BMS shall be based on the use of electronic controls with direct digital control of plant items and equipment via intelligent outstations relaying information by a multiplexed communication network to a central processor unit. A structured cabling system shall be used to provide a backbone to the new controls installation. The controls specialist shall liase with the structured cabling installer to agree on the final number and location of all Ethernet connections required to complete the new controls installation.

The complete automatic controls installation shall be capable of being fine-tuned to achieve full compliance with the design requirements and to reinforce staff training / familiarisation with the system. The controls specialist shall allow for visiting site on three separate occasions post occupation to fine tune the controls installation in line with the final occupancy and temperature profiles. These visits shall be in addition to any visits resulting from snagging and defects. Within the heating systems, the following functions shall be provided: safe shutdown of services under emergency conditions; plant failure alarms etc.

The BMS shall include all controls required to provide the full control and correct operation of the heating strategy described below. The main panel shall be capable of reading information relayed from all of the individual block panels.

Facilities shall be provided within the BMS controls installation for the future compilation of monitoring trends and historical information. A graphical front end shall be used to provide the primary control interface for the BMS, with graphics created for each system and control element. A security password system shall be incorporated to automatically prohibit commands from unauthorised people, with access levels hierarchically arranged such that a minimum level can be set to “read only” and at the highest level to access all information. 25% spare points capacity shall be provided for future extension to control / monitor any future installations.

10.2 Preferred Starting Sequence of Heating Plant Operation

Note: This section applies when all plant, including CHP's are installed and operational.

- CHP Units first followed by the Gas Fired Boilers.
- The sequence shall be user selectable via the BMS Graphics
- Each sequence shall have a built in time delay period of 20 minutes (User adjustable) prior to starting.
- In addition to this each individual heat source shall be broken down into stages i.e. CHP Unit and Gas Boilers 1-5. The staging for each shall operate on a lead/lag/lag/lag/Standby bases with changeover occurring daily, at midnight.
- The system common flow and return header shall each be fitted with a temperature sensor.
- The heat sources shall be enabled based on starting sequence and then the stages shall be sequentially enabled on a lead/lag/lag/lag bases as required, to achieve and maintain Water Temperature at Setpoint (73ºC User adjustable).

While the sequence of operation should normally be selected based on energy efficiency, it is important that the sequence is changed every few months to ensure that all plant is operated for a minimum period. This is a maintenance procedure.

The heat sources shall also be enabled by:-

- Respective Immersion frost thermostats

The heat sources shall be disabled by:-

- System low pressure
- System high pressure
- Fire alarm
- Respective Gas Detection System

Increasing Load Sequence of Operation

The BMS shall monitor the differential pressure on the Main Headers via differential pressure sensors fitted in the Main Header pipe work and shall increase the speed of the enabled primary pumps to constantly provide a positive static pressure in the Main Header Flow pipe work during periods of increasing heat demand from the sub circuits.

Low Pressure Hot Water Circuits

Heating circuits shall be distributed to heat units and heat substations where required in each residential block as indicated on drawings. The secondary pumps will be reacting to Polling of differential pressure sensor locate within each block. The index will change as the Phasing of the development expands.

Pump-Sets

Each pump-set shall consist of 3 No. pumps each having a variable-speed (Inverter) which shall operate on a Duty/Assist/Assist basis. Changeover from duty to standby shall occur weekly at midnight on Sunday.

The Circuit shall be enabled by its own Time Schedule which shall be accessed through the BMS graphic. The Time Schedule shall have the facility for up to ten on/off periods per day (standard week) and shall be programmed in advance for assigned dates (exceptions).

The run status of each pump shall be monitored both by a current switch and via a volt-free contact on the pumps inverter.

If a pump fails to run when requested then a fault alarm shall be generated and the alternate pump shall be switched on. If the alternate pump fails then another alarm shall be generated and this pump remains enabled. The fault shall manually reset through the BMS graphic.

The pumps shall also be enabled by:-

- Respective Immersion frost thermostat
- Outside frost
- Heat dissipation control

The pumps shall be disabled by:-

- System low pressure
- Fire alarm

Temperature Monitoring

The BMS shall monitor the circuit flow and return temperature and display it on the BMS Graphics. All heat meters shall be linked to the BMS, the BMS shall log instantaneous power, and flow and return temperatures as a minimum.

Pressure Control

The BMS shall monitor the pumps flow pressure via a pressure transmitter mounted in the primary flow and return header, and shall modulate the inverter speed to maintain a user adjustable flow-return differential pressure.

Frost Protection

If the outside frost thermostat is activated, then a hard-wired interlock shall enable the 'Duty' pump to run.

If the common header immersion frost thermostat is activated, then a hard-wired interlock shall enable the 'Duty' pump to run.

Low Pressure Hot Water System Pressure Interlocks.

A low-pressure condition shall disable the pump-set.

CHP Plant and associated controls

The CHP Plant shall have 2 No. modes of operation:-

Manual Mode:

In manual mode the BMS user shall enable/disable the CHP Unit from the BMS Graphics

Auto Mode:

Auto Mode No.1 (Thermal Priority Mode)

In this mode the CHP Plant shall be enabled by the starting sequence as outlined above provided its own Master Time Schedule is enabled which shall be accessed through the BMS graphic. The Time Schedule shall have the facility for up to ten on/off periods per day (standard week) and shall be programmed in advance for assigned dates (exceptions). The Schedule shall be setup to run during the hours from 8am – 11pm.

Temperature Control

Once enabled the BMS shall monitor the Common Flow & Return Water Temperatures via Immersion Temperature Sensors mounted in the Flow & Return Headers and switches the CHP Units in stages, on a lead/lag/lag/lag basis, as required, to achieve and maintain Water Temperature at Setpoint (90ºC User adjustable).

If during the starting sequence a unit fails to run after a preset period of time the next unit in the sequence shall be enabled.

Auto Mode No.2 (Normal Operation Mode)

In this mode the CHP Plant shall be enabled by its own Master Time Schedule which shall be accessed through the BMS graphic. The Time Schedule shall have the facility for up to ten on/off periods per day (standard week) and shall be programmed in advance for assigned dates (exceptions). The Schedule shall be setup to run during the hours from 8am – 11pm.

High Temperature Control

The BMS shall monitor the CHP Plant header temperature via an immersion temperature sensor and shall modulate the diverting valve with reference to a user-adjustable set-point (70 ºC) on the return temperature sensor.

Common to Both Modes

Temperature Monitoring

The BMS shall monitor each units flow and return temperature and display it on the BMS Graphics.

Status Monitoring

The 'Run' and ‘Common Fault’ of each CHP Unit shall be monitored and alarmed.

The ‘Immersion Frost Thermostat’, ‘Flue Failure’ and ‘Gas Detection’ shall be monitored and alarmed. The Blast Cooler shall be monitored and alarmed.

Interlocks

In order for the CHP Unit to be enabled the CHP Primary Pumps must be running.

Metering

The following energy metering shall be recorded by the BMS:-

- CHP Unit Heat Meter, Boiler & Main Heat Meter, Gas Meter and Electrical Production Meter
- All meters shall be totalled at 900 second intervals.
- Daily accumulated total shall be displayed.
- Yesterday's accumulated total shall be displayed.
- Grand accumulated total shall be displayed.
- Daily accumulated total shall be logged at 900 second (15 minutes) intervals.
- End of day (midnight) total shall be logged at 86400 second (daily) intervals.
- Grand total shall be logged at 3600 second (hourly) intervals.

Monitoring

The following information shall be displayed on the BMS:-

- CHP Unit Distribution Board Load

CHP Primary Header Pump-Set

The pump-set shall consist of 3 No. pumps each having a variable-speed (Inverter) which shall be operated on a Duty/Assist/Standby basis. Changeover from duty to standby shall occur weekly at midnight on Sunday. The pump-set shall be enabled before the CHP Units based on heat demand from any of its sub circuits.

The run status of each pump shall be monitored both by a current switch and via a volt-free contact on the pumps inverter.

If a pump fails to run when requested then a fault alarm shall be generated and the alternate pump shall be switched on. If the alternate pump fails then another alarm shall be generated and this pump shall remain enabled. The fault shall be manually reset through the BMS graphic.

The pumps shall also be enabled by:-

- Respective Immersion frost thermostat
- Outside frost
- Heat dissipation control

The pumps shall be disabled by:-

- System low pressure
- Fire alarm

Pressure Control

The BMS shall monitor the primary flow pressure via a pressure transmitter mounted in the primary flow and return header, and shall modulate the inverter speed to maintain a user adjustable flow-return differential pressure.

Frost Protection

If the outside temperature falls below 3 ºC then the outside frost thermostat shall be activated. This shall be hard-wired to run the 'Duty' pump, provided all the CHP Plant is off. This 'stat shall automatically reset when the outside temperature rises above the thermostat differential.

If the CHP Units return temperature falls below 8 ºC then the immersion frost thermostat shall activate and an alarm shall be generated. This 'stat shall be hard-wired to run the 'Duty' pump as well as all of the CHP Plant. This 'stat shall be automatically reset when the water temperature rises above the thermostat differential.

Low Pressure Hot Water System Pressure Interlocks.

The low-pressure hot water system shall be fitted with 2 no. pressure switches, which shall be hard-wired, interlocked with the plant.

A low-pressure condition shall disable all pumps and CHP Unit and an alarm shall be generated.

A high-pressure condition shall disable CHP Unit and an alarm shall be generated.

Gas Boiler Plant and associated controls

The Gas Boiler Plant shall have 2 No. modes of operation:

Manual Mode

In manual mode the BMS user shall enable/disable the Gas Boilers from the BMS Graphics.

Auto Mode

In Auto mode the Gas Boiler Plant shall be enabled by the starting sequence as outlined above provided its own Master Time Schedule is enabled which shall be accessed through the BMS graphic. The Time Schedule shall have the facility for up to ten on/off periods per day (standard week) and shall be programmed in advance for assigned dates (exceptions).

Temperature Control

Once enabled the BMS shall monitor the Common Flow & Return Water Temperatures via Immersion Temperature Sensors mounted in the Flow & Return Headers and shall switch the Gas Boilers in stages, on a lead/lag/lag/lag basis, as required, to achieve and maintain Water Temperature at Setpoint (73ºC User adjustable).

If during the starting sequence a Boiler fails to run after a preset period of time the next unit in the sequence shall be enabled.

Temperature Monitoring

The BMS shall monitor each Gas Boiler flow and return temperature and display it on the BMS Graphics.

Status Monitoring

The 'Run' and 'Common Fault' of each Gas Boiler shall be monitored and alarmed.

The 'Immersion Frost Thermostat' shall be monitored and alarmed.

Interlocks

In order for the Gas Boilers to be enabled the Gas Boilers Primary Pumps must be running.

Metering

The following energy metering is recorded by the BMS:-

- All meters shall be totalled at 900 second intervals.
- Today's accumulated total shall be displayed.
- Yesterday's accumulated total shall be displayed.
- Grand accumulated total shall be displayed.
- Today's accumulated total shall be logged at 900 second (15 minutes) intervals.
- End of day (midnight) total shall be logged at 86400 second (daily) intervals.
- Grand total shall be logged at 3600 second (hourly) intervals.

Gas Boiler Primary Header Pump-Set

The pump-set shall consist of 3 No. pumps each having a variable-speed (Inverter) which shall be operated on a Duty/Assist/Assist basis. Changeover from duty to standby shall occur weekly at midnight on Sunday. The pump-set shall be enabled before the Gas Boilers based on heat demand from any of its sub circuits.

The run status of each pump shall be monitored both by a current switch and via a volt-free contact on the pumps inverter.

If a pump fails to run when requested then a fault alarm shall be generated and the alternate pump shall be switched on. If the alternate pump fails then another alarm shall be generated and this pump shall remain enabled. The fault shall be manually reset through the BMS graphic.

The pumps shall also be enabled by:-

- Respective Immersion frost thermostat
- Outside frost
- Heat dissipation control

The pumps shall be disabled by:-

- System low pressure
- Fire alarm

Pressure Control

The BMS shall monitor the primary flow pressure via a pressure transmitter mounted in the primary flow and return header, and shall modulate the inverter speed to maintain a user adjustable flow-return differential pressure.

Frost Protection

If the outside temperature falls below 3 ºC then the outside frost thermostat shall be activated. This shall be hard-wired to run the 'Duty' pump, provided all the Gas Boilers are off. This 'stat shall automatically reset when the outside temperature rises above the thermostat differential.

If the Gas Boilers return temperature falls below 8 ºC then the immersion frost thermostat shall activate and an alarm shall be generated. This 'stat shall be hard-wired to run the 'Duty' pump as well as all of the Gas Boiler Plant. This 'stat shall be automatically reset when the water temperature rises above the thermostat differential.

Low Pressure Hot Water System Pressure Interlocks.

The low-pressure hot water system shall be fitted with 2 no. pressure switches, which shall be hard-wired, interlocked with the plant.

A low-pressure condition shall disable all pumps and Gas Boilers and an alarm shall be generated.

A high-pressure condition shall disable all Gas Boilers and an alarm shall be generated.

Automatic Controls Installation Configuration

The automatic controls installation shall comprise of the following:-

- Central TREND 963 BMS outstation/monitoring facility including PC and monitor located in the Energy Centre with an additional head end (Location to be Confirmed by Barratt Homes). Both systems shall include graphics and all interfaces with other systems and software capable of energy monitoring and billing.
- Password protected BMS monitoring and control via the local building network.
- Mechanical Services Control panel (MSCP) within the Energy Centre incorporating BMS outstations, local indication controllers, starters, and IP network connections etc.
- TREND EMIC interfaces and PTW3 RS232 M-BUS converters as required within the mechanical risers of each building core
- A structured cabling network for relaying controls signals between all outstations, and controls bus for communications from each outstation and final control element.
- All control valves, actuators, motorised dampers, sensors, controllers, starters, thermostats and, low voltage controls field wiring inclusive of TREND IQXCite controller at each core riser and TREND IQXcite controller + IQView display at each individual block.
- Interfaces with all other building systems including Fire Alarms system, Electrical systems etc.
- All TREND controllers should be installed with 25% spare capacity.

The BMS shall utilise the site wide resilient fibre ring network supplied by the DH provider and CAT6 backbones provided by the structured cabling installer. The BMS will also allow for password protected access to the various control functions via the local intranet / web browser. The control interface shall provide 3 levels of access: general, technical access and full. General access shall provide limited access to timeclock settings; technical access shall provide access to timeclock settings, temperature set points and other low level control functions.

Central BMS Outstation / Server

The contactor shall provide a central TREND 963 BMS outstation/monitoring facility including PC and 19" flat screen monitor located in the Energy Centre and additional web capable PC primarily set up for energy monitoring and billing purposes within the concierge (Location TBC). The TREND 963 shall include a full graphics display of the full heating and ventilation systems showing set points, valve positions, damper positions, measured temperatures and allow user interface to adjust presets and clear alarms.

All faults/alarms/plant status signals described in the specification and indicated on the drawings shall be displayed via the central outstation. The PC shall be capable of backing up the controls system on a regular basis, originally set for weekly backup.

Graphical User Interface

The following shall be allowed for:-

- The graphics shall be dynamic, and shall be provided for the following items and all other items required to ensure full control of all systems;
- One overview site plan graphic detailing each building on the current/new site with buttons to each individual building.
- A graphic for each building plan and include summary of the systems status. The plan buttons to the major plant systems and locations.
- One graphic for each building showing the floor plan with single line pipework, temperature set points and minimum maximum and actual heat on/off for each apartment heat unit.
- Graphics to indicated pumps operating, flow and return temperatures.
- Graphics to indicate fan operation and communal area temperatures.
- Provide controls for the instigation of system operations.
- Provide separate graphics page for every item of plant
- Provide a software library of plant schematics and symbols, the format/contents of which should be confirmed with the specifier based upon samples.
- Provide a facility to allow the operator to modify and/or generate additional schematics and symbols
- Ensure that the system can accommodate the addition of 25% extra graphics 'pages'
- Ensure that the graphics can be displayed in a layered approach (building layout down to plant subsystems and components). A single page shall be provided for each item of mechanical plant, apartment heat unit, meter, etc.
- Each graphic shall incorporate an 'About' button which will provide direct access to a text file that describes the plant, safety interlocks, normal and emergency operation, reset procedure, outline of control strategy, plant data – capacity, manufacturers references, etc.
- Set-up logging of all monitored conditions
- Graphic slides shall be in a two-dimensional, consistent structure format. Provision shall be made to view photographs of each plant item via each page.
- Mechanical plant status.

Energy Monitoring

Each apartment on the site shall have a heat unit incorporating a heat flow meter on secondary LTHW circuits. These shall be used alongside the primary heat meter located in each building for billing purposes, energy sub-metering and the control of the circuit flow rate.

The Energy Centre gas and heat consumption shall be measured via BMS connections to new pulse meters. In addition, electricity consumption for all major loads shall be monitored from pulse output meters installed on sub main supplies to each mechanical plant motor control panel.

Additional heat flow meters shall be fitted to the heat substations secondary LTHW circuits located in each block within the development. These shall be used for both energy sub-metering and the control of the circuit flow rate.

This information shall be logged on the BMS, from where it can be downloaded, printed and interrogated. This information shall also be able to be exported in Excel format.

The BMS shall contain an energy monitoring graphical display, which shall indicate the following information:-

- Heat consumption at each heat unit in kWhr (week to date, month to date, year to date).
- Energy Centre electrical energy consumption in kWhr (week to date, month to date, year to date).
- Gas energy consumption in kWhr (week to date, month to date, year to date).
- Energy Centre water consumption in litres (week to date, month to date, year to date).
- LTHW flow rate per circuit (max / min / average flow rate in week to date, month to date and year to date)
- Hear Demand in kW at any given time.

Mains Failure

Upon mains failure the mechanical plant shall fail safe. All plant shall automatically re-start in a controlled manner on re-instatement of power.

Monitor the status of the main high voltage switches and the ACB's connecting the incoming mains supply and the CHP unit to the main LV switchboard.

Frost Protection

Frost protection shall be provided on the mechanical services installation complete with electrical contacts to provide a signal to the BMS.

Frost protection shall be as follows:-

- Stage 1: Should the internal space temperature drop to an adjustable pre-set minimum (10°C) the circulating pumps will be initiated. Ensure operator can pre-select which plant is to be started. Ensure automatic standby plant operates on failure of duty plant.
- Stage 2: Should the heating return temperatures from any of the LTHW circuits drop to an adjustable pre-set minimum (6°C) the LTHW boilers shall be initiated and will run until the return temperature rises to 15°C.

Building / Plant protection

Include protection routines to operate plant in order to protect the building fabric and its contents against the effects of low internal temperature and of condensation.

If air temperature falls below the pre-set protection temperature, turn on the heating system and related plant and supply heat to maintain the air temperature at or above the protection set point temperature. Ensure that the frost protection routines override other operating schedules and operate building protection whenever the normal heating is switched off.

The Following shall also be monitored:-

- Low Pressure Hot Water System Alarms
- Fire Alarm
- LPHW System Low Pressure
- LPHW System High Pressure
- Pressurisation Unit Fault
- Immersion Frost Activation – CHP Header “future”
- Immersion Frost Activation – Gas Boiler Header
- Immersion Frost Activation – Main Header
- Outside Frost Activation
- Gas detection alarms – CHP Unit “future”
- Gas detection alarms – Gas Boilers
- CHP Unit Common Fault “future”
- CHP Unit Run Failure Alarm “future”
- CHP Unit Flue Failure Alarm “future”
- CHP Header Pump-set Run Failure Alarm “future”
- CHP Header Pump-set VSD Trip Alarm “future”
- Gas Boiler No. 1-5 Common Fault
- Gas Boiler No. 1-5 Run Failure Alarm
- Energy Centre Ventilation
- CAT 5 Booster Set
- Primary & Secondary Pumps

Additional Monitoring

The BMS shall monitor the following and display it on the BMS Graphics:-

- Outside Air Temperature
- Main Header Flow Temperature
- Main Header Return Temperature
- Main Header Flow Differential Pressure
- De-coupling Unit Flow Temperature
- De-coupling Unit Flow Differential Pressure
- De-coupling Unit Return Differential Pressure
- De-coupling Flow Switch

Data Logs

All analogue inputs and outputs shall be continuously logged by the Building Management System at 900-second intervals and values shall be time and date stamped.

Miscellaneous Supplies from Control Panel

- Supply to all Pressurisation Units
- Supply to Gas Detection Unit No.1
- 2 No. Spare Single Phase Supplies
- 2 No. Spare Three Phase Supplies

Fire Alarm interlock

The control system shall be interlocked with the main building fire alarm system such that all boilers, pumps etc connected to the BMS shut down on fire alarm activation. Audible and visual Indication of fire alarm condition shall be provided at the BMS. The plant status in the event of a fire alarm shall be determined by consultation with the local fire officer.

11 ACOUSTIC AND VIBRATION CONTROL

The contractor shall supply, install, test and commission all vibration control and acoustic measures necessary in the Energy Centre to meet the requirements of the Basis of Design clause of this specification.

The vibration control measures shall include flexible connections to all rotary equipment including pumps and fans and all such equipment shall be isolated from the building structure by the use of spring hangers or resilient pads built into plant bases.

12 MAINTENANCE TOOL AND SPARES

The mechanical Contractor shall include all spares and specialist tools recommended by the manufacturers of the equipment to be installed. A full spare set of consumable items (such as filters) for each piece of equipment shall be included. The tools and spares shall be handed to the Client enclosed in suitable storage containers, which shall be located within the Energy Centre unless otherwise advised.

13 BUILDERS WORK IN CONNECTION

The contractor shall include for supplying, carrying out, fitting and installing all builders work requirements of the mechanical services in the Energy Centre and chiller plantroom and shall include for this in his tender return. All builders work must be coordinated by the Contractor with the requirements of other services and with the building requirements.

The mechanical and electrical sub-contractors shall provide the main Contractor with any necessary drawings of builders work required and in accordance with the main Contractor's programme of works. Builder's work which requires only marking on site shall be set out by the mechanical and electrical sub-contractors and indicated using recognised trade methods.

The mechanical and electrical sub-contractors shall be responsible for direct expanding bolt or raw plug type fixings of pipework, heaters, ductwork, etc. to the building fabric. All other builder's work including builder's work enclosures and other builder's work associated with the electrical and mechanical services sub contracts shall be carried out by main building contractor on the sub-contractor's behalf.

The mechanical and electrical sub-contractors shall provide the main contractor with any necessary drawings of building work required and in accordance with the main contractor's programme of works. Builder's work that requires only marking on site shall be set out by the mechanical and electrical sub-contractors and indicated using recognised trade methods.

The tendering mechanical and electrical sub-contractors shall agree the detail of all builders' work in connection with the mechanical and electrical installations with the main building contractor at the time of tender and ensure that all work required is included in the overall tender price submitted by the main contractor.

The builder's work requirements for the Energy Centre and chiller plantroom works shall generally include, but not be limited to, the following.

- Plant bases, including the modification or removal of existing Phase 1 plant bases. Where bases are removed the floor shall be made good.
- All requirements relating to the fixing and support of mechanical services equipment, pipework, ducts, control panels, cabling, etc.
- All containment required by the electrical wiring and controls cabling including that between control panels and devices served and any chases that are required.
- Holes and weathering for ventilation system intakes and discharges.
- Holes in the building structure to accommodate pipework, flue dilution ductwork, ventilation terminals and ventilation ductwork.
- Equipment support frames.
- Water tank bases and piers.
- "Step-overs", gantries and protection required both to protect services crossing access ways from damage and to protect maintenance personnel from injury.
- The co-ordination of the mechanical services requirements within the building programme.
- Making good.

The contractor shall include within his tender any access panels necessary to gain access to equipment requiring regular maintenance that are located in builder's work ducts, above ceilings and in service shafts. All access panels shall be properly framed out and, if not specified to be hinged elsewhere in this document, shall be secured with brass cups and screws or alternative means of fixing approved by the Engineer. The mechanical sub contractor must ensure the main contractor includes such requirements in his tender.

14 TESTING AND COMMISSIONING

The Contractor shall include for the commissioning and testing all services installed under the contract. The Contractor shall also include for the services of a reputable commissioning company to commission the installations. The proposed commissioning company shall be identified in the Contractor's returned tender.

The Contractor shall include for the chlorination, water treatment, commissioning and testing of all services installed in a phased manner to suit the programme. This shall include the recommissioning of services to the existing Phase 1 building as described in this document.

The contractor shall allow for all temporary installations, isolations and water treatment required to test, commission and handover each phase of the works.

The commissioning shall be carried out in accordance with relevant British Standards, Codes of Practice, Building Regulations, BSRIA Application Guides and the Chartered Institute of Building Services Engineers commissioning codes:-

- Code A - Air Distribution Systems;
- Code C - Automatic Controls;

- Code R - Refrigerating Systems;
- Code W - Water Distribution Systems.

The contractor shall allow for testing in accordance with Building Regulations and any attendance required on the Building Control officer.

The commissioning shall also include the following:-

- Flushing, refilling and chlorination all domestic water pipework systems;
- Flushing, refilling and dosing all heating and chilled water systems;
- Checking that all ductwork systems have been thoroughly cleaned and are free from debris and not compressed, restricting their cross sectional area. The fan systems are not to be run until this has been established;
- Witnessing the commissioning of all specialist plant items, commissioned by the specialist supplier;
- Ensuring that all control systems are functioning as designed and specified;
- Balance ventilation systems and produce commissioning sheets showing air flows at all terminals.

Records of all tests carried out shall be submitted to the Engineer. Any fault discovered during commissioning shall be remedied by the Contractor at his own expense and re-commissioning carried to demonstrate to the Engineer that the system concerned is sound and operating to the specified parameters.

The contractor shall submit to the engineer all test and commissioning results for approval prior to arranging witnessing of the services concerned. The test results shall include details of the test carried out, the duration of the test where relevant and the service upon which the test was carried out. Commissioning results shall include design and test results for all air volume flows.

Upon completion of commissioning the systems shall be offered to the Engineer for witnessing. The Contractor shall provide adequate prior notice of witnessing arrangements and shall agree with the Engineer the extent of witnessing required. Witnessing shall be arranged in as efficient a way as possible so that all services can be witnessed during a single site visit unless additional visits are unavoidable. The contractor shall ensure that all equipment necessary to carry out the measurements and tests to be witnessed, the necessary representatives of specialist installers and the commissioning company are available on the agreed date at the appointed time. The contractor will be required to rearrange witnessing at his own expense if any of these requirements are not met.

Pipework Pressure Testing

All water services pipework shall be pressure tested to 1.5 times working pressure or 2 bar (g), whichever is the greater, for a period not less than 2 hours. The test pressure shall be increased to 2 times working pressure where required by the Local Water Authority.

Any items of equipment not suitable for the hydraulic test pressure shall be temporarily disconnected to allow the test to proceed to full pressure. Disconnected items of plant shall then be separately tested at the lower pressure for which they are designed.

Mains Water Services

The mains water services shall be commissioned in accordance with Water Authority's requirements inclusive of a thorough cleansing, flushing and reverse flushing, followed by chlorination and then, after the required standing period, a further flush through.

Chlorination

The Contractor shall thoroughly flush and then chlorinate the whole water systems in each building in accordance with CIBSE TM13, HS (G) 70 and BS6700 and as detailed below prior to completion and provide test certificates on completion to prove that the whole is in satisfactory condition. The works shall be carried out by a Specialist Contractor.

All cold water and hot water pipework shall be chlorinated from (and including) the point of connection to the water authority supply through to the point of supply.

Chlorination shall be carried out as follows:-

- Clean and flush out to remove dirt and debris. No water is to be used for domestic purposes during this operation nor until chlorination is completed;
- Prepare the necessary quantity of disinfecting chemical to give a chlorine concentration of 50mg/litre. Follow the manufacturer's instructions;
- Chlorinate new mains or mains extensions first, followed by communication pipes, and supply pipes in that order;
- Add the prepared solution to the pipework, cistern/tank and draw through the system;
- Allow a contact time of one hour after the disinfecting chemical has been drawn through the system;
- Take a sample at the end of the time and check for residual chlorine with a comparator. If less than 30mg/litre is indicated, repeat the process until a residual is obtained;
- Thoroughly flush out to remove all traces of heavily chlorinated water;
- Discharge chlorination water as instructed by the Employer's Agent.

On completion of chlorination the Contractor shall provide analysis as follows:-

- Take samples from a minimum of 10% draw off points after testing and chlorination;
- Dispatch samples to an approved testing laboratory for bacteriological and chemical analysis;
- Pay all charges for samples and analysis;
- Submit analysis result to the Engineer on receipt;

- Rectify any faults revealed by sample analysis which impair the quality of water beyond the limits set in the EC Directive on the quality of drinking water and pay all charges for re sampling/chlorination.

Seasonal Test

The Contractor include for returning to site for checking the operation of the systems in the season opposite to that when the project was originally commissioned. The contractor shall carry out any retesting, re-commissioning or adjustment of controls at no cost to the contract.

Demonstration to the Employer

Subsequent to the completion of all testing and commissioning to the satisfaction of the CA, when directed by the CA operate the plant and demonstrate that the overall systems function correctly in accordance with the requirements of the specification.

Full running and operation for a period of at least 5 days shall be considered reasonable for this demonstration and this period shall be allowed in the programme.

During this period be responsible for the recording of results and the operation and maintenance of the plant. If appropriate, use this time to instruct the Employer's staff in the operation and maintenance of the systems.

Provide an operational report of the demonstration and print out of the conditions maintained within the space for the required demonstration period.

Instruction of Employer's staff

At a time to be agreed with the CA and prior to practical completion instruct the Employer's staff in the use, correct operation and general maintenance of the Works and be satisfied that such staff are competent to take over the installation on completion

The Contractor shall include for all costs associated with Client's training which shall take the form of a one day period during which time the client's representative shall be instructed in the operating and emergency procedures for the installation.

Include adequate periods to instruct the Employer's staff in the operating and maintenance of the Works. Submit to the CA for approval a detailed training programme and method statement for the training of the Employer's staff.

During such periods of instruction undertake and be responsible for the correct operation and maintenance of the installations.

Employ the services of relevant specialists and suppliers necessary for this purpose and provide each person with a comprehensive set of teaching notes and diagrams.

All the associated training equipment required by the trainer(s) to enable the training to be demonstrated effectively shall be provided.

For all instruction periods maintain training records which shall be submitted to the CA on completion. All attendee names shall be recorded and signatures obtained from all attendees confirming they have understood the training given. A schedule of names shall be provided within the operating and maintenance documentation.

Results and Test Certificates

All testing and commissioning results must be available to the Engineer for approval before the works, or any part or phase of the works, will be accepted for handover. The electrical services certificates, gas safety certificate, water services completion certificate and chlorination certificates are essential in this regard.

15 BUILDING LOG BOOK AND OPERATING MAINTENANCE MANUALS

Unless otherwise agreed the whole, or any part of, the contract works will only be deemed to be complete when the contractor has issued to the engineer two copies of all manuals and operating and maintenance instructions in stiff backed ring binders. These shall include all “As Installed” record drawings and the other information identified below comprising one set of paper prints and one electronic copy on compact disc included with each manual. The operating and maintenance manuals shall incorporate the requirements of the ‘building log book’ as defined in Part L of the Building Regulations.

Two proof copies of the manuals including draft “As Installed” record drawings and the building log book shall be issued to the engineer for comment of format and general content, before the above-mentioned final issue. The proofs for comment shall be sent to the engineer in sufficient time to allow him not less than three weeks to approve them. The operating manuals shall contain the following information:-

- Contents page.
- A description of the building, its intended use, the services design philosophy and the intended purpose of the individual systems.
- A schedule of the floor areas of each building zone by environmental service type.
- Description of the equipment used and method of operation of the installation including provisions enabling the specified performance to be sustained during occupation.
- Handbooks, maintenance instructions, drawings and spare parts, list of all components, plant and equipment used in the contract works.
- Line diagrams indicating the main features of the plant drawing attention to the method of setting the control dampers, switch gear, safety precautions etc.
- Schedule of routine maintenance complete with routine oil and grease points and recommended lubricants.
- Schedule of periodic and preventative maintenance for specialised equipment.
- Schedules of method of adjustments and typical fault finding routines.
- Wiring diagrams of plant, etc.
- Service manual for all specialised plant giving all details, as listed above.
- Schedules of equipment and motors related to the "As Installed" drawings and giving name of manufacturer, serial number of plant, electrical supply, input power and output rating.
- Simple descriptions of the operational and control strategies of the energy consuming services in the building.
- Description of emergency action which should be undertaken in the event of breakdown of equipment. Telephone numbers of essential contacts.
- Outline design data of plant.
- A schedule of the building’s energy supply meters including description, location and instructions for use. Also a description of how the energy performance of the building can be calculated from these readings.
- Test and performance data.
- Test certificates.

- Commissioning sheets and report confirming that the building services equipment has been satisfactorily commissioned.
- Schedules of set points of all controls, valves, dampers, sensors, overloads, timers, etc., a description thereof and the resultant effect of adjustment of these set points.

The "As Installed" drawings and diagrams shall show the following where they form part of the mechanical sub contract works:-

- The location, including level if buried, of utility supplies whether carried out by the contractor or by the appropriate utility together with the points of origin and termination.
- The layout, location and extent of all pipe and ducted services showing pipe and duct sizes, together with the position and identification of all valves and dampers for regulation, isolation and other purposes.
- Layouts showing the locations of all plant and equipment, terminals and control devices.
- The layout, location and extent of all electrical cable, cable tray, cable trunking, conduit, distribution board, switches and outlets.
- Ductwork Manufacturer's drawings.
- Comprehensive diagrams showing in detail all power wiring and all control wiring.
- Schedule of all pipeline valves giving the numbers with which they are labelled and with which they are indicated on the "As Installed" drawings.
- Schedule of all air termination and control devices including volume control dampers, terminal grilles and diffusers giving the size of the units, the design duty and the duty measured during tests.

The "As Installed" record drawings shall be prepared to the following scales:-

- Floor Plans 1:50
- Floor Sections 1:50
- Plantrooms details of services, plant details, etc. 1:20
- Site plans 1:200
- Ductwork manufacturing drawings 1:50 or 1:20

In the event of the contractors failing to comply with this clause in the stipulated time, the contract administrator shall have the power to recommend that the Contract Works as being unacceptable for hand-over to the employer due to insufficient information being available to enable the Employer to operate and maintain the plant in accordance with the Health and Safety at Work Act, and furthermore shall have the power to instruct the Work to be carried out by others and deduct the resultant costs from the contractor's final account.