Specification

for

Mechanical Services Installation

at

Curnock Street Estate
Camden Road
London

Apollo Property Services Group
for
London Borough of Camden
Housing and Adult Care

May 2009
PR247/DBU
REV B 22/6/09

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May 2009

Curnock Street Estate **PR247**

1. Extent of the Works

Curnock Street Estate consists of:

House	Accomodation type	No of units	No of units per stack
Mexborough	Flats	66	6
Billingley	2 bed Maisonette	18	2
Hickleton	2 bed maisonette	20	2
Ravenscar	2 bed maisonette	18	2
Goldthorpe	2 bed maisonette	34	2
The Marr	1 no Pub	Ground and first	
	Ground floor offices	7	
	Flats on first floor	7	
	2 bed maisonettes on 2nd and 3rd floors	7	1 office, 1 flat, one mainsonette
Warmsworth	3 bed maisonette	18	2
Darfield	3 bed maisonette	18	2
Thurnscoe	3 bed maisonette	18	2
Trimdown	3 bed maisonette	32	2
Conisborough	Town Houses	9	1

Under Ground Car Parks	Run by	Houses above served
Public	NCP car Park Dominic Sullivan Lomax Carpark Corporation Ltd Curnock Estate Carpark 38-40 Pratt St London NW1 0LY Tel: 020 7388 2244 Fax: 020 7388 4546 Email: d.sullivan@lomaxcarpark.co.uk	Mexborough, Billingley Goldthorpe Darfield
Private	LB Camden Jaqui or Ashford 020 7974 2628	Conisborough Ravenscar Trimdon Thurnscoe

The work includes the following:

(i) Replacement of all external below ground district heating pipe work and hot water supply and return to Barnborough House

(ii) Replacement of the district heating pipework within the two under ground car parks and the district heating pipework serving the properties above the boiler room.

(iii) The replacement of the roof top cold water tanks serving the hot water system and cold water down services, located in Mexborough House including all pipe work and valves within the roof tank room with two new tanks.

(iv) Provision of TRV's and lock shield valves to all radiators within the tenanted properties, leaseholders and commercial properties served by the district heating system.

(v) A new low level air intake fan set to the boiler room

(vi) Sound attenuation to the boiler room as recommended by the acoustic report to achieve 10 dBa below the ambient background noise.
(vii) All field wiring and temporary lighting.
(viii) All associated builders work & redecorations
(ix) Testing, commissioning of the plant and tutorial sessions.

The contractor will ensure that all new systems are fully compatible and integrated with the existing installation and that all services (district heating, hot water provision and installation of TRV's and lockshield valves and any other services he alters during the course of the works) are fully working and installed to the client's satisfaction.

2 Existing Services

a) District Heating

The existing district heating system consists of 3 pairs of LTHW flow and return pipework leaving the boiler room. Two pairs which feed the following exit the boiler room into the adjacent car park:
Billingley
Ravenscar
Goldthorpe
Darfield
Thurmscoe
Trimdon
Conisborough
Mexborough
The third pair exits the boiler room on the opposite wall. These pipes go underground to feed the following blocks:
Barnborough
Hickleton
The Marr
Warmsworth.

All this pipework, including the branches to the properties is to be renewed.

b) Cold Water Tank serving the hot water calorifiers:

The cold water tank serving the hot water calorofiers is located in the roof plant room of Mexborough House. The tank has a volume of 3.45 cubic metres total. This is to be replaced and the installation brought upto to current WRAS regulations.

The cold water tank serving the cold water down services to the estate is located in the roof plant room of Mexborough House. The tank has a volume of 23.0 cubic metres total. This is to be replaced and the installation brought upto to current WRAS regulations.

The final installation will consist of 2 new 8000 litre storage volume tanks (total capacity 13,000 litres each)

c) Heating within the properties:

Currently a pair of feed and return pipes branches from the main heating pipes in the car parks or underground and rises through the building to serve the properties directly above. Generally the distribution pipe work on the lower floor of each property is surface run with the pipework for the first floor being buried in the slab. There are no control valves on the radiators or other form of heating control within the properties.

d) The Boiler Room.

The current low level air intake fan is to be replaced along with undertaking various attenuation measures to reduce the sound level (currently measured at LA 76dB 1 metre from the plant room) to an acceptable level.

3 Specification

As-installed drawings

Upon completion of the works the client will be forwarded a full set of fully dimensioned as installed drawings. The drawings can be provided in electronic form as well as hard copy.

3.1 District Heating System

The scope of works is to replace all the existing LTHW system distribution pipe work within the car parks and below ground
New pipe work (flow and return) will be installed to supply hot water to Barnborough.

3.2 Liaising with site users:

Prior to the start of the works the contractor will issue a schedule of how he is going to carry out his works with the least disruption to the site users. The following is a list of interfaces the contractor will have. It is not exhaustive and is only a guide for the contractor:

Residents: Working in flats and maintaining safe access within and without the blocks using Apollo resident liaison team.
Users of the private car park: Maintaining safe driving routes whilst replacing high level pipe work. It may be necessary to modify the existing vehicle entry system.
Users of the public car park: This is far busier than the private car park and the contractor will be expected to work closely with the car park operator to ensure safe working and access for the users.

3.2.1 Heating Outages

If the heating to any property is to be turned off for more than 30 minutes, the occupier is to be offered the use of fan heaters.

The contractor will supply and collect the fan heaters as required. It is anticipated that during the course of the works several blocks may be isolated whilst their common feed pipes are being renewed. The contractor will have sufficient heaters available to be able to supply all the properties concerned.

He is responsible for distribution and collection of the heaters.

3.3 Commissioning of the new services

The new services will not be commissioned and brought into service on the day before the weekend. This is so that any emergencies which might arise may be dealt with on the Friday and left over the weekend.

Whilst services are being commissioned the contractor will check that there is sufficient inhibitor in the system. He will make a daily record of the inhibitor charge in the dosing pot and replenish as required.

At the end of the works the contractor will have the inhibitor levels within the district heating system formally analysed to show that they are within tolerance.

3.3.1 Installation Responsibilty

The contractor will be responsible for the complete installation, maintenance of services and all interfaces with the underground works. He will instruct the underground contractor as to exactly how and where the connections to the risers and underground car park pipe work are to be made and be responsible for the joints.

3.3.2 BWIC, Making good and redecoration

The contractor will include for the costs of all new builders work holes and the making good and redecoration of all areas where he has carried out works.

3.4 Existing Services

Prior to the start of the work the contractor will carry out a cat scan of the site to locate the existing services.

The contractor will make every effort to ensure that his works do not damage or cut off the existing services to the site

If during the course of the works the contractor does cause damage to the existing services he will be expected to co ordinate their repair as speedily as possible and be responsible for all costs including consequential damage.

3.4 Replacement of all external below ground district heating pipe work

3.4.1 Scope

The underground heating pipes feeding the following blocks will be replaced along with the pipes feeding the heating from the public car park to the tenants car park:
Warmsworth
Barnborough
Hickleton
The Marr (including the pub and commercial offices)

Furthermore the contractor will supply and install a new hot water supply and return pipe from the existing system to Barnborough, terminating in tails just above ground level to be connected into the existing risers for this block.

The hot water supply and return system to Barnborough where buried will be a bonded system, in which steel carrier pipe, insulation and outer casing are moulded together to form a solid unit. Thus, the expansion movements of the steel carrier pipe will be transferred to the outer casing via the foam insulation.
The pipe system will be installed as a system locked/restrained by friction in which the temperature variations in the district heating system pipe system are absorbed either as axial stresses in the steel carrier pipe, by reduced expansion movements or both.

For Warmsworth and Hickleton Houses the below ground pipe work will be terminated in the ground floor cupboards next to the existing services for connection to the existing risers. They will be 32mm
The contractor will supply and fit the isolation valves and strainers on both the flow and return of the risers.
For the Marr the below ground pipe work will terminate in the man hole in the front entrance
For Barnborough the district heating flow and return and the hot water flow and return will be terminated just above ground level for connecting to the new service riser to be installed. They will be 32mm.

All pipework installation will be carried out in strict accordance with the following:

a) Design and Installation will be as detailed in EN 13941 approved by CEN on 27th December 2002

b) Pipework manufacturer's specification.

c) Current European and British Standards, e.g. EN 253, EN448, EN488 and EN489**.**

The contractor will employ a specialist contractor to supply and install the entire system using pre insulated pipe work

The following are preferred specialist installers for the installation of the specified system:

1. Vital Energi Utilities Ltd

Burnden House
Roman Road
Blackburn
Lancashire
BB1 2LD
Phone number: 01254 296 000 Fax: 01254 296040
Contact: Sales@vitalenergi.co.uk

2. PPSL District Energy Ltd
The Coach House
Boxwell Road
Berkhamsted
Hertfordshire
HP4 3ET, UK
Tel: 01442 874808 Fax: 01442 876293
Contact: info@ppsl-districtenergy.co.uk

3.4.2 Piping System Design

The supplier will ensure the project is Designed According to EN13941

Details of equipment, pipework and the distribution system layout indicated on the layout drawing(s) are approximate.

Note that a bypass system will be required at the end of each pipe run. This will consist of a 15mm by pass pipe with a quarter turn ball valve.

A complete installation capable of performing within the specified design conditions for the duration of the systems design life will be provided. The system will be fully in accordance with the recommendations and instructions of the pipe component manufacturer.

The distribution of forces and pipe movement for the whole piping system will be carefully considered and the system installed accordingly.

Maximum resultant stresses and movements will be considered at all critical positions in the proposed piping system. Critical positions will include anchors, bends, branches and building entries.

All loading conditions will be considered in order to ensure that maximum values of resultant stress and movement have been established. The effect of structural discontinuities and pipeline supports will be taken account of.

The supplier will prepare designs for thermal expansion calculations for each part of the works in accordance with **EN 13941**.

The supplier will liaise with all other utilities in the design and selection of routes.

3.4.3 Mechanical Installation

3.4.3.1 Pipes

3.4.3.2 Pre-insulated pipes

The prefabricated pipes will be made of a steel pipe, polyurethane foam insulation with integral copper alarm wires and an outer casing of high-density polyethylene (HDPE). The materials will be bonded together to form a solid unit in accordance with EN253.

The pre-insulated pipework installation will be able to operate at continuous temperatures of 140°C with short periods up to 150ºC.

In order to ensure uniform shear strength, the steel pipe will be grit blasted to min. preparation grade Sa 1 (ISO 8501-1: 1988) immediately before foaming.

3.4.3.3 Insulating Property

The pre-insulated pipes will be supplied with insulation with a performance of no less than 0.027 (lamda).

3.4.3.4 Steel pipes

The dimensions of the steel pipes will be in accordance with ISO 4200/DIN 2458. The pipes up to DN300mm will be delivered as welded pipes in steel quality P235TR1 according to EN10217-1 or a corresponding standard. Welding factor v = 1.0.

3.4.3.5 Foam insulation

The moulded polyurethane foam will consist of min. 88% closed cells.
The polyurethane foam will be guaranteed to withstand continuous temperatures of up to 140 ^{o}C without any detrimental effect.

The supplier will be able to present documentation of the lifetime of the applied foam insulation in relation to the operating data.

3.4.3.6 Documentation of heat loss

Using the lambda value in section 3.4.3.3 of this specification the supplier will present calculations of the current heat loss for the individual pipes as well as the total system, and for the maximum temperatures around the outer casing.

3.4.3.7 Outer casing

The outer casing will consist of a resistant high-density polyethylene material **(HDPE)** with the following properties

Density: Min. 950 kg/m^3
Elongation: Min. 350%
Yield stress: Min. 19 N/mm^2

In order to obtain the optimum bond between outer casing and PUR-foam, the inner surface of the outer casing will be subjected to a **corona** treatment during extrusion.

3.4.3.8 Receipt, handling and storage

Upon receipt, all materials are to be inspected for quality; any materials found to be of sub-standard quality will be rejected. Materials will also be checked for the required markings and certification, e.g. manufacturers and national standards markings, works certificates, time of production, etc.

All pipework, fittings and associated materials will be stored on site in strict accordance with the pipework manufacturer's recommendations.

Before, during and after installation it will be ensured that the insides of the pipes and components are clean, dry and free from foreign bodies. All free steel pipe ends will be protected from the intrusion of dirt and foreign bodies by suitable means, e.g. plastic caps. If during the installation process a free pipe end is left unsupervised, steel plates are to be welded on to ensure that the pipeline remains clean.
Adequately wide straps according to the dimensions in question will be used as lifting tools together with sufficiently wide supports. As a guideline, straps will be at least 100mm wide. Metallic straps, chains, wires etc will not be used. Security of all stored equipment is the sole responsibility of the supplier.

3.4.3.9 Alarm wires

The district heating pipe network will be monitored by an alarm wire circuit in connection with a documented, proven technique.

3.4.3.10 Joints

An independent Technical Institute will have subjected the chosen joint/muff to a SandBox Test in accordance with EN489.

After welding of the steel pipes, the joints will be sealed with muffs and insulated.

The pipework manufacturer will approve the method of jointing and the pipework manufacturer will manufacture all jointing materials.

Under no circumstances will third party joint assemblies be used.

The jointing materials will be delivered wrapped and be kept in a dry place until the pipe system has been installed and the insulation work can be started, packaging will not be removed from the assembly components until shortly before joint installation is commenced.

The joint will be easy to inspect by the supervision personnel, as planned visual check points will be able to show that installation and foaming have been done correctly.

The joint types applied will be power transmitting, and it will be possible to have them pressure tested for tightness before they are insulated.

It is essential that sufficient workspace be provided to ensure a quality jointing procedure.

The assembly will be executed under dry conditions above ground or in a completely dry excavation. Proper protection may be established by lifting the pipes off the bottom of the excavation and by covering the assembly area with a tent.

The casing joint installation should be planned in such a way that the muffs are fitted; pressure tested and insulated the same day.

3.4.3.11 Joint Types:

3.4.3.12 Fusion welded Band Joint.

The fusion-welded joint will be of the **Open type**, it will be installed after the welding of the steel service pipe. This will ensure the Joint will be clean from any contamination.

This joint type is welded together with the outer casing of the pre-insulated pipe to form an unbreakable unit. The fusion-welded muff will be made of polyethylene, PE incorporating **imbedded** copper wires/grids in a weld zone.

The welding will be done by a tested and approved procedure which can be applied without problems outdoors under all weather conditions.

After pressure testing the joint, it will be possible to repair any leaks by a welding process,

without having to remove the joint.

Once the installation of the joint has been completed, tested and insulated, the filling/testing hole(s) will be sealed by welding.

Polyethylene welders will posses valid qualifications, which document their ability to perform reproductive welding of the quality specified.

Documentation and Quality Assurance

The progress of the welding process will be followed on a graphic display. The data of the process should be continuously saved on a floppy disk and internally in the welding machine on its Hard Disk.

The saved data will form the basis of documentation of each muff by means of a computer-based monitoring program.

3.4.3.13 Identification of Weld

Each weld will have a unique number for identification during the welding process and for later documentation.

The number will be shown on the display during welding and will be used when storing welding data both on the floppy disk and the built in hard disk of the welding machine.

On completion of the welding process, it will be possible to document a fault-free welding procedure.

3.4.3.14 Mechanically Steel Fitting Taper Lock Joints

This joint complies with EN489

The following points should be given careful attention when installing this type of joint:

(i) Correct positioning of coated shell muffs on pipe.
(ii) Correct application of sealing strip(s) on shell muffs and casing pipe ends.
(iii) Proper execution of clamping connection.
(iv) Once the joint has been completed, tested and insulated, the filling/testing hole(s) are to be sealed durably and in a watertight manner.

Note: Mechanically clamped joints may be used on pipework of all sizes up to outer casing 400mm

Tightness test of casing.

Tightness testing of all joints is to be carried out using air or other suitable gas, before the air gap between the steel pipe and casing is insulated.

The test pressure applied will depend on the type of joint used. Testing can normally be done by applying an over-pressure of 0.2 bar to the joint.

Tightness is to be checked by use of a suitably sized pressure gauge and suitable fluid indicator. The test fluid will not be detrimental to the casing, joint material or the surroundings. The test period should be for a minimum of 1-minute duration.

3.4.3.15 Insulation of joints

The PUR-foam insulation will completely fill the joint. The foam losses will be less than 0.1 litres for each joint.

Polyurethane foam liquids will be delivered in sets with measured quantities for each joint size. A distinct indication on the packing of each set will show for which joint size the set is to be used.

It will be possible to mix the two liquid components efficiently in a closed system, so that the entire process of mixing and pouring the liquids into the joints can be done without the fitter running any risk of coming into contact with them.

On large projects joints may be foamed by the use of machines. In such cases the quality and quantity of the foam is to be examined by means of trial 'bag injection'.

The client/consultant Contract Administrator may require destructive procedure tests to be carried out on a limited number of finished joints. Finished joints are cut open, and insulation joint and foam are inspected by suitable means.

Under no circumstances will pre-fabricated insulating half-shells be used.

3.4.4 Alarm system

The Alarm system will be in accordance with EN14419.

The alarm system will be established on the basis of copper wires moulded into the insulation. The system will be able to detect the ingress of moisture in the foam insulation by a measurement between copper wire and steel pipe and it will be able to accurately locate the fault before damage leads to corrosion of the steel pipe.

Moreover, the alarm system will be able to detect a break of the measuring wire and it will be prepared for central surveillance by a combination of the integral copper wires and other system components.

As previously stated, the alarm system offered will be an integral part of the pipe system, as designed and supplied by the pipe system manufacturer.

Sufficient reference points will installed along the route of the district heating to enable the correct monitoring of the completed system.

3.4.4.1 Jointing of alarm wires

The supplier will deliver the crimp connectors and tools necessary to ensure a correct jointing of the wires. All wire joints will be cleaned, crimped and soldered.

For the installation the supplier will deliver a portable-measuring instrument which is to be used for test measurements which ensure that the wires have been installed correctly in accordance with given instructions.

The supplier will deliver a hydroscopic material to be placed around the wires in each joint in order to ensure a rapid and reliable detection of any fault occurred.

3.4.4.2 Instruction material

The supplier will prepare a complete diagram for the wire circuit and position of components. When the installation is taken into operation, a complete instruction manual for fault locating and maintenance will be placed at the customer's disposal.

3.4.4.3 Central surveillance

The supplier will install a complete system connected to a Fault Detector or if instructed a Fault Locator within an agreed location.

3.5 Installation techniques

The pipe system will be installed as a system locked/restrained by friction. This will be done by observing the requirements to a firm bond between steel pipe
insulation and outer casing as described under point 1. The temperature variations of the district heating water will be absorbed either as axial stresses in the steel carrier pipe, by reduced expansion movements or by a combination of both.

3.5.1 Expansion movements

In the case of expansion movements at bends and branches the supplier will use an increased layer of sand.

3.5.2 Sand layer for expansion

Expansion movements at bends and branches are to be absorbed by providing an extra wide sand layer between the outer casing of the pipes and the trench walls. The supplier will indicate the thickness of the sand layer on the detailed design drawings.

3.6 Valve arrangements

Isolation valves will be delivered as pre-insulated units, which can be buried directly in the soil, like all other components. Insulation and outer casing material will fulfil the same quality requirements as described under sections 1 and 2 and which apply to all other components in the system.

Isolation valves will be designed on the basis of a maintenance-free ball valve with an all-welded valve body and a stainless polished valve ball placed in spring-loaded Teflon seats.

Valve arrangements will be so designed that a problem free operation is ensured regardless of their position in a pre-stressed pipe system.

Where required the supplier will provide extended valve spindles to ensure safe operation and corrosion resistance.

All valves will meet current European Standards and be fully compatible with the operating parameters of the system.

3.6.1 Operating equipment

For the operation of valves in dimensions smaller than □ 219.1 mm the supplier will deliver standard T- keys.

3,7 Branch system

The supplier will indicate system solutions by which in the case of subsequent connections to a main pipe branches can be installed at any point of the pipe run.

Cutting of the main pipe run will be avoided. It will be possible to install branches at right angles to the main pipe run as well as parallel with it.

The supplier will indicate which branches are to be reinforced. Before their insulation, it will be possible to subject the branch fittings to a pressure test to check their tightness.

Whatever branch technique is used, the finished branch will be of the same quality as the other parts of the system.

3.7.1 Hot tapping

The completed District Heating main will allow for future connections to be made without the need to isolate or drain down the network.

Further information can be made available if required but no cost has been allowed for hot tapping within this tender return.

3.8 Bends/directional changes

Bends and curved pipe elements will be delivered as system solutions, which after installation are to the same quality as all other system parts.
Note: Only pre-fabricated bends are to be used on main runs.

3.8.1 Pipes of small diameter

Directional changes in the pipes of small diameter will, to the extent possible, be effected by curving the pipes on site (using special tools as specified by the manufacturer).

3.8.2 Pipes of large diameter

Directional changes in pipework of large diameter will, to the extent possible, be effected by using pipes curved in the supplier's factory according to the indicated curving angle.

3.8.3 Curving of pipes

For the curving of pipes on site as well as in the factory, techniques and equipment will be used which ensure that sporadic overloading of the materials used is avoided.

3.8.4 Mitred pipework

Mitred pipework will only allowed in special cases. Depending on the position of the mitre and the pipe dimension, the supplier will provide the necessary instructions for size and execution. This operation is only to be considered following approval from the client/consultant Contract Administrator.

3.9 Venting

Every effort will be made at the design stage to ensure that the installation of vent components within the underground pipework network is not required. Where the installation of vents cannot be avoided, they will be standardised components manufactured by the pipework supplier. The components Insulation and outer casing material will fulfil the same quality requirements as described under point 1 and which apply to all other components in the system.

3.10 Pits

Where (for whatever reason) it is necessary to construct underground pits as part of the underground pipework installation, the design specification will be of the highest standard and agreed with the client/consultant Contract Administrator prior to the commencement of works. The proposed pit construction will ensure the prevention of water penetration from any external source.

Where the pits are for access to isolation valves, the pits will be built up of 200 by 200 valve pit rings with a standard valve access lid at the surface. All valve pits will be numbered in embossed steel plate with reference to the site as built drawing.

3.11 Testing

3.11.1 Steel pipework weld testing

Testing will be as detailed in EN 13941 and relevant Project class

All steel pipe welding is to be undertaken by certified coded welders. Certification will be in compliance with current British and European Standards. Original Certificates for individual welders are to be made available to the client/consultant Contract Administrator upon request. Welders may be submitted to a welding test with at least the same acceptance criteria as the criteria for the finished work, with reference to EN 25817.

3.11.2 Flushing and filling the pipework system

The newly installed pipework system will be fully flushed or pigged, the flushing water will be from a suitable cold water main supply (The supplier to arrange and provide suitable mains water connection).

3.11.3 Strength Testing

Testing will be as detailed in EN 13941 and relevant Project class.

Following the District Heating pipework being backfilled the completed system will be hydrostatically pressure tested to 1.5 times the systems operating pressure for a period of 24hours.

3.11.4 Repairs

Any repairs required prior to backfilling will be carried out in strict compliance with the pipework manufacturer's recommendations. All repairs will be completed to the client/consultant Contract Administrator's satisfaction.

3.12 Training

The supplier will have training facilities and carries through courses for fitters and supervisors. The training courses will as a minimum include theoretical training in system function and installation as well as practical training in the installation of joints and alarm components.

3.13 Instruction on site

The supplier will ensure that there is a full time resident engineer on site to closely supervise the correct installation of the system. The resident engineer will be experienced and fully trained in all aspects relating to the pipework system being installed. The resident engineer will have previously occupied the same supervisory role on at least 5 projects of similar or larger size. The previous projects will have been using the same pipework supplier's materials and equipment.

The resident engineer will communicate with the client/consultant Contract Administrator on a daily basis and be available for advice and instruction.

3.14 Planning assistance

The supplier will make technical assistance available to the client/consultant during the detail planning and the installation phase.

3.15 Quality assurance

The underground pipework system being installed will be expected to have a service life of 30-60 years. This long service life is only obtainable when the installation is performed as high quality work.

High quality work can only be evaluated and assured when a system for quality assurance has been implemented for the project.

The supplier will be able to document and demonstrate that all quality activities throughout the entire procedure from customer's request, development/design, purchase, manufacture, and installation to delivery to the customer are carried out under well-organised and controlled conditions.

As a minimum the supplier will be able to forward a quality manual or other kind of description of the quality system. The spheres of responsibility and authority concerning quality will be defined and described in such a manner that the effect of the system and the authority of the quality manager can be judged.

The quality system will be based on the requirements laid down in the international standard for quality systems, the ISO 9001.

All on site procedures will be controlled by an approved quality system, to ISO 9002.

3.15.1 Certificate

Upon request, the supplier will be able to document the company's quality in a certificate. The certificate will contain inspection and test results for raw materials, semi-manufactured and finished components for the current delivery.

3.15.2 Operating and maintenance manual

Upon completion of the works the client will be forwarded a copy of the detailed, prepared O&M manual according the terms and conditions of the final contract.

3.15.3 As-installed drawings

Upon completion of the works the client will be forwarded a full set of fully dimensioned as installed drawings. The drawings can be provided in electronic form as well as hard copy.

3.16 Extended Guarantee(s)

The system shall have a minimum warranty period of 12 years from date of acceptance and handover to the client. The system life expectancy shall at the prescribed operating temperatures be no less than 100 years.

3.16.1 Defects liability period

From completion of the works until 12 months from the date of handover to LB Camden.

3.16.2 General materials Guarantee

All associated components, including alarm system, will be covered by a manufacturers 5-year guarantee

4.0 Civil Works

4.1 General

This section covers the ground engineering works associated with the laying of the piping system. The civil engineering works and associates material specification will be to the approval of the client/consultant Contract Administrator.

The final routes will be determined by the contractor and approved by the client/consultant Contract Administrator before work commences on site. As far as practicable, routes will follow the features of the site such as roadways and building lines. Road crossings will normally be at right angles to the line of the road.

4.2 Ground Works Design

The contractor will be responsible for the design and execution of all ground engineering work, which is necessary to ensure the suitability, compatibility and correct location within the system of components selected by him to meet the specified performance of the installation.

Ground works design will be based upon good working practice and will include the following:

a) The piping system design requirements of this specification.

b) The particular ground and site conditions relating to the site.

c) The location of existing services, building structures and other obstructions, and constraints along the route of the pipework system.

d) The expected ground movement.

e) A minimum ground cover of 400mm below the base of the road layer or the ground level of grassed areas. Where this cover cannot be achieved reinforced concrete flags placed above the initial 150mm of backfill sand will limit the ground pressure loading on the pipeline to 50 kN/m^2.

Trenching and bedding will be designed with due consideration of ground conditions, loading requirements, construction requirements, pipe strengths and pipe gradient.

The trenching design will accommodate the following surcharge loadings:

(i) Main Roads - A group of 8 wheels arranged as in BS 5400: Part 2 type HB road loading, each wheel having a static force of 90 kN with an impact factor of 1.3, all acting simultaneously.

(ii) Light Roads - A group of 2 wheels spaced 0.9 metres apart, each having a static force of 70kN, with an impact factor of 1.5, both wheels acting simultaneously.

(iii) Grassed Areas - The same wheel arrangement as for (b) but with a static force of 30kN and an impact factor of 2.0.

(iv) Construction Areas - As per item (a) using the maximum static force associated with the largest mechanical item of plant to be used on site.

Road areas will include all verges up to 2 metres outside the kerb lines.

The design of all anchor blocks will be based on the loading data derived from the contractor's piping system calculations taking full account of the ground conditions relating to the site.

4.3 Planning of the Site Works

The sequence of the site operations will be planned so that the work advances steadily and efficiently. Due recognition will be given to the work programme and proximity of other contractors.

The contractor will programme the Works so that they proceed with minimum inconvenience and disruption to the site occupants (and other users).

The sequence of operations will be as follows (where appropriate):

(i) Site investigations and trial digs.

(ii) Setting out.

(iii) Breaking up of hard surfaces.

(iv) Excavation, trench supports, support of existing services and de-watering of trenches.

(v) Preparation of trench bottoms.

(vi) Initial bedding or other support.

(vii) Pipelaying and jointing processes.

(viii) Inspection and preliminary testing of pipe integrity.

(ix) Completion of sand bedding (including sidefill and first 150mm layer of bedding).

(x) Backfilling of trench and withdrawal of trench supports (including laying of warning tapes).

(xi) Disposal of surplus soil.

(xii) Temporary reinstatement of surfaces.

(xiii) Final testing and commissioning of the piping network.

(xiv) Permanent reinstatement of surfaces.

(xv) Takeover and defects liability period.

The programme of excavation work will ensure that the opening of trenches, and installation of the piping system, is only carried out over such lengths as can readily be completed in one continuous operation. It will be organised so that there is sufficient labour, plant and material to keep the complete excavation ahead of pipe laying with the smallest possible length of trench standing open at any one time. Excavation of new sections of pipelines will not be connected until an adequate supply of pipe and components are available. A reserve of appropriate materials and equipment will be kept on site for immediate support of unexpected ground conditions.

Where work is likely to be suspended for any appreciable length of time, the construction schedule will be arranged so that lengths of trench are not left open.

4.4 Site Investigation

The contractor will be deemed to have visited the site and to have taken account of the topographical and other features apparent from a visual inspection of proposed piping routes. The contractor will check and verify all information supplied to him, prior to commencing detailed design. The contractor will carry out a site investigation and ground exploration, as necessary to obtain the necessary design information.

4.5 Ground Works Provisions for Pipe Movement

The contractor will make the necessary provision to fully account for thermal movement of pipe casings within his design and installation.

Systems using underground voids, culverts, lubrication and non-bonded techniques, for expansion control, will not be accepted.
Concrete anchor blocks and other associated builders work will be shuttered and cast to details shown on the approved drawings. Anchors to comply fully with pipework manufacturer's specification.

4.6 Maintenance of Existing Works

Before commencing any site operations, the contractor will notify (in writing) the service and utility authorities of the impending installation works and obtain details, and locations, of all installations (whether buried, hidden or visible) existing in the vicinity of the works.

Requests by any such third parties to witness any trench opening(s) will be notified to the client/consultant Contract Administrator and strictly adhered to.

Unless otherwise approved by the client/consultant Contract Administrator, excavations within 600mm of existing services will be by hand digging. All services uncovered, whether expected or not, will be reported immediately to the client/consultant Contract Administrator; they will be supported by slings and other suitable means and be adequately protected. Any damage to services, however minor, will be reported immediately to the client/consultant Contract Administrator; no repairs or replacement will be carried out without approval from the client/consultant Contract Administrator.

A photographic and a written record will be kept of the condition of any drain, manhole or other existing work which may be uncovered. Any defect evident will be brought to the attention of the client/consultant Contract Administrator.

The contractor will not use or interfere with the existing service installations without permission of the client/consultant Contract Administrator, or where appropriate, service and utility authorities. The contractor will take precautions to avoid damage to existing services and draw his operative's attention to the attendant risks and dangers.

If damage to existing installations occurs during works, then:

(i) The contractor will immediately notify (in writing) the client/consultant Contract Administrator and, where applicable, service and utility authorities. Details of the damage and proposed action the contractor will take will be given.

(ii) The contractor will make arrangement for repair to the satisfaction of the client/consultant Contract Administrator and, where applicable, to the satisfaction of the service and utility authorities.

(iii) In the case of urgent repairs, the contractor will accept any arrangement made by the Client/consultant Contract Administrator. Such arrangement made by the client/consultant Contract Administrator will not affect the extent of the contractor's liability.

4.7 Trenches/Excavations

All setting-out, excavations to required invert levels and backfill of trenches for the underground mains to approved drawings. All excavations to be in accordance with relevant British Standards, ACOP's and construction Regulations, including the provision of temporary fencing, scaffolding, bridging, barriers and watching required.

The excavations will be shored up in compliance with Health and Safety regulation requirements. All shoring will be positioned to ensure that it does not obstruct the installation works. If this is not possible, attendance will be given to remove and replace shoring as necessary during pipework installation (only to be carried out if safety regulations are not contravened).

The excavations will be graded to falls (to ensure the complete removal of air from the newly installed pipework) and the trench floor compacted (without the introduction of sand). If found conditions require it, a concrete blind should be laid and graded to provide a firm trench bottom.
Excavations will be set out to the required invert levels. The client/consultant Contract Administrator may require the contractor to prove the set levels via the use an adequate levelling device, i.e. Dumpy, Thompson, Cowley etc. The Contract Administrator may request the above checks be made at any stage of the works.

Adequately dimensioned welding pits (bell holes) to be excavated wherever welding is taking place in the confines of a trench. This welding pit is to ensure the welder has adequate access to make a perfect joint.

Excavated spoil is to be taken away from the trench area. If this is not possible/practical, the spoil may be placed on one side of the trench, leaving a minimum of 1 meter between soil and edge of trench. The opposite side of the trench is to be kept clear to allow access for plant and material for the installation of the new pipework.

The excavations will be kept clear of water at all times from the commencement of works until the backfill is completed. Pumps are to be provided where necessary to ensure this requirement is met.

Trenches are to be maintained, i.e. removal of materials due to trench collapse etc. This will be carried out from commencement of the works until backfill is completed.

4.8 Access/Installation

Access will be provided along the route of the underground mains installation for distribution of materials and installation plant. When pipes and fittings are transported to the trench site, precautions will be taken to avoid damage. Temporary support can be arranged by means of suitably sized wooden sleepers, sand bags or styrene blocks. The supports will be able to carry the load of the pipes without damage to the casing pipe or insulation

4.9 Inspection

Trenches and newly installed pipework are to be closely inspected immediately prior to the sand backfill to ensure that the pipework's outer casing is undamaged in any way. A minimum clearance of 150mm is required to be provided around the outer casing of the pipework throughout the entire length of the new pipework installation. Any section found not to comply with this requirement will be rectified before sand backfill can commence. Contractor to advise the client/consultant Contract Administrator of date and time of inspection to allow joint inspection to be made if so required. Notification to be in writing and an allowance of 48 hours to be provided prior to inspection date.

4.10 Sand for backfilling

Upon request the supplier of the pre-insulated pipes will give an approval of the chosen sand material.

4.11 Backfilling

Sand backfill should commence immediately following the successful inspection of both the trenches and newly installed pipework. Care should be given to ensure no damage is caused to the trench or installation pipework during the backfill process.

The backfill sand is **manually** compacted down (to prevent voids occurring) in layers of 100mm, ensuring that a 150mm layer of compacted sand is provided around and above the pipework's outer casing. Each layer is to be completely compacted before the next layer is laid. The compacted sand layer will provide a complete support to the pipes around their entire circumference.

Normally, manual compaction is achieved by hand and watering. Careful and even compaction is essential. Sand to be placed without any displacement of the underground mains installation.

A warning tape will be placed 250mm above the crown of each pipeline. Warning tapes will be of polythene not less that 150mm wide and 0.1mm thick. They will be yellow in colour and bear the continuously repeated legend "DISTRICT HEATING" in block letters not less than 30mm high.

The client/consultant Contract Administrator may request paving slabs to be laid immediately above the finished sand level for added warning/protection. The additional protective measures, if required, are to be covered by a provisional sum included in the tender summary.

Above the sand surround a backfill with selected material not exceeding 75mm in size, free from rubble, half bricks, sharp objects and building rubbish, will be placed in 150mm layers. Each layer to be hand tamped and compacted to give a minimum cover of 450mm between the crown of the underground mains and the base of the road layer or the ground level of grassed areas.

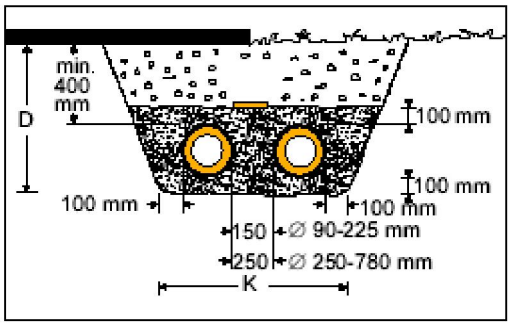
Where the specified cover cannot be achieved reinforced concrete flags placed above the initial 150mm of backfill sand will limit the ground pressure loading on the pipeline to 50 kN/m^2.

4.12 Reinstatement of Surfaces

Those parts of the site (and any areas outside the site) disturbed by the Works will be reinstated to equal the conditions existing before the works commenced. The surface of any road or footpath which has been disturbed by the excavation will be reinstated to the approval of the client/consultant Contract Administrator. Cultivated areas, top soil and turf will be permanently reinstated to harmonise with the adjoining surface.

4.13 Excavation of Trench

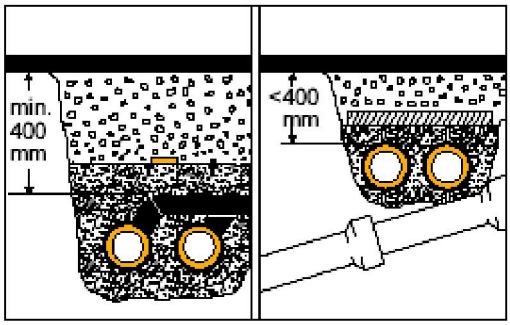
The Contractor's pipes are installed in trenches in accordance with the minimum dimensions appearing from the table.



Excavation of
Trench (Straight runs)

The min. dimensions, stone less sand layer, distance between the outer casings and the cover of the pipes, required for a correct system function, appear from the trench profile.

The minimum cover of 400 mm allows amax. surface load of 800900 kPa (0.8-0.9N/mm2). In areas with heavy traffic 400 mm are measured from the top of the pipes to the bottom of the road layer.



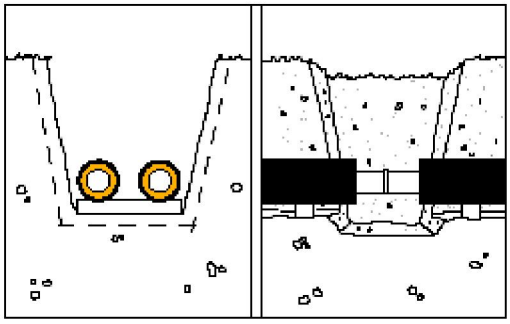
In areas with no traffic 400 mm are measured to the top of the area (1).
In connection with pipe dimensions larger than ø 609.6/780 mm the necessary installation depth and pipe distance are determined in each case.

Do not forget warning tape (2). At branches the 400 mm are measured from the top of the branch pipe. If the cover is less than 400 mm the pipes must be secured against overloading – e.g. by means of a reinforced concrete plate.
Excavation of trench The Contractor pipes are installed in trenches in accordance with the minimum dimensions appearing from the table.

Installation in trench

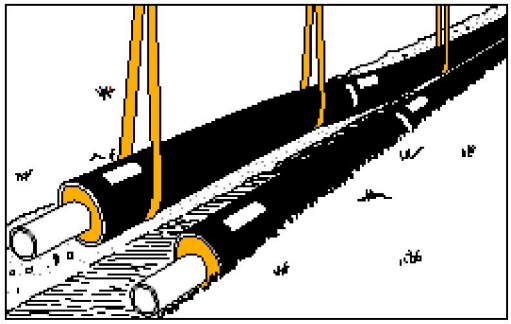
The pipes can be installed in the trench, supported by cushions of sand or sleepers which are removed before the trench is filled with sand. In case of joints it is recommended to increase the trench width and depth to 250-300 mm to ensure good space for welding and installation of the muffs.

Connection above trench



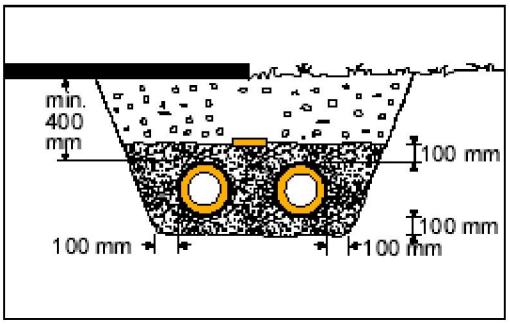
A simple and quick installation is achieved by connecting several pipes above or alongside the trench.
Support the pipes by sleepers, made fromsquare timber e.g. 100 x 100 mm, withsuitable distance between them.
Sleepers must also be used, if several pipe lengths are installed alongside the edge of the trench. When installing pipes with built-in surveillance system place the pipes so that there is only one label at each joint.
This is necessary for the surveillance system to function. See section 23, the surveillance system.

Lowering into trench



When a pipe length has been welded together, the pressure test has been carried out and the muffs installed and insulated, lower the section into the trench with wide straps by means of cranes. The number of straps and cranes depends on the length and dimension of the pipe section.
When utilizing this installation technique, it is important to keep the pressure limitation of max. 300 kPa on the outer casing. Deflections may not result in tensile stresses > 200 kPa, corresponding to a material strain of approx. 0.1%.
See curved pipes, section 2, elastic radius.

4.14 Backfilling



Level the bottom of the trench with a min.100 mm stone free sand layer which is compacted. Remove all sleepers after installation of the pipes and cover with 100 mm stone free sand.

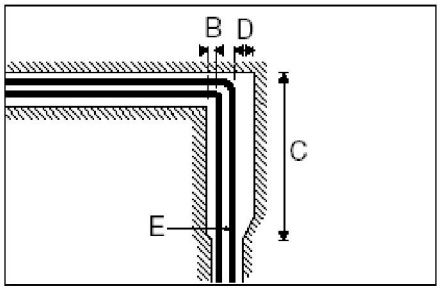
Place the warning tapes on the sand surface and make final backfilling with an optional stone free material. The sand surrounding the pipe is to protect the pipes and to ensure the friction between the outer casings and the sand which restrains the expansion of the pipes as provided in the installation rules.

4.15 Expansion Zones.

Sand pads for installation methods II, III, IV

The thickness and length of the sand pad appear in the table.

Special measures must be taken in connection with major dimensions and large installation depths.



Service pipe Dim. ø out. mm	Thickness of sand layer: Outer casing/ wall D mm	B mm	Between outer casing E mm	Length expansion zone C m
26,9	150	100	150	0,8
33,7	150	100	150	0,8
42,4	150	100	150	1,0
48,3	150	100	150	1,0
60,3	200	150	150	1,2
76,1	200	150	150	1,3
88,9	250	150	150	1,5
114,3	300	150	150	1,8
139,7	350	200	200	2,0
168,3	350	200	200	2,2
219,1	450	250	250	2,7
273	550	300	300	3,1
323,9	600	350	350	3,5
355,6	650	400	350	3,6
406	700	400	400	4,3
457	800	450	450	4,7
508	850	500	500	5,0
559	950	600	500	5,2
610	1050	650	600	6,0

5.0 Replacement of district heating pipes in the underground car parks and new risers to Barnborough

5.1 Scope:

All the feed and return pipe work for the district heating system (LTHW feed and return) is to be replaced within the car park, including the tee offs to the risers for each block. Upon completion and commissioning of the new pipe work the existing pipe work will be stripped out and disposed of by recycling.

Generally the pipe work is running down the centre of the car parks with tee offs to each riser for each block

5.2 Pipe Work:

The new pipes will be medium grade steel to BS EN 10255:2004.

The diameter of the main pipes will be as shown on the drawings, with the tee offs to the block risers being 32mm except for Mexborough where they will be 40mm

All pipe work will be pressure tested to one and half times working pressure.

5.3 Pipe Work Routing

The contractor will always maintain a floor to bottom of insulation distance of 2.2 metres when installing the new pipe work within the car parks.

The new pipe work will be installed in parallel with the existing. Generally there is enough space within the ceilings to install the new pipe work and commission it, before taking down the existing. However two areas are congested.
The first is where the pipe work comes from the boiler room into the public car park. Here the new pipe work for the services feeding the private car park will be re routed round the back of the car parking bays. It should then be possible to remove the existing pipe work and replace this with the pipes for the public car park.
The second area is by the exit to the public car park. Here it is anticipated that the existing pipe work will have to be removed first before the new can be installed

5.4 Pipe Work Supports

The pipe work will be supported with a standard pipe work clips such as Munsenn Rings from the soffit of the car park. The connections into the concrete will have anti vibrations mountings.

The pipe work will be supported at every bend and tee off and as per the recommended distance shown in BS 3974-2:1978

5.5 Expansion Joints

Expansion joints will be allowed for as shown on the drawings. There is one per straight run within each car park zone

5.6 Insulation

5.6.1 General

Thermal insulation is to be to BS 5422 and BS 5970. Insulation shall not be applied to any pipework until hydraulic tests have been satisfactorily completed and documented.

5.6.2 Insulation Material

Insulation materials shall be inherently proofed against rotting, mould and fungal growth and attack by vermin, be non hygroscopic and in all respects suitable for continuous use throughout the range of operating temperatures and within the environment required.

Unless otherwise indicated all thermal insulating materials used within any building, shall when tested in accordance with BS 476 Part 4, be classified non-combustible. Alternatively, all thermal insulating materials used within any building shall be non-combustible with a facing of combustible material provided that the facing material is not more than 0.8mm thick and it has a class 1 surface spread of flame when tested in accordance with BS 476 part 7

Thermal insulating materials shall be free from substances which in the event of a fire would generate appreciable quantities of smoke, noxious or toxic fumes. Evidence of fire classification of the proposed material shall be provided if required by the C.A.

All insulation materials shall be free from asbestos.

5.6.3 Provision of Insulation

All main LTHW and pipe work is to be insulated with 25mm thick class ‘L’ Armaflex manufactured by Armstrong World Industrial, oversized sections secured with aluminium bands, arranged for easy dismantling and reinstatement to enable access to valves. Seal with tape at joints.

The Tee offs to the risers will be insulated in 13mm thick class 'L' Armaflex.

Junctions and changes in direction in pipework must be completely covered with insulation without the thickness being reduced. Mitred joints at bends are not permissible.

5.7 Provision of a by pass valve

At the end of each pipe run the contractor will supply and fit a 15mm bypass and ball valve.

5.8 Labelling

All valves except radiator valves shall be provided with engraved brass or traffolite labels 75 x 50 x 1.6mm thick engraved with the function served and installation fitted in e.g. "LTHW feed", etc.

All pipework and insulated pipework will be banded with colour coded identification bands, also flow indication arrows to be installed.

5.9 New risers to Barnborough

Currently the risers for Barnborough terminate in the soffit of the first floor ceiling. The contractor will supply and fit new 32mm diameter flow and return pipes for both the district heating nad hot water from the risers in the first floor soffit to the ground floor.
On the ground floor the contractor will supply and fit the isolation valves and strainers connect to the new below ground tails.

After commissioning and insulating the pipes the contractor will supply and fit weather enclosures as agreed with Apollo to hide the new risers. He will provide by means of a lockable door access to the valves and strainers.
The contractor should allow for good quality locks, whose keys are not readily available to the public. The locks must be vandal resistant.

6 Replacement of the Cold Water Feed Tank to the Calorifiers

6.1 Scope:

The cold water feed tanks to the calorifiers in the boiler room and for the cold water down service to the estate are located in the roof space of Mexborough House. The contractor will replace these tanks with 2 new insulated GRP tanks fully conforming to all current WRAS regulations. He will also renew all associated pipe work and valves in the roof plant room, fully insulating them against condensation.

By the completion of the section of the works, the contractor will have replaced the large tank with two smaller tanks serving both the calorifiers and the cold water down service and stripped out the small tank serving the calorifiers.

In order to do this work the contractor will have to provide temporary or permanent lighting to the plant room. Both options will be priced.

6.2 Location of the Mains Water Supply Stop Cock

The contractor will ensure that all his staff working on the tank replacements are familiar with the location of the mains water stop cock so that in an emergency the water can be turned off.
Prior to the start of works the contractor will demonstrate to Apollo that the stop cock is fully operational by turning off the water supply temporally to show that no water is being fed through the ball valves into the two tanks in the room.

6.3 Securing all pipe work in the roof top plant room.

Prior to the start of the working in the plant room the contractor will secure all pipe work by providing extra supports so as to minimise the risk of damage to the pipes during the works.

The contractor will maintain the smaller down service tank as fully operational except during any planned outages. These outages will be kept to a minimum

6.4 Maintenance of down service to the calorifiers and cold water service

The contractor will maintain a water down service to the calorifiers and cold water down services at all times. This will be done by modifying the pipe work in the plant room to provide a service both to the calorifiers and to the cold water down service from the existing small tank. An additional 2 inch mains feed and ball valve will have to be provided to this existing small tank in order to provide enough flow whilst the larger tank is being stripped out and replaced.

6.5 Informing Residents of the works:

The contractor will inform Apollo's resident liaison office by means of a letter two weeks prior to start of work and on the day before work starts of the work to be carried out on the tanks.

The letters will amongst other information state the nature of the work, the proposed days times for outages and a contact name and telephone number.

6.6 Outages

When the water supply supply (either mains or down service) has to be taken out of service for more than 30 minutes the contractor will inform Apollo's resident liaison office in writing again stating the nature of the works, the time, duration and date of the outage and giving a contact name and telephone number.

It is expected that these outages would have been programmed into the tank schedule of works.

6.7 Replacement of the tank:

Two new 8000 litre water storage tanks will be installed to replace the two tanks currently installed.
The new tanks will be a complete installation, including insulation, fixed vents, overflow, lid and warning pipes. They will also include a new ball valve each and all associated pipe work back to the mains water isolation valve in the roof space. The installation will comply with all current WRAS regulations and advice.

Outlet fittings will also be supplied with the tanks, so that the tank manufacturer' may incorporate these into the tank walls.

It is expected that the tank will come complete with all necessary connections so that no penetrations will be made by the contractor into the tank or integral insulation.

The tanks will be piped and valved in such a way that they will normally be fed in equal quantities, but capable of being isolated from each other for maintenance purposes.

6.8 Sizing of the new tanks:

The new tanks will have a water capacity of 8000 litres each. Due to the poor access via the lift motor room and associated hatches it is expected that the tanks will be sectional tanks made up of 600 by 600mm pre insulated panels. The contractor must check that this size will fit through the access hatches before ordering.

6.9 Overflows and warning pipes for each tank.

An overflow pipe will be supplied and fitted, sized according to the sizing information given in the water regulations R16. They will be of proprietary manufacture and incorporate a 0.65mm screen, positioned to give a head of water above the screen.

A warning pipe will be supplied and installed, again sized and routed as per the Water regulation R16.

If necessary the new overflow or warning pipe may be joined to an existing common warning pipe from the other tank providing this is done via a tundish and the design is such that water cannot enter the overflow pipe from the common pipe.

The siting of the tundish should be such it is easily visible.

All other overflows or warning pipes must also be disconnected from the common pipe via a tundish arrangement.

Under no circumstances should a warning pipe be attached to a overflow common pipe or vice versa, without the contract administrators written approval.

6.10 Materials of Construction:

The tank will be of polyester resin/glass fibre reinforcement with GRP lids.

They will be insulated with integral insulation to give atleast 12 hours protection from freezing. This will be 50mm thick giving a U value of 0.45 w/m2

6.11 Stripping out:

The contractor will include for stripping out all redundant materials and their removal from site. The contractor will be deemed to have allowed for all stripping out as necessary, No further monies will be available.

The tank will first be isolated from all connections to it, including if appropriate the vent, overflow and warning pipes.

All pipes and the vent will be capped off to prevent dust and dirt getting into them.

However the roof spaces will be left in a neat and clean condition.

6.12 Inspection and repair of the new tanks base

When the tank is removed the contractor will inspect the tank base and make any proposal for the repair of the base. The base must be level and flat and be capable of supporting the entire base of the new tanks.

If the materials of the tank base are not suitable for re use and cannot be repaired, the base will be stripped out and replaced with marine ply or equal and approved.

6.13 Drip trays

The new tanks will be sat upon a suitable sized drip tray. This will drain to the outside roof. These will be supplied and fitted by the contractor.

6.14 Installation of the new tanks

The new tanks will be installed strictly in accordance with the tank manufacturer's instructions and then filled and commissioned as per the WRAS regulation and manufacturer's instructions.

The tanks will then be cleaned and chlorinated prior to be put into service.

Typical commissioning procedure is to fill the new tank with water and check for leaks to the tank and connections.

Leave tank full for a minimum of 12 hours and then check that the level has not dropped and there are no signs of leakage

Drain down tank, clean out and chlorinate as per WRAS instructions

6.15 Servicing of existing valves

All the valves associated with the water distribution within the roof space will be serviced. The valves will be eased and greased with silicone grease and either left closed or fully open (and turned back half a turn for gate valves)

Any valves which cannot be operated will be replaced.

6.16 Upgrading pipework insulation

Pipework within the roof spaces should be upgraded to meet the minimum specifications of 12 hours duration without freezing as per the WRAS calculator available on their web site.

6.17 Clean and Disinfect tanks and pipework

The tanks will be drained, flushed out and then disinfected according to the water regulations section R13 and BS 6700 1997 using sodium hypochlorite at 50 mg/l for one hour. The concentration of chlorine will be checked at the end using a proprietary testing kit and repeated if the level is below 30mg/l.

The water will be discharged separately from the down service to sewer, providing the level of sodium hyperchlorite is not about 50mg/l.

6.18 Labelling

All valves with engraved brass or traffolite labels 75 x 50 x 1.6mm thick engraved with the function served and installation fitted in e.g. "Mains Water feed", etc.

7.0 Installation of Thermostatic radiator valves (TRV'S) and lock shield valves

7.1 Scope:

The contractor is supply and install thermostatic radiator valves and lock shield valves on all the radiators connected to the district heating scheme. He will carry out a pre installation video survey of each property and again at the end.

It is also expected that some of the radiators will be blocked and consequently he should allow for taking down one radiator per property and flushing it out.

7.2 Surveys

The contractor will make a video record of each property before he starts. He should particular attention to the state of the floor coverings around each radiator tail and any staining on the ceiling.

He will record any radiators which are not coming up to full temperature and arrange firstly to bleed them and if this does not work to take them down and flush them out.

He will also confirm whether the radiator tails are metric or imperial sized.

He will also record and report to Apollo any radiators which appear to be leaking, so that they can be reported to LB Camden maintenance department for the radiators to be replaced.

At the end of the works the contractor will carry out another video survey to prove that he has not damaged anything within the property.

7.3 Protection of the resident's property

The contractor will adequately protect the residents floor coverings and any other surfaces. He should request any vulnerable objects such as ornaments be moved away from areas where he is working.

7.4 Installation of the TRV's and Lockshield Valves

The contractor will drain down each riser and supply and install a new TRV on the feed to each radiator and a chromium plated lockshield valve to the return of each radiator. He will then refill the system and balance the radiators so that they all become warm.
The contractor should note that as each riser serves each floor of each property, he have to balance radiators within one flat to get another flat's radiators to perform properly.

The contractor should be aware that the system was installed in the 1960's and consequently the pipe work could be imperial sized rather than metric and therefore must have the correct fittings available.

A suitable TRV is the Danfoss RA-FS which will have to be adapted for imperial connections.

7.5 Decoration of the radiator tails and any other pipe work alterations within properties

The contractor will repaint the radiator tails and any other bare pipe work he has installed with one coat of under coat and one of gloss.

7.6 Return Visits

The contractor will allow for two return visits per property to bleed any radiators where air may have become trapped.

8.0 Noise attenuation to the boiler room

Scope:

The noise from the plant room has been measured at about LAeq76B and the measures specified below are to reduce the noise level to 10 dBa below ambient night time levels.

The contractor will supply and fit a new run and standby fan set for the low level air intake into the boiler room, complete with attenuators.

He will also supply and fit the duct work and attenuators

The contractor will supply and fit the acoustic enclosure recommended in the acoustic report along with new doors at the bottom of the access stair in the plant room.

The contractor will supply and fit the new acoustic louvers as required in the acoustic report along with blanking panels to fill in the remainder of the front aspect.

As this is is a specialist item the contractor will use Stuart Acoustic to supply and fit the equipment as described below except for the ductwork and air inlet grille to the new mechanical intake fans

The contact details for Stuart acoustics is as follows:
Stuart Acoustics
Frobisher Business Park
Hants, SO51 0EZ
Tel: 01794 528350
Contact: Colin Craddock

8.1 New low level air intake fan:

A new low level run and standby fan rig will be installed, bringing ducted air from the outside, through an attenuator.

From the fan set the contractor will install a second attenuator and then a three vent dispersal system at low level to bring air in line with each of the boilers.

A suitable fan set is 2 number Flakt Wood 50JM/20/2/6/34 producing 5.09 cu metres per second of air at 250 pascals. The fans will be inverter driven.

The quotation number from Flakt Woods for the fans and controller is: DGL/Q005/44674A00.

These are 3 phase 415 volt fans which will be cabled back to the BMS panel.

The final fan choice will be confirmed when the final plant room attenuation design has been carried out

8.2 Ductwork and Air intake Grille and Extract Grilles for the mechanical intake fan.

This section is contractor supplied and fitted items in conjunction with Stuart Acoustics

The contractor will visit site and design the complete duct work route. For the purposes of pricing the duct size will be 1.6m square.

The air intake grille will be supplied and fitted by the contractor

The air grilles from the ductwork into the plant room will be fitted by the contractor. Air velocities should not exceed 1.8 m/sec

The duct work will terminate with a mesh giving 60% free area or better. This is a contractor supplied and fitted item, along

8.3 Electrical Connections

All electrical work will carried out by a competent electrician to comply with the IEE regulations 17th edition.

The run and standby controller is a CCRD3 supplied by Flakt Woods.

The controller has an auto change over every 12 hours to allow even wear of the fans along with a volt free contact to cable back to the BMS unit if a fan trips. When a fan trips the other fan will automatically come on.

The boilers should shut down automatically if neither fan is running. However this facility should be timed out to allow the fans to change over normally.

8.4 Acoustic Screen to the boiler fan system:

There are 3 No Boilers located at the south end of the plantroom closest to the open grill. Each unit is served by a centrifugal air supply fan. Noise from the fans is high at LAeq 83dB at 1 metre.

In order to not affect the air flow balance to the boilers gas burners the following partial acoustic screen will be supplied and fitted by Stuart Acoustic:

a) Provide a metal framework forming a 3 sided structure, leaving the boiler side open.
b) Clad the structure with 18swg steel sheet removable acoustic panels.
c) These panels should interlock and be lined internally with 50mm thick Class O fire retardant acoustic foam of 30kg/m3 density.
d) The above needs to be capable of being manhandled to facilitate access to the fans/burners for maintenance.

8.5 Fresh Air Intake and Fan System

a) Locate the new fan such that atmospheric and job side attenuators will be fitted.
b) The atmospheric and job side attenuators should be as follows:
Supply and fit a design sized 1200mm long rectangular galvanised steel attenuators. They will have a 150mm central splitter and 50mm thick sideliners. The contractor will supply and fit all supports and mounting required by the heavy weight and length of the attenuators. The system including the fan transition pieces and attenuator will be lagged with 10kg/m2 acoustic lagging material.
The insertion loss for the attenuators should be as follows:

Octave Frequency in Hz ref dB 2 x 10-5 pas						
63Hz	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz
6	10	19	33	42	42	30

N.B. This fan system can be located within the new acoustic louvre grill as discussed below. The fan intake grille will be the same size as the attenuator.

8.6 Open Grill area (High Level ventilation grilles)

The contractor will employ Stuart Acoustic to supply and fit a single 300mmm deep acoustic louvre (designed size to match opening) to the atmospheric side of this system.
The insertion loss for the attenuators should be as follows:

Octave Frequency in Hz ref dB 2 x 10-5 pas						
63Hz	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz
4	8	10	16	17	16	14

Note: The air intake for the fans will be within this array.

8.7 Front of Boiler Room

This is a contractor supply and fit section.

The contractor will supply blanking plates and a new pair of steel access doors to the plant room in order to smarten up the appearance of the front elevation.

8.8 Acoustic Survey

Upon completion of the acoustic works the contractor will commission a 24 hour noise survey to show that the targets have been met.

Summary of Tender

The tenderer is to itemise in this summary various lump sum prices, each inclusive of all on costs, for which he is prepared to carry out the works specified in the relevant sections and which make up a total contract tender price exclusive of any discounts to the main contractor which is to be shown separately.

1. Preliminary

(i)	Insurances, indemnities etc.,	£	
(ii)	Supervision		£
(iii)	Builders and full engineering working drawings	£	
(iv)	Site accommodation		£
(v)	Protection of Plant and Materials	£	
(vi)	Notices to Authorities	£	

2. Section 1 Technical Specification £

3. Section 2A Generally £

4. Schedule of Work

a	Cost of supply and installation of the below ground district heating pipework from the boiler room to the Marr, Hickleton, Barnborough and Warmsworth	£
b	Supply and installation of the hot water flow and return pipe work from the tee off point as shown on the drawings to the risers at Barnborough	£
c	Supply Installation of the wires and monitoring system for leak detection in the below ground pipework	£
d	Cost of civil works associated with a, b and c	£
e	Replacement of the district heating pipe work in the public car park including tees to risers	£
f	Replacement of the district heating pipe work in the private car park including tees to risers	£
g	Cost of the new ground floor risers to Barnborough	£
h	Cost of enclosures for g	£
i	Supply of the new cold water supply tanks including overflow, warning pipe, ball valves, isolation valves and strainers and vents and screens	£
j	Fitting of the cold water tanks and pipe work and valves etc as in part i	£
k	Supply and fitting of the thermostatic radiator valves and lock shield valves in all properties served by the district heating	£
l	Supply of the new boiler room air intake fan set and controller	£
m	Mechanical installation of the fan set	£
n	Design, supply and installation of the duct work and attenuators associated with the fan set	£
o	Supply and fitting of the acoustic enclosure to the high level ventilation and louvers	£
p	Supply and fitting of the acoustic enclosure to the air supply for 3 no boilers	£
q	Supply and fitting of the new blanking plates to the front of the boiler house	£
r	Supply and fitting and painting of the replacement	

	steel doors to the boiler room	£
s	Cost of Acoustic report	£
t	Builders Work	£
u	Redecorations	£
v	Testing and Commissioning	£
w	O& M Manual and Log Book	£_____

Sub-Total £_____

Section 5 Controls and Electrical Work

a	Cost of alarm system for below ground pipe work	£
b	cost of temporary lighting to the cold water tank room	£
c	Cost of the electrical installation to the air intake fans to the boiler room, including wiring to the controller and BMS system	£

Sub-Total for Controls Carried Forward £_____

Contingency Sum for Mechanical and Electrical Works £20,000-00

Less any discount to main contractor £_____

Total Contract Sum £_____

Alternative price
Cost of permanent lighting to the cold water
Tank room £

Name of Mechanical Services Contractor

_____
_____

Signature _____
Date _____

End of Mechanical Services Summary of Tender

Appendix 1: Acoustic Report

Environmental Noise Assessment Report

Evaluation of Noise Emissions from Operation of the District Heating Plant Room Curnock Street, Camden, London

E N L
Acoustic Consultants
Channel House, 386 Seafront,
Hayling Island, Hants, PO11 OBD
Tel/Fax: (02392) 468697

NOISE SURVEY REPORT No EN/CSE/May 2009
DISTRICT PLANTROOM, CURNOCK STREET ESTATE, CAMDEN, LONDON.

1.0 INTRODUCTION

1.1 Instruction: To provide consultancy services including noise monitoring,

advise and evaluation with reference to an environmental noise impact assessment of the operation of the District Plantroom serving the Curnock Street Estate.

1.2 Client: Mr D Unerman – Triangle Design Consultancy.

1.3 Survey Location: District Plantroom, Curnock Street Estate, Camden, London.

1.4 Initial Survey Date: i) 13 May 2009
ii) 15 May 2009

1.5 Survey Times: i) 1100 hrs to 1600 hrs.
ii) 2100 hrs to 0100 hrs

1.6 Weather Conditions: i) Light cloud, dry and still.
ii) Light cloud, dry and still

1.7 Instrumentation: CEL 593 C1R Precision Sound Analyser Type 1
CEL 284/2 Acoustic Calibrator Type 1
(Calibration Certification from November 2008)

1.8 Initial Report Date: 26 May 2009

1.9 Acoustic Consultant: R B Parker, MIOA, MCIEH, ENL Acoustic Consultants

2.0 BACKGROUND INFORMATION

2.1 The Plantroom

2.2 It is understood that the plantroom has been in use since the mid 1960's, presumably being constructed at the time the Estate was built. The purpose of the plantroom is to provide district hot water and heating to the Curnock Street Estate of Council owned high rise apartments/maisonettes. The plantroom operates 24 hours per day.

2.3 Location and Layout

2.4 Curnock Street Estate is a purpose built apartments/maisonette community comprising of blocks of 4/5 storey residential units with basement car parking and several small retail shops. The plantroom is located centrally in the Estate occupying the basement of the Goldthorpe Building directly under the block of apartments/maisonettes.

2.5 There are 3 main boilers in the plantroom combined with other plant serving the system. Ventilation into the plantroom is both natural (via street level

grills) and forced ventilation (via fresh air intake fans on the south and north elevations. There are no acoustic controls in place apart from 'acoustic' covers shrouding the gas burner fans. Tests indicate that these devises serve no useful acoustic purpose.

2.6 Although no specific history is available it is understood there have been complaints about noise from the operation this plantroom for some time. The Council are considering this issue as part of a refurbishment programme taking place in this area.

2.7 Initial Site Inspection and Analysis.

2.8 The plantroom is accessed via double steel doors leading to stairs down into the plantroom. The room is part of a sustainability built development with a separating concrete floor slab between the plantroom and the residential units over of minimum 300mm. Ventilation into the space is via:

i) Open grill (partly glazed) on the south elevation, running the width of the plantroom.
ii) An intake fan and duct work drawing air in via the open grill.
iii) An intake fresh air duct system to the north side of the plantroom at high level.

2.9 There appears to be no air flow plan insofar as fresh air accessing the plantroom is through all 3 routes above and warm air out is via the open grill. Investigations confirmed that the main sources of noise emissions are as follows:

a) The centrifugal fans serving each boiler. One per boiler. Noise emissions from these sources are about LAeq 84dB per unit at 1 metre.
b) General machinery noise in the plant Room. Typically reverberant noise in the plantroom ranges from LAeq 73dB to LAeq84dB.
c) The fresh air intake fan (located at ground level) as measures at 1 metre externally is producing LAeq76B at 1 metre.

2.10 Initial Assessment of Environmental Impact.

2.11 Insofar as the Apartments located over the plantroom are concerned the environmental impact is from tonal noise and an elevated background noise level. This is dealt with in more detail later in this report. Typically background levels are increased by 5dBA or more. This is not as great as would be expected by observation as the slab overhang partly protects the apartments from the full impact of the noise from the plantroom.

2.12 The properties situated opposite the plantroom in the Marr Building are, however, subjected to high noise levels over existing background noise. The environmental

impact is high.

3.0 PURPOSE OF THE REPORT

3.1 The purpose of this report is to provide an environmental noise assessment to evaluate the above mentioned issues. The assessments made in accordance with British Standard 4142:1997 (British Standard used extensively by LA's to assess noise problems), compliance with planning conditions and statutory noise law are set out below.

4.0 ENVIRONMENTAL NOISE MEASUREMENT CONSIDERATIONS.

4.1 Environmental measurements were made in accordance with BS7445:1991 Parts 1-3. In all cases the microphone was positioned 1.2 metres above ground level in the
following locations:

i) Within the Plantroom
ii) 1 metre from the open plantroom grill.
iii) In front of the Marr Building
iv) At the rear of the Goldthorpe Building in the piazza area.

4.2 Measurements have been assessed and rated under procedures in British Standard 4142:1997 - Method for rating industrial noise affecting mixed residential and industrial areas. This standard is extensively used to assess the impact of noise from commercial/industrial activity upon residential properties.

4.3 Measurement periods of 5 minutes are used during the survey to ensure as these
periods are considered an adequate range of measurements to be taken. Calibration of instrumentation must be carried out at the beginning and end of each monitoring period, in accordance with good practice.

4.4 The noise level descriptors to be used for the survey:

i) L_{AeqT}dB - Time weighted equivalent continuous A-weighted sound pressure
ii) L_{A90T}dB - A-weighted sound pressure level exceeded for 90% of the measurement period. This index is used to measure background noise level.
iii) L_{Amax}dB - A-weighted maximum sound pressure level measured at 125msecs. This is used to describe short period noise events.
iv) L_{Amin}dB - A-weighted minimum sound pressure level measured at 125msecs. This is used to describe short period noise events.

5.0 ENVIRONMENTAL MONITORING RESULTS

5.1 Overall Environmental Background Noise Levels

5.2 In order to assess the current situation environmental monitoring was undertaken at various positions to provide background noise level information. The results are set out below.

5.3 Table 1 - Environmental Background Noise Levels

Position 1 - At the rear of the Goldthorpe Building in the piazza area - noise from plantroom not audible at this location.	Period	L_{Aeq}dB	L_{A90}dB	L_{max}dB	L_{min}dB	L_{A10}dB
	Daytime Levels					
	1200-1300	56	49	69	46	59
	1300-1400	57	48	68	45	60
	1400-1500	59	48	72	45	60
	1500-1600	58	48	75	45	61
	1600-1700	57	47	72	45	59
	Late Evening Levels					
	2100-2200	57	46	74	44	60
	2200-2300	56	46	71	43	60
	2300-0000	55	46	68	44	59
	0000-0100	56	45	72	43	58

5.4 Table 2 - Octave Frequency Levels - Detailed Analysis of the Noise Emissions

Monitoring Location	Octave Freq in Hz ref 2 x 10^{-5} Pascalls							
	A	63	125	250	500	1K	2K	4K
1m from gas burner	84	79	89	82	79	80	76	72
1m - Intake Fan at GL	76	74	77	74	71	73	70	63
1m from open grill at GL	70	74	77	70	67	66	62	58
Adj Front of Marr Building	60	61	61	56	53	57	51	45
1F level in Goldthorpe Building	54	66	57	53	51	52	46	37
Rear of Goldthorpe Building	53	64	58	50	48	48	45	34

5.5 Comments

5.6 Environmental background noise monitoring was carried out at Position 1 (Table 1) to establish the existing background noise levels in the absence of the plantroom noise.

Investigations confirmed that due to the location of the plantroom and in particular the open grill, noise primarily affects the Marr Building.

5.7 In Table 2 the following information should assist in understanding the readings:

1. 1 metre from gas burner - these levels were taken internally to confirm noise emissions from the boiler burners.
2. 1 metre from Intake Fan at GL - the intake fan is not attenuated with the intake grill located at ground level (GL)
3. 1 metre from open grill at GL - this position was to the side of the intake fan.

4. Adjacent to the front of Marr Building - 3.6 metres from the front façade adjacent front of ground floor commercial units (residential on first floor and above)

5. First Floor level in Goldthorpe Building - this was an external reading on the ex tended balcony area of the building, which overhangs the basement plantroom.

6. Rear of Goldthorpe Building - out of sight of the plant room and the background noise levels are not influenced by noise from plant room itself.

6.0 ASSESSMENT

6.1 Time Periods/Assessment Consideration - Assessment Procedure

6.2 The purpose of the assessment is to illustrate the current impact of the plantroom operation on local residents and the predicted assessment upon completion of the acoustic and ventilation upgrade works.

6.3 The British Standard 4142:1997 - 'rating of industrial noise affecting mixed residential and industrial areas' - offers guidance and calculation procedures for the assessment of noise that is likely to give rise to complaint. Although the title indicates that any such assessment is restricted to industrial noise, in the absence of any other suitable environmental noise standard, is used extensively by acoustic professionals, local authorities and academics for the assessment purpose.

6.4 The measurement technique is a system which utilises the measures equivalent continuous A-weighted sound pressure level over a given reference time period, being 1 hour during the day and 5 minutes during the night, of the specific noise to which are applied certain corrections which take into account any tone, impulsive or irregular character of the noise.

6.5 In BS4142:1997 Section 9 reference is made to the assessment method. This section describes a methodology by which the simple arithmetic difference between the rating level and the BNL can be evaluated. It is stated that a difference of +5dB (ie Rating Level - BNL) is of marginal significance. A difference of +10dB or more (ie Rating Level - BNL) indicates that complaints are likely.

6.6 Table 1 - Current Assessment at the façade of the Marr Building

Assessment Criteria at residential properties	
1. Sound pressure level 1 metre from the open plantroom grill	76dB
2. Distance Correction to 1F Apartments - 20 metres	-26dB
3. Qo Correction for reverberation	+6dB
4. Acoustic Feature Correction	+5dB
5. $L_{Aeq(5\ mins)}$ Rating Level	61dB

6. Lowest Background Noise Level (to 0100 hrs)	45dB
7. Assessment Level (Line 5 - 6)	+ 16dB

6.7 The assessment indicates that there is a significant exceedance of the background noise level from the current operation of the plant room at the nearby residential properties.

6.8 Table 2 - Assessment at the façade of the Marr Building with Acoustic Works in Place

Assessment Criteria at residential properties	
1. Sound pressure level 1 metre from the plantroom grill after acoustic treatment	61dB
2. Distance Correction to 1F Apartments - 20 metres	-26dB
3. Qo Correction for reverberation	+6dB
4. Acoustic Feature Correction	0dB
5. $L_{Aeq(5\ mins)}$ Rating Level	41dB
6. Lowest Background Noise Level (to 0100 hrs)	45dB
7. Assessment Level (Line 5 - 6)	-4dB

6.9 The assessment indicates that upon completion of the acoustic treatment there is no exceedance of the background noise level from the operation of the plant room at the nearby residential properties. For information, the London Borough of Camden would normally require -10dBA below background levels, if this was a planning or environmental health enforcement matter.

7.0 CONCLUSIONS.

7.1 The assessment undertaken for the Company has concluded that post the implementation of acoustic measures noise from the operation of the plantroom should not have any adverse impact on local residents.

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8.0 RECOMMENDATIONS

8.1 In terms of specification for noise control the following is recommended:

1. BOILER FAN SYSTEMS

i) There are 3 No Boilers located at the south end of the plantroom closest to the open grill. Each unit is served by a centrifugal air supply fan. Noise from the fans is high at LAeq 83dB at 1 metre.

In order to not affect the air flow balance to the boilers gas burners the following partial acoustic screen is recommended:

a) Provide a metal framework forming a 3 sided structure, leaving the boiler side open.

b) Clad the structure with 18swg steel sheet removable acoustic panels.

c) These panels should interlock and be lined internally with 50mm thick Class O fire retardant acoustic foam of 30kg/m3 density.

d) The above needs to be capable of being manhandled to facilitate access to the fans/burners for maintenance.

2. FRESH AIR INTAKE FAN AND SYSTEM

a) Locate the new fan such that atmospheric and job side attenuators can be fitted.

b) The atmospheric and job side attenuators should be as follows: Fit a design sized 1200mm long rectangular galvanised steel attenuators. They should have a 150mm central splitter and 50mm thick sideliners. These attenuators will need to be supported, due to their heavy weight. The system including the fan transition pieces and attenuator should be lagged with 10kg/m2 acoustic lagging material.

The insertion loss for the attenuators should be as follows:

Octave Frequency in Hz ref dB 2 x 10-5 pas						
63Hz	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz
6	10	19	33	42	42	30

N.B. This fan system can be located within the new acoustic louvre grill as discussed below.

3. OPEN GRILL AREA

Open Grill Fresh Air Extract Louvre from plantroom to outside.

Install a single 300mmm deep acoustic louvre (designed size to match opening) to the atmospheric side of this system.

The insertion loss for the attenuators should be as follows:

Octave Frequency in Hz ref dB 2 x 10-5 pas						
63Hz	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz
4	8	10	16	17	16	14

8.2 The specification does not cover any structural matters in terms of loadings and structural stability which may arise from the acoustic works. The recommendations are the acoustic element only. Other suitably qualified Consultants need to ensure these matters are to legislative and other standards for health and safety etc.

APPENDIX 1 - GLOSSARY OF ACOUSTIC TERMS

1. **A-weighted decibels - dB(A)** - Approximately equivalent to the human ear frequency response. A simulated measure of the loudness level of the noise as heard by the listener. Specific corrections are made to simulate this response.
2. **Ambient noise** - Totally encompassing sound in a given situation at a given time.
3. **Attenuation** - the amount by which a noise is reduced.
4. **Corrected Noise Level or Rating level L_{ArT}** - the specific noise level plus any adjustment for the character of the noise.
5. **Decibels** - a unit of sound level using a logarithmic scale. It is the ratio of the measured sound pressure and the reference level ie $10 \log_{10}(P^2_1/P^2_{ref})$ where 1 = rms pressure and ref = 2×10^{-5} N/m^2.
6. **Frequency in Hertz** - sound is propagated in wave form. Sound frequency is expressed in cycles per second or Hertz. Most noises comprise many frequencies. One Hertz equals one cycle per second.
7. **L_{AeqT} - Equivalent Continuous A-weighted sound pressure level** - the value of the A-weighted sound pressure level in decibels of the continuous steady sound that within a specified time interval has the same mean square sound pressure as a sound that varies with time.
8. **L_{A90T} - Background Noise Level (BNL)** - the A-weighted level of the residual noise in decibels exceeded for 90% of a given time interval. The level of noise underlying all fluctuating noise s reaching a given location. This tends to be dominated by the more distant, non-local sources and events.
9. **$L_{A10(1hour)}$ dBA - Road Traffic Noise** - the value of $L_{A10(1hour)}$ dBA is the noise exceeded for 10% of a period of one hour.
10. **Noise** - A complex sound often defined as unwanted sound.
11. **Precision Grade Instrumentation** - There are 2 basic grades of instrumentation guaranteeing different grades of accuracy of which precision grade instrumentation is the most accurate.
12. **Sound Pressure Level** - the sound pressure level in decibels is given by: $20 \log_{10}$