SURREY CITY ENERGY

Design Criteria Manual

Energy Services Design Requirements

A Design Guide for Connection to District Energy

March 2024

Updates and Current Versions

Please verify the City of Surrey web site before using this document to ensure you are using the most up-to-date version. The current version of the criteria is available at the City of Surrey website by following the on-page links to Surrey City Energy > Connections for Developers.

Revision Summary

The following is a summary of the key updates to this guideline in the present version. Please refer to the relevant section for complete details.

Section #	Revisions
1.5.3	Clarified City ownership and construction responsibility extends to the flange face at edge of ETS package.
Figure 2	Updated Typical ETS Installation Schematic
2.1.6	Describes Developer responsibilities for ETS startup.
2.1.7	Describes Developer responsibilities for ETS commissioning.
3.1.1	Added recommended design practices for hydronic systems including Hybrid Heat pump systems, heat rejection systems, and 3-way ETS blending valves. Added suggested controls strategy for Hybrid Heat Pump systems.
Figure 3	Updated typical building heating system configuration.
Figure 4**Error! Reference source not found.**	Added ETS 3-way blending valve detail.
3.1.2	New maximum design temperatures for building heating systems. Supply ≤ 60 °C Return ≤ 45 °C Updated max design temperatures for different types of terminal units.
3.1.3	New requirements for hydronic heating OAT reset control.
3.2.1	New section on DHW systems design including recommended piping configuration, circulator sizing, VFD requirement, balance valve requirement, and control strategy.
Figure 6	Added typical storage-type DHW heating system diagram.
3.2.2	New maximum design temperatures for DHW heating systems. Supply ≤ 60 °C Return ≤ 45 °C
3.3	New section on ETS Room Requirements. Consolidated listing of architectural, mechanical, and electrical requirements for ETS Room.

Page

SECTION 1

Introduction

1 INTRODUCTION

1.1 Definitions / Acronyms

BAS	Building Automation System
City	City of Surrey
DE	District Energy
DE-Connected	Developments that are connected to and receive service from SCE.
DE-Ready	Developments that are not immediately connected to SCE but can easily connect in the future.
DES	District Energy System
DHW	Domestic Hot Water
DPS	Distribution Piping System
EC	Energy Centre
ETS	Energy Transfer Station
FAR	Floor Area Ratio; calculated by dividing the area of all floors of a building by the area of the lot.
Full Compatibility	All space and DHW heating is served (or able to be served) by SCE.
GHG	Greenhouse Gas
GPH	Gallons Per Hour
HVAC	Heating, Ventilation & Air-Conditioning
MAU	Makeup Air Unit
OAT	Outdoor Air Temperature
Partial Compatibility	Residential in-suite heating may be by electric baseboards.
SCE	Surrey City Energy
ΔT	Delta-T; change in temperature (typically between supply and return water).

1.2 Document Purpose

The City of Surrey (City) is committed to sustainability and is currently developing a District Energy System (DES) to serve space heating and domestic hot water needs of buildings in the Surrey City Centre. The City has established an energy utility, Surrey City Energy (SCE), as a business unit of the Engineering Department. SCE is responsible for delivering the City's DES.

This document provides preliminary information to developers, building owners, engineers and architects to tailor their designs to DES conditions, thereby optimizing the benefits of the DES. SCE will work closely with the developers of new buildings in City Centre and their HVAC engineers to ensure good design integration between buildings and the DES.

1.3 Requirements for your Development Project

Surrey's DES By-law (No. 17667) establishes City Centre as a District Energy (DE) service area. The DE service area is divided into two areas: Service Area A and Service Area B (illustrated in Appendix I of the bylaw). The following table explains the level of DE compatibility that is required of your development project.

Service Area	Floor Area Ratio (FAR)	DE Compatibility	DE Connection
Service Area A	Equal to or Greater than 1.0	Full	DE-Connected
Service Area B	Equal to or Greater than 2.5	Full	DE-Ready
Service Area B	Between 1.0 and 2.5	Partial	DE-Ready

All new developments within Service Area A with a build-out floor area ratio (FAR) equal to or greater than 1.0 will be required to provide full hydronic thermal energy systems including (but not limited to) domestic hot water, make-up air units, and hydronic space heating. These developments will be immediately connected to SCE (i.e. prior to occupancy).

All new developments within Service Area B with a build-out FAR equal to or greater than 2.5 will also be required to provide full hydronic thermal energy systems including (but not limited to) domestic hot water, make-up air units, and hydronic space heating. These developments will be "DE-Ready" for future connection to SCE when it is available.

All new developments within Service Area B with a build-out FAR between 1.0 and 2.5 will be required to incorporate hydronic thermal energy systems to allow for future connection to SCE but will not be required to utilize hydronic systems for space heating within individual residential units. Hydronic systems will be required for all other space heating and hot water heating in the building. Developers may elect to exploit the full benefit of district energy by making all heating loads "DE-Ready".

1.4 Introduction to District Energy

1.4.1 What is District Energy?

District Energy (DE), also known as Community Energy, Neighbourhood Energy, and District Heating, is a system that distributes thermal energy, typically in the form of hot water, from a central energy centre through a network of buried piping to individual customer buildings. The DE System (DES) interfaces indirectly via heat exchangers with the buildings' space heating and domestic hot water systems. No other heat sources are required.

The DES consists of three main components:

1. Central Energy Centre(s) (EC) – the energy source
2. Thermal Distribution Piping System (DPS) – the network
3. Energy Transfer Stations (ETS) – the building interface

1.4.2 DES Owner

The City of Surrey has established an energy utility, Surrey City Energy (SCE), as a business unit of the Engineering Department. SCE is responsible for delivering the City's DES.
SCE will bill customers directly or through a service provider.

1.4.3 Building Heating System Design Implications

Developers are generally required to heat their buildings using hot water only, but have flexibility in designing the building internal heating systems in accordance with their preferences and specific requirements. The building hydronic space heating winter design temperatures cannot exceed 60°C supply and 45°C return. The domestic hot water supply temperature may remain at up to 60°C year round. The building designers will receive support and guidance from SCE in designing their heating, ventilation and air-conditioning (HVAC) systems to derive the most benefit from the DES. See Section 3 for more details.

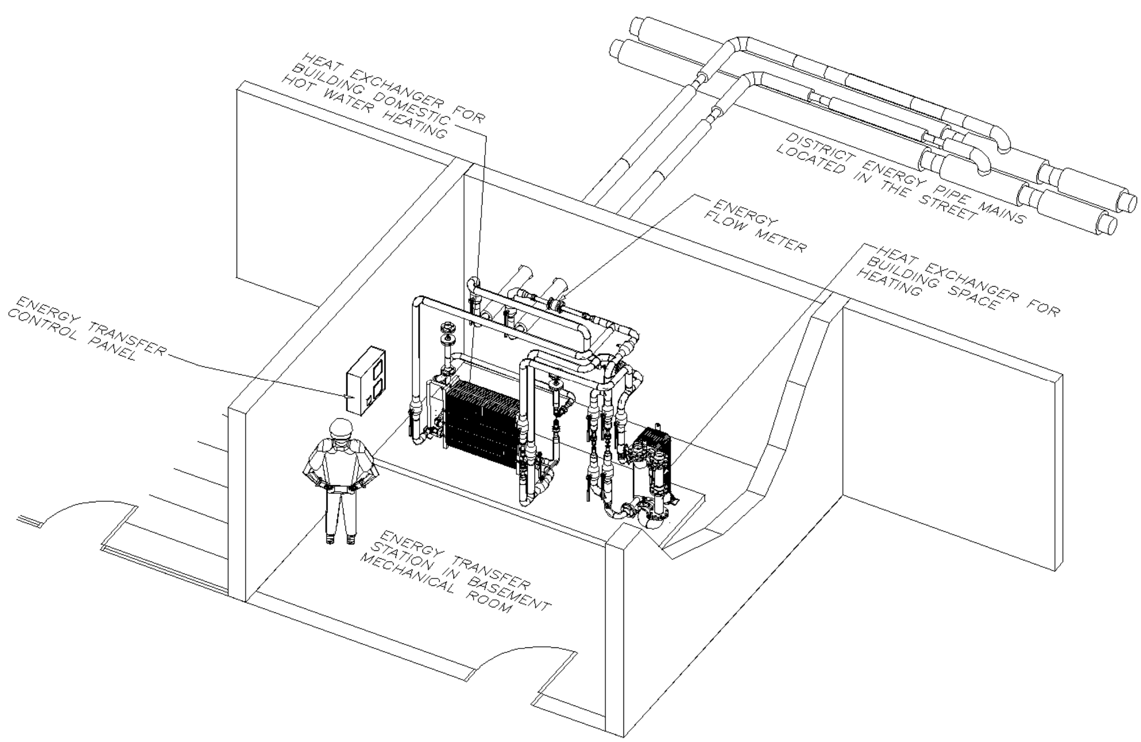
Partial connection buildings are permitted to use electric baseboards for residential in-suite space heating.

1.4.4 Energy Transfer Station Space Requirements

SCE will design and install the necessary pipes, heat exchangers, associated controls, and energy meters to interface with the building heating systems. This equipment, referred to as the Energy Transfer Station (ETS), will be owned and operated by SCE and located inside the customer's building. ETSs are generally located in the basement or parkade, and typically occupy approximately 20% of the space of the conventional boiler plant that they replace. See **Figure 1** as an example of a typical ETS located at an exterior wall near the DE piping mains in the street. Section 2 contains more details on mechanical room requirements.

The DES distribution pipelines are buried in the roads throughout City Centre. Branch lines from the DES distribution pipelines will connect to each building's ETS.

Figure 1: Typical ETS Installation in Building Basement



1.4.5 DE-Ready Buildings

Some buildings in City Centre will not be immediately connected to the DES, but must still be compatible with the system. These "DE-Ready" buildings require their own hot water boilers to serve space heating and DHW requirements. DE-Ready buildings are designed such that they can readily connect to SCE in the future, which includes compatibility of the HVAC and domestic hot water systems and provision for future installation of DE equipment and interface with the building mechanical systems.

1.5 DES Description

1.5.1 Central Energy Centre(s)

As with many other recent DE utilities, SCE will be constructed in phases. The first ECs will use high efficiency natural gas boilers to provide heat to the system. As the system grows, alternative energy sources, such as sewer heat recovery, and biomass from local wood residues, will be introduced. These alternative energy sources will serve base load requirements of the system and deliver the majority (>70%) of the annual heating energy. Once there is sufficient renewable capacity online, natural gas boilers will provide peak heating and reliable backup capacity to ensure full and uninterrupted service to customers.

The production equipment and controls are state-of-the-art, based on the best of today's commercially proven technology. Other energy conversion technologies will be continually evaluated in light of new opportunities and changing circumstances. The DE infrastructure is designed to facilitate the future use of new renewable energy sources for heating and power.

Prior to final commissioning of any new building, SCE will be capable of serving 100% of its thermal energy requirements, from either temporary or permanent energy supply facilities.

The capacity of SCE will gradually increase as City Centre grows, and is sufficient to meet the total thermal energy needs of all connected, in-service buildings. The system has a higher level of reliability than is generally found in stand-alone heating systems in individual homes or commercial and multi-use residential buildings.

1.5.2 Thermal Distribution Piping System

The DES consists of a closed loop two-pipe hot water distribution piping system (DPS); the same water is heated in the Energy Centre(s), distributed to the buildings, through the ETS, and returned back to the EC to be reheated and redistributed. No water is drained or lost in the system and no additional water is required during normal operation.

The DPS is generally composed of an all-welded, pre-insulated direct bury piping utility in City streets. The distribution network is designed based on the size and location of customer buildings and EC's. Distribution network modelling is completed to optimize system performance and efficiency, and to ensure that all customers will always receive sufficient thermal energy. This modelling is updated periodically as the system grows and evolves.

Variable speed pumps located at the EC control flow through the distribution system to maintain sufficient pressure and flow at every ETS. The DE supply temperature is automatically adjusted based on the outdoor air temperature (OAT), but is never less than 65ºC, such that it can always serve all domestic hot water (DHW) loads directly[1].

Achieving a large temperature difference (delta-T; ΔT) between DE supply and return water is critical to system operation. Low DE return water temperature is important for the optimal use of renewable and low-grade heat sources. DE return temperature is determined by the HVAC systems in customer buildings; hence, it is crucial for SCE to ensure that buildings connected to the system meet performance requirements.

1.5.3 Energy Transfer Stations

Each building will normally have its own ETS that is owned by SCE. The key components of an ETS generally include:

- DE supply and return pipes from the building penetration (interface with distribution system);
- Heat exchangers to transfer the heat to the building's hydronic space heating and DHW systems;
- Controls to regulate the flow required to meet the building's energy demand and maintain the DES return temperatures; and,
- Energy meters to monitor the energy used by each customer for billing and system optimization purposes.

City ownership, design, and construction responsibility extends up to the flange face of isolation valves at the edge of the ETS package as shown by the Contract Boundary line in **Figure 2** below.

ETS's generally have two heat exchangers: one for space heating, and a second to directly serve DHW. This is typical of most hot water DES in North America and around the world. There is a vast amount of experience and data regarding DES performance and reliability with this configuration. Heat exchangers are very reliable (with no moving parts) and it is not necessary to have redundant units in an ETS. Though very unlikely, SCE is able to repair or replace a faulty heat exchanger quickly and on short notice. It is important to note that a leaking or faulty heat exchanger can often continue to supply heat, and the repair/replacement can be scheduled for a convenient, low demand period.

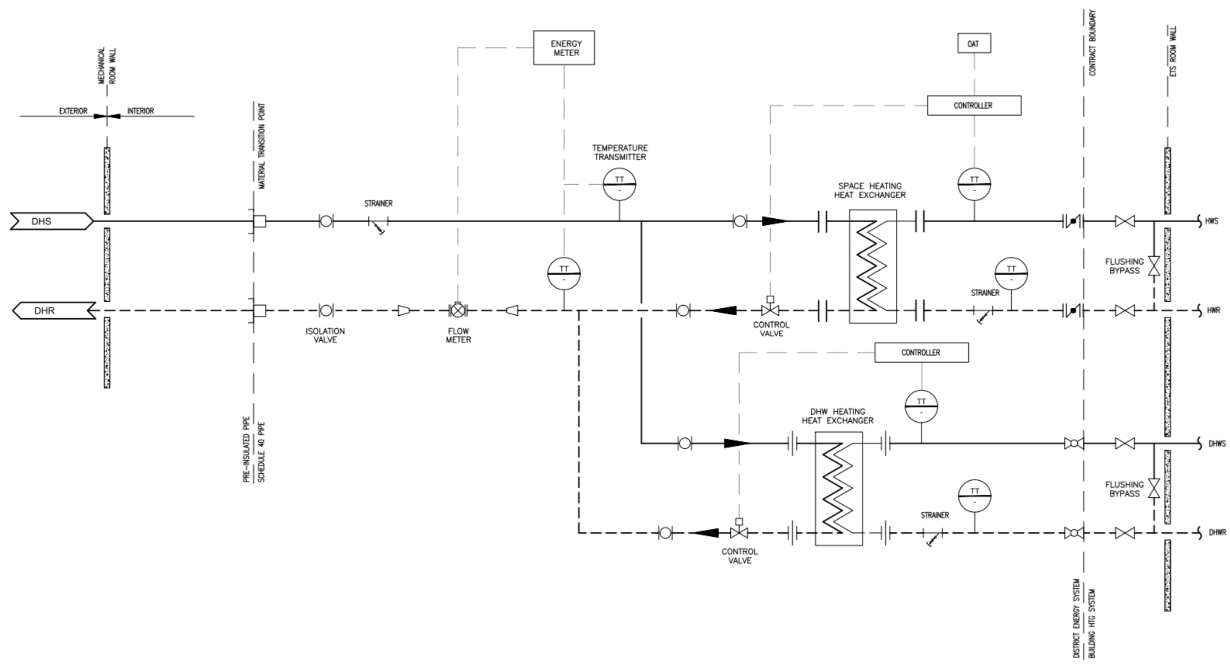
The redundancy needs of specific buildings may be considered. An ETS with redundant heat exchangers is more costly and requires more space in the customer building. The customer will

[1] I.e. without requiring other heat sources or equipment to elevate the temperature to meet the requirements of the building.

have to provide this additional space in the mechanical room. Ultimately, SCE is responsible for the cost, maintenance and reliable operation of the ETS, including the heat exchangers.

As shown in **Figure 2** below, flow though the District Energy side of the ETS is controlled to achieve the building's supply temperature setpoint.

Figure 2: Typical SCE ETS Installation in Building Basement



1.5.3.1 Thermal Energy Metering

The thermal energy metering system is an important component of the ETS. Thermal energy meters consist of a flow meter, temperature sensors on both supply and return pipes, and an integrator / calculator.

The energy meter collects data on cumulative water flow, cumulative energy, peak thermal power demand, flow rate, and supply and return temperatures. Data from each meter is transmitted to a central DES computer for utility billing purposes and to monitor and optimize performance of the DES and customer buildings.

Utility energy meters consist of high quality and accurate components: a magnetic or ultrasonic flow meter, matched pair platinum temperature sensors, and a sealed factory-programmed integrator (i.e. calculator). Magnetic and ultrasonic flow meters have low pressure drop and good range and accuracy while requiring very little maintenance. The matched pair temperature sensors allow for very accurate measurement of temperatures (required in thermal energy calculation).

1.5.4 DE-Ready Buildings

DE-Ready buildings are not immediately connected to SCE. They do not house an ETS, though are required to provide space for future installation of an ETS. Provision must be made for future installation of an ETS and service lines through the building foundation to the ETS.

DE-Ready buildings provide their own thermal energy for space heating and DHW (likely using natural gas boilers although other heating sources, such as air-to-water heat pumps are allowed and encouraged). This equipment is the sole responsibility of the building. SCE will provide guidance and support to ensure that DE-Ready buildings meet all DE design criteria requirements.

No equipment may be installed in the space allocated for the future ETS, including but not limited to natural gas boilers or other thermal energy generating equipment. Designers should consider how district heating lines will connect in the future without disruption to the system's operation. Provision of tees and valves for seamless integration of the future ETS is preferable.

1.6 SCE Contact Information

For more information on the DES and requirements of customer buildings, please check the following website for contact information: Surrey City Energy

SECTION 2

Division of Responsibility

2 DIVISION OF RESPONSIBILITY

The following section outlines the responsibilities of the Developer and SCE to ensure efficient and seamless integration of the DES into the customer building.

2.1 Developer's Responsibility

2.1.1 HVAC System

The building developer is responsible for designing and installing the building HVAC systems. There are some differences and similarities with conventional systems, as explained below.

The following conventional building elements are not required for DE-Connected buildings[2]:

- Boilers, furnaces, heat pumps, domestic hot water heaters or any other heat production equipment.
- Auxiliaries to heating systems such as stacks and breeching.
- Natural gas service.

The building will require internal thermal distribution systems, including:

- Internal distribution pumps and piping (i.e. a hydronic space heating distribution loop)
- Heating elements such as fan-coil units, air handling unit coils, and/or perimeter (baseboard) or in-floor radiant heating systems.

The following are some design conditions that are specific to district energy:

- The building will host branch (service) lines from the DES distribution piping. The DES branch lines will enter the building, similar to other utilities, and transfer heat to the ETS.
- The building owner and SCE will agree on a suitable location for the ETS. The ETS will invariably require less space than comparable heat production equipment (e.g. boilers) that the ETS displaces. To reduce DES piping inside the building, it is best if the ETS is as close as possible to the DES branch pipeline entering the building – generally on an exterior wall in the basement of the building, nearest to the main street.
- Whereas buildings not connected to DE may or may not have hydronic systems, buildings covered by the DE Bylaw are always hydronically heated[3].

[2] DE-Ready buildings will require this equipment to serve hydronic and DHW heating requirements.
[3] Partial connection buildings may use electric baseboards for residential in-suite space heating.

- The DES will operate most effectively and efficiently with the use of low temperatures in the building heating systems.

Section 3 discusses specific requirements of the hydronic heating and DHW systems for compatibility with hot water district heating.

SCE will review the HVAC and plumbing design of each building but will not be responsible for the design (which is executed by the builder). SCE will make suggestions as necessary to ensure appropriate integration with the DES.

2.1.2 Required Compatibility

As described in Section 1.3, individual customer buildings may have different connection requirements. With the exception of buildings in Service Area B with a FAR between 1.0 and 2.5, Full Compatibility is required (i.e. for all heating requirements). This includes but is not limited to all rooftop and air handling units, fan coils, perimeter baseboards or radiators, and in-floor heating throughout the building.

Buildings in Service Area B with a FAR between 1.0 and 2.5 have Partial Compatibility requirements. For these buildings, electric baseboards are permitted for residential in-suite space heating.

2.1.3 Installation and Operation Contract Boundary

The customer is responsible for all piping and other components necessary to connect the hydronic heating and DHW systems to the ETS at the agreed DE service demarcation point on the secondary side of the heat exchangers. SCE and the customer will establish the exact location of the demarcation point during the design process. Typical demarcation is at the face of the isolation valves for the heating water loop and domestic water loop at the edge of the ETS skid. An example is shown in Figure 2.

2.1.4 ETS Room

The customer will provide suitable space for the installation of the ETS, including space for service lines and interconnecting piping, in a mechanical room in an agreed-upon location.

SCE will require access to the ETS and service line within a customer's building for installation, regular maintenance and repairs. This will be facilitated through a statutory right-of-way and covenant.

For detailed ETS Room Requirements, refer to Section 3.3.

2.1.5 Hydronic Heating Water Quality & Expansion

Building owners are responsible for filling and managing their own building hot water heating system. The DES requires that the water treatment for the building system meet the minimum criteria set forth below:

Chloride:	< 30 ppm
Nitrate:	< 5%
Hardness:	< 2 ppm
pH Level:	9.5-10
Iron	< 1 ppm

The customer will employ the services of a water treatment subcontractor to provide the necessary chemicals, materials and supervision for a complete cleaning and flushing of all piping to the ETS demarcation point. System startup and commissioning will only occur after acceptable water quality analysis results have been obtained. **Certification from the water treatment contractor verifying that the water quality is adequate is required before the customer can flow water through the ETS.**

The building owner is responsible for the water quality of the building hydronic heating system and annual testing and reporting to SCE.

2.1.6 ETS Startup

The developer must request ETS startup through SCE with 7 days of notice. Prior to startup of the ETS, the developer must:

- Provide engineer's confirmation that hydronic systems are substantially complete, pressure tested, and ready for operation.
- Flush, clean, and introduce corrosion inhibitors into the building's internal hot water system (i.e. on the building side of the demarcation point) and submit reports to SCE.
- Provide startup reports for primary pumps which circulate through the ETS.

Refer to **APPENDIX B** for details of ETS Startup Process.

A representative of SCE will complete an inspection of the customer heating systems prior to ETS startup to ensure systems are installed as per the City-approved building permit design drawings.

After ETS startup, SCE will operate the ETS to provide commissioning heat at a fixed setpoint to the building to assist with building systems startup and testing.

2.1.7 ETS Commissioning

New buildings connected to the DES must be commissioned. Commissioning of building mechanical systems is critical to the successful operation of the building heating systems and ETS, and ensuring SCE's return water temperature requirements are met.

The developer's commissioning agent is required to complete testing of the space heating and DHW heating systems under simulated high- and low-load conditions. Commissioning reports must be submitted to SCE documenting the results of the testing. Reporting is to include system setpoints, supply water temperatures, and return water temperatures under various load conditions. Refer to the detailed ETS startup and commissioning requirements in **APPENDIX B**.

During commissioning, the developer is responsible for the building's internal hot water system beyond the DE service demarcation point, including the internal distribution system, terminal units and building control system.

2.1.8 Changes to the Building System

The customer is not permitted to materially change the design or substitute any pertinent equipment during the installation without approval from SCE. After commissioning, any changes to the building's hydronic or DHW system that may impact DES performance shall be reported to SCE.

2.1.9 Changes to ETS

The ETS is owned and maintained by SCE. Under no circumstances can the Customer or any of its contractors adjust, modify or otherwise tamper with any ETS equipment. This includes adjusting or changing the position of any valves, gauges or instruments and tampering with the controls and control panel.

2.1.10 Sub-Metering

Customers may install energy meters on individual units, suites or sub-systems within the heating and/or DHW systems within their building. These sub-meters will be the sole responsibility of the customer and will not affect the obligation of the customer to pay the SCE bill based on SCE's thermal energy meter (part of the ETS) for the whole building. Sub-meters are generally not utility grade and therefore less accurate. If a customer decides to use sub-meters, it is recommended that they be used for allocation of total building thermal energy only.

2.1.11 DE-Ready Buildings

DE-Ready buildings are responsible for design, installation, commissioning, operation, and maintenance of all systems within their building, including all heating generation equipment.

2.2 SCE Responsibility

2.2.1 SCE Equipment within the Customer Building

SCE will design, install, operate and maintain the ETS at the agreed-upon location. City responsibility extends up to the flange face of isolation valves at the edge of the ETS skid. SCE will install, own and maintain the primary (DE) distribution pipes up to the ETS. Branch pre-insulated pipelines will generally be direct buried from the mainline to the building penetration. From that point, DE piping is run inside the building to the ETS.

SCE will provide strainers on the DE and building side at each heat exchanger, which will be maintained by SCE. SCE will service the energy metering equipment and verify accuracy at regular intervals per manufacturer's recommendations.

SCE will provide temperature transmitters, pressure gauges, temperature gauges, thermowells, control valve(s), energy meter(s), and a control panel for the ETS. Temperature transmitters for the secondary side of the heat exchangers will also be provided to facilitate monitoring and control of the building side heating and DHW systems. SCE's ETS controls will adjust the primary HWS temperature from the ETS based on an OAT reset schedule requested by the Developer's Engineer.

2.2.2 ETS Startup

SCE will start up the ETS when requested by the developer. Documentation must be submitted by the developer prior to ETS startup (see Section 2.1.6). The building operator is required for this process as the building internal hot water system must be ready to accept heat from the DES.

ETS startup by SCE includes startup of the energy meter, verifying ETS controls, and opening City-owned utility service valves. SCE is responsible for verifying all components up to the DE service demarcation point.

2.2.3 ETS-Building Commissioning

ETS-Building Commissioning is the process of testing the building system operation and return water temperature to the ETS under various simulated operating conditions. ETS-Building Commissioning is completed by the developer's commissioning agent. SCE will support this process with monitoring and tuning the operation of the ETS and making setpoint adjustments, if requested.

2.2.4 District Energy Side Water

SCE will provide the make-up water requirements for the DE system. All necessary water treatment is accomplished at the Energy Centre.

Thermal expansion of water in the DE system is accommodated at the Energy Centre.

SECTION 3

Requirements for Building Heating Systems

3 REQUIREMENTS FOR BUILDING HEATING SYSTEMS

This section provides technical requirements for hydronic heating and domestic hot water (DHW) systems for new developments in Surrey City Centre. This section applies to both DE-Connected and DE-Ready buildings.

The requirements in this section represent best practices that, if followed, will help buildings operate below the 45 °C ETS heating water return temperature limit.

The information provided in this document should be regarded as a general guideline only, and the developer's Engineer shall be responsible for the final building-specific design. The developer and their engineering team are responsible to ensure the building meets all applicable aspects of the *BC Building Code*, *Surrey District Energy System By-law #17667*, and other applicable codes and standards.

SCE will review engineering plans and provide technical assistance to building developers to improve integration of the customer building with the DES. Heating system schematics, layouts, equipment schedules and sequence of operation or control strategies are required to assist in SCE's review process.

3.1 Hydronic Heating Systems Requirements

The hydronic heating system shall be designed to provide space heating and ventilation air heating requirements for the whole building, supplied from a central ETS located within the building. Design space heating flow rate and supply/return temperature to the ETS must be clearly marked on the schematic drawings and must match the SCE Application for Service.

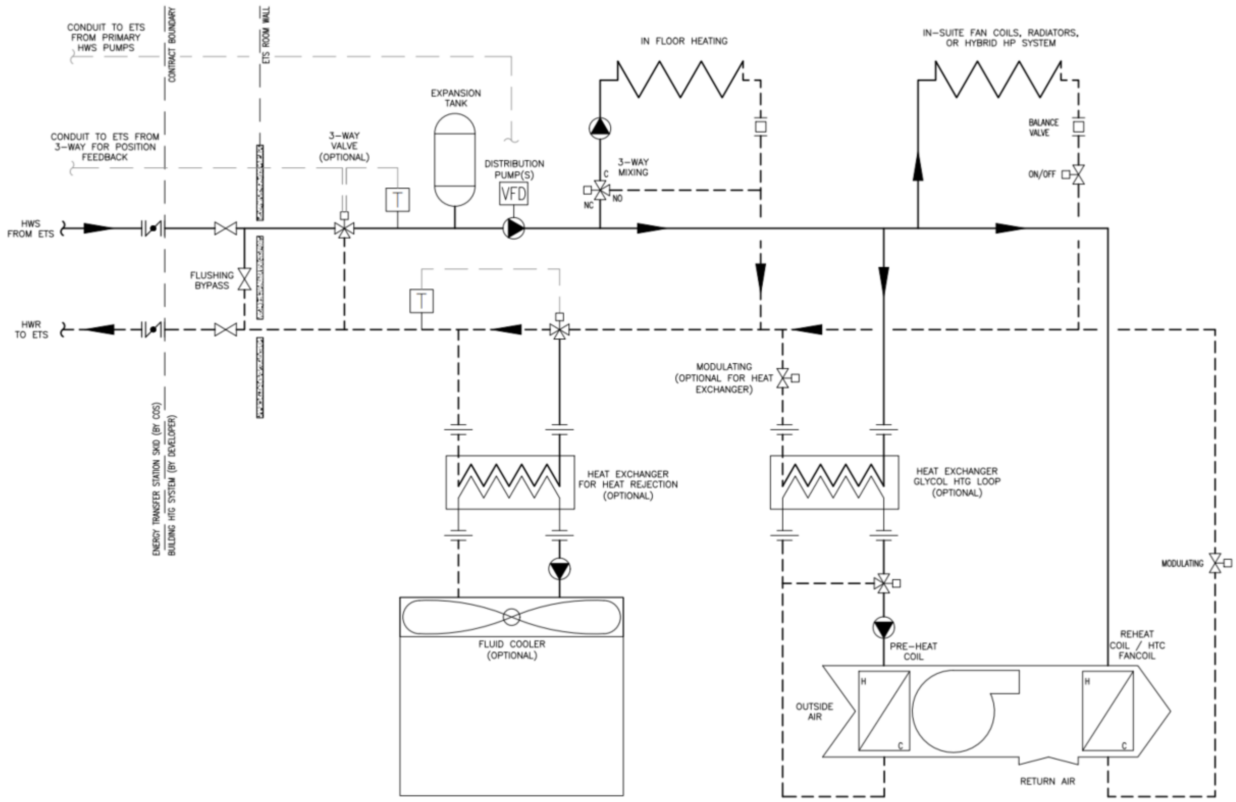
The building heating system shall be designed to minimize hot water return temperatures over all conditions. Heating water return to the ETS from the building heating system must not exceed 45°C at any time of year. The following design practices should be implemented to achieve this result.

3.1.1 Piping Design and Control Strategy

The building heating system must be designed for variable hydronic flow with variable speed pumps to minimize pumping energy, and using 2-way modulating (or on/off) control valves at terminal units (radiators, fan coil units, etc.). Alternatively, 3-way mixing valves at terminal units may be used. Bypass valves (e.g. 3-way bypass valves) are not permitted.

Many types of heating terminal units can be used in DES-connected buildings. See **Figure 3** for typical hydronic heating system configurations.

Figure 3: Conceptual Building Heating System Configurations



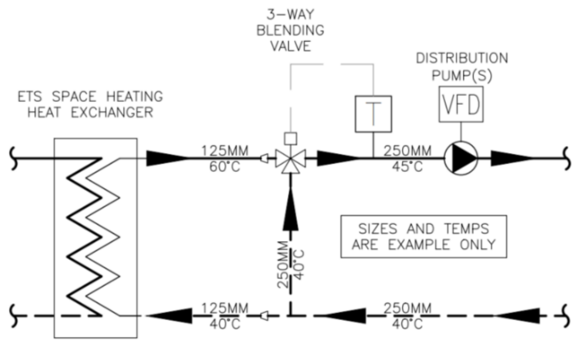
A properly balanced system assists with maintaining occupant comfort while also achieving desired HWR temperature from terminal units. Balancing valves should be installed on all terminal equipment. Balancing valves on individual risers or floors, or a reverse-return piping design should be provided for larger projects to assist with proper balancing of the system.

Where Hybrid Heat Pumps are used to provide air conditioning and reject heat to the primary building heating loop, a fluid cooler or cooling tower is normally provided to reject excess heat during the cooling season. One option is to tie-in heat rejection is immediately before the HWR to the ETS. An example configuration is shown in Figure 3 below.

Fluid cooler controls should be configured to prevent heat rejection mode when the Building Automation System (BAS) is asking for heat from the ETS and vice versa. A dead-band of at least 5 °C should be provided in the BAS between initiation of heat rejection or heat addition from the ETS.

For systems which operate with low supply temperature and low delta-T (i.e. Hybrid Heat Pumps) a 3-way blending valve may be provided as shown in **Figure 4**. The blending valve may operate to mix higher temperature primary HWS from the ETS with building return to achieve a lower secondary loop HWS temperature. This strategy can reduce the size of piping between the main mechanical room and the ETS. This valve should also be used in heat rejection mode to bypass all flow around the ETS.

Figure 4: ETS 3-Way Blending Valve (Example)



A detailed sequence of operation must be provided on the drawings or in the specifications for all buildings. For buildings with hybrid heat pumps, control of any heat rejection system and/or 3-way blending valves, along with associated setpoints to enable and disable heat rejection mode and heat supply mode must be explicitly provided. A typical control sequence would be based on the following general strategy (a more detailed sequence should be provided by the engineer):

Example Heating Loop Control Strategy:

1. The heating loop HWS setpoint is determined by the OAT reset curve.
2. The ETS operates to maintain its HWS temperature at the calculated setpoint when heating is enabled.
3. *(If applicable)* When heating is enabled, a 3-way blending diverts flow to the primary (ETS) loop and modulates to maintain the secondary (building) HWS temperature at the secondary loop setpoint.
4. *(If applicable)* If the HWR from the building is greater than the calculated HWS setpoint, ETS heating is disabled and the fluid cooler operates to maintain the HWR prior to the ETS at the calculated building loop HWS setpoint.
5. The sequence should include appropriate dead bands and time delays to avoid cycling of equipment.

Building-specific control sequences and temperature requirements of the selected terminal units must be considered in determining the detailed sequence of operation and setpoints.

3.1.2 Hydronic Space Heating Design Temperatures

Hot water generated by the ETS shall be distributed via a 2-pipe system to the various heating elements (terminal units) throughout the building. The building heating system **<u>must</u>** be designed for ETS supply and return temperatures **<u>no greater</u>** than those specified below. <u>Design supply and return temperatures to the ETS must be shown on the schematic and must match the SCE Application for Service.</u>

Maximum Hydronic Space Heating System Temperatures[4]	
ETS Supply Temperature, **Max.**	60°C (140ºF)
ETS Return Temperature, **Max.**	45°C (113ºF)

The specified temperatures shall be regarded as absolute upper limits. Engineers are encouraged to design HVAC system well below the maximum ETS supply and return temperature limits. Many SCE-connected buildings are operating successfully with peak winter design supply temperature of 49 °C (120 °F) or less. Lowest possible heating water supply and return temperatures are desirable. HWS from the ETS will be reset based on OAT temperature (see Section 3.1.3). The building return temperatures must be kept to a minimum to allow SCE to take advantage of alternate-energy technologies.

Most types of heating systems (i.e. terminal units) can operate at lower temperatures. Terminal units must be selected based on temperatures as low as can be reasonably achieved. The table below outlines maximum supply & return temperatures for terminal units.

It is recommended (where possible) to select most terminal units **below** the maximum supply and return temperatures outlined below to ensure combined hydronic space heating system return temperature does not exceed the maximum return temperature under any operating conditions.

Type of Terminal Unit	**Maximum HWS**	**Typical HWS**	**Maximum HWR**
Radiant in-floor heating	49ºC (120ºF)	49ºC (120ºF)	38ºC (100ºF)
Hybrid heat pump	45°C (113°F)	43°C (110°F)	35°C (95°F)
Low-temperature convector (w/ fan assist)	60°C (140°F)	50°C (122°F)	45°C (113°F)
Fan coil units & reheat coils[5]	60ºC (140ºF)	55ºC (131ºF)	45ºC (113ºF)
Air handling pre-heat and 100% outside air heating coils	60ºC (140ºF)	55ºC (131ºF)	40ºC (104ºF)

Note that perimeter (baseboard) radiators are commonly designed for HWS temperatures in excess of 70 °C to provide adequate heat output. These systems will struggle to maintain

[4] Building supply and return temperatures should be as low as possible. Lower temperatures are possible with some systems (e.g. hybrid heat pumps, low-temp radiators, in-floor heating, and ventilation make-up air units).
[5] If unit heaters or forced-flow heaters are considered, these should follow the fan-coil design recommendations.

comfortable space temperature operating with HWS temperatures of 60 °C or less. In addition, it is a challenge to meet the mandatory HWR temperature limit with this type of system. The use of baseboard radiators is discouraged. Baseboard radiators should only be considered for low-heating intensity, non-occupied spaces such as storage rooms.

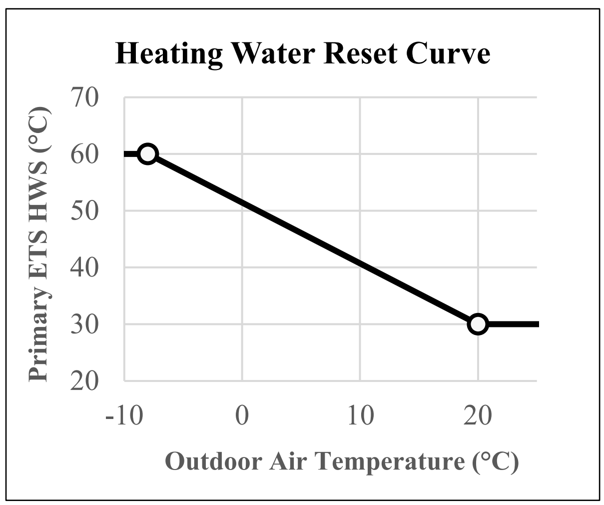
3.1.3 Hydronic Space Heating Temperature Reset

The ETS will control the supply water temperature to the primary hydronic circuit (i.e. the temperature of the water leaving the space heating heat exchanger) based on an outside air temperature reset schedule. This is the maximum temperature available to the building hydronic circuit. Secondary heating loops may have a separate (lower) reset schedule, if applicable.

The developer's engineer must provide the maximum and minimum HWS temperatures and corresponding Outdoor Air Temperatures (OAT) as part of the building design—preferably located on the mechanical heating schematic. SCE will use this information during commissioning of the ETS. Primary HWS from the ETS will be linearly reset between the maximum and minimum temperatures. An example hydronic heating circuit OAT reset schedule and corresponding curve is shown below.

Figure 5: Example Temperature Reset Schedule and Curve for Surrey

Heating Water Reset Schedule		
	Primary (ETS) HWS	Secondary HWS[6]
OAT ≤ -8 °C	60°C (140ºF)	*(if applicable)*
OAT ≥ 20 °C	30°C (86ºF)	*(if applicable)*



[6] Secondary HWS must be less than or equal to primary (ETS) HWS temperature.

3.2 Domestic Hot Water Heating Requirements

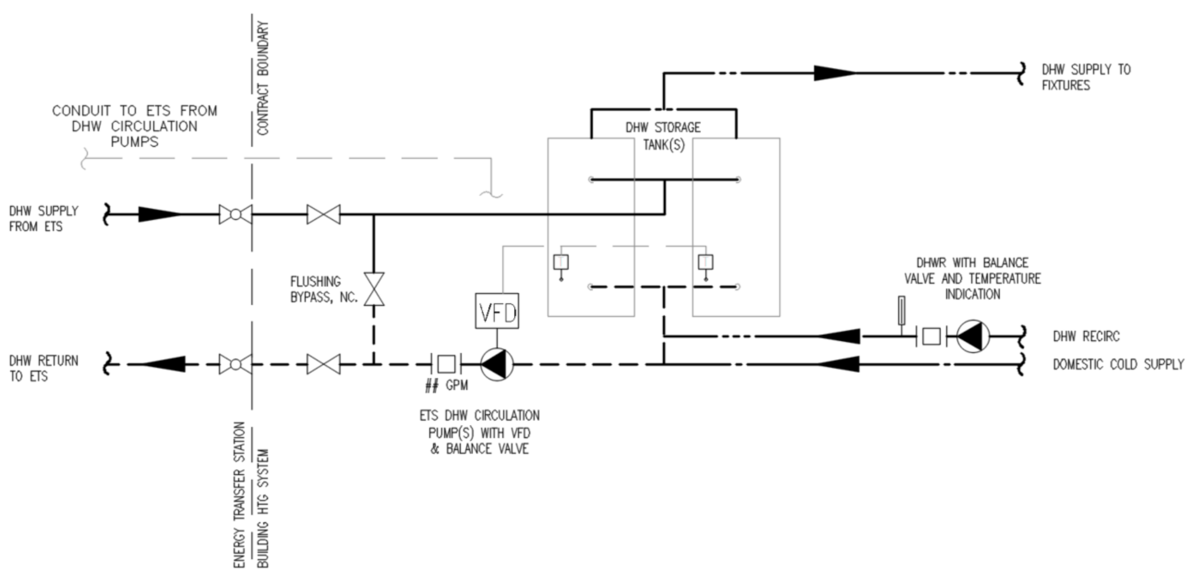
The Domestic Hot Water (DHW) system shall be designed to provide all DHW requirements for the building, supplied from a dedicated DHW heat exchanger at the ETS. SCE understands that DHW systems generally must operate at 60ºC (140ºF) and the DES is able to supply this temperature to all buildings at all times.

Similar to space heating systems, DHW systems must also be designed to return water, at all times, no greater than 45 °C to the ETS for re-heating. Careful design, balancing, control, and commissioning of DHW systems is necessary to meet this requirement.

3.2.1 DHW Piping Design and Control Strategy

Customer DHW systems may be storage tank type systems or instantaneous. Storage type systems are encouraged as they generally result in better customer-side temperature control, smaller nominated capacity, and a lower DES Connection Fee. A typical storage-type DHW system is shown in the following figure.

Figure 6: Conceptual DHW Heating Configuration



To minimize the temperature of DHW that is being returned to the ETS for re-heating, the following design practices (as shown in **Figure 6**) should be implemented. Alternative design approaches may be used so long as they satisfy SCE that the DHW return temperature requirement will be met. The return temperature performance of DHW systems will be verified during ETS commissioning by SCE.

All domestic cold water (DCW) for the DHW system should be supplied directly to the DHW return line to the ETS heat exchanger. The DCW supply should be on the suction of the ETS circulation pumps.

Pumps which circulate DHW from the tanks to the ETS for re-heating should be provided with VFDs to modulate the ETS flow based on DHW demand. VFDs provide electricity savings and reduce potential for erosion-related pipe failure in the DHW recirculation piping. Pump speed should be modulated proportionally to the tank temperature difference from setpoint.

Size DHW ETS circulation pumps appropriately. Pump sizing should be based on the necessary gallons per hour (GPH) of hot water production required based on the building DHW load and storage tank sizing. Typical DHW ETS heat exchanger capacity in Surrey is based on heating the necessary GPH from 4 °C to 60 °C. Pump head should be determined based on the expected piping pressure drop at the design flowrate and including a 5 PSI pressure drop across the ETS heat exchanger at design.

Balance valves or multi-purpose valves should be provided on the pumps or piping circulating DHW from the storage tanks to the ETS. Balance valves and/or the pump VFD maximum speed should be set to deliver the design flow rate to the ETS during peak DHW heating demand conditions.

Design DHW flow rate and supply/return temperature to the ETS must be clearly marked on the schematic drawings and must match the SCE Application for Service.

DHW recirculation systems from the building should be provided with balancing valves. Balancing valves should be set to achieve a low return temperature (45 °C or less) back from the building DHW system during periods of low DHW demand.

3.2.2 DHW Design Temperatures

The maximum DHW supply and return temperatures that must be achieved on the customer-side of the DHW ETS are listed in the following table. Lowest possible return temperature to the ETS is preferred.

Domestic Hot Water Heating System Temperatures (Building Side)		
	Storage Type System	*Instantaneous Type System*
Supply Temperature, **Max.**	60°C (140ºF)	55°C (131ºF)
Return Temperature, **Max.**	45°C (113ºF)	40°C (104ºF)

3.3 ETS Room Requirements

The ETS Room must be designed to meet the following requirements. The elements noted below must be shown on the respective drawing packages.

3.3.1 Architectural Requirements

- A dedicated ETS room is required in all Service Area “A” projects. The ETS room must be clearly shown on the drawings. The room must be dedicated for use by SCE. The ETS room should generally be located in the first level of underground parking.
- Service Area “B” projects require only a 10 m^2 housekeeping pad be installed for the ETS.
- The size of the ETS room for Service Area “A” projects depends on a number of factors, including customer load, number of heat exchangers, configuration of the hydronic heating and DHW systems, and specific restrictions within the customer building. Typically, a single high rise tower with one ETS requires a room size of 4.3m wide x 5.2m deep with a minimum ceiling height of 2.7 m. ETS room size will be provided by SCE.
- The room must have a double access door, minimum 1.8m wide x 2.0m high (72” x 80”) and an unobstructed 2.0m wide access pathway to the parkade for installation of the ETS skid.
- The customer’s is required to provide a concrete housekeeping pad of the required size, on which the ETS heat exchangers will be installed. Note on the drawings that the exact size and location of the housekeeping pad will be established by SCE during the design process.

3.3.2 Mechanical Requirements

- The ETS room shall be ventilated and maintained at a temperature between 10ºC and 35ºC. Electric or hydronic heating is acceptable for heating the ETS room.
- No other building mechanical equipment shall be located in the ETS room.
- Provide a floor drain connected to the sanitary sewer system in the ETS room.
- Provide a ¾” hose bibb in the ETS room.
- The exact location of the DE service line penetration will be established by the customer and SCE during the design process. The penetration may be a core drill (after the foundation is poured) or a sleeve installed prior to foundation pouring. The customer is responsible for providing and maintaining the penetration for the service line. Note on the drawings:

  "Wall penetration for DES piping & communication conduit to be provided by the general contractor. CoS ETS contractor will coordinate exact location of wall penetration with general contractor. GC to be responsible for coring and water sealing around CoS-installed piping."

3.3.3 Electrical Requirements

- Provide a dedicated 15A 120V electrical service, with a lockable breaker, to power the ETS control panel.
- Provide a 120V wall outlet in the ETS room.

- Provide a 50mm (2)" conduit (with string) from the district energy room to the roof of the building for COS SCADA antenna.
- Provide a dedicated 15 amp 120V, 60 Hz, single phase electrical circuit at the rooftop near the 50mm (2") conduit location.
- Provide a #6 gauge grounding wire at the rooftop near the 50mm (2") conduit location.
- Provide a 25mm (1") conduit (with string) from the district energy room to the Tel/Comm room.
- Provide a 25mm (1”) conduit (with string) from the ETS room to the location of the building HWS pumps and (if applicable) 3-way ETS diverting valve. SCE will directly monitor the pump status via a hardwire connection.
- Provide a 25mm (1”) conduit (with string) from the ETS room to the location of the building DHW heating ETS circulation pumps. SCE will directly monitor the pump status via a hardwire connection.
- Provide one 20mm (3/4”) electrical metallic tubing (EMT) conduit from the ETS room to a north facing exterior wall for the outdoor air temperature sensor wiring.

3.4 Supplemental Energy Sources in Customer Buildings

At the discretion SCE, some heating energy served by solar thermal sources and/or by heat recovery from refrigeration or waste heat sources within the building may be permitted.

If either of these “supplemental energy sources” is implemented, they are the sole responsibility of the Customer. Net metering (i.e. sale of thermal energy back to SCE) will not be considered; all energy generated by supplemental sources in customer buildings must be used within the building. Use of a supplemental energy source does not change the hydronic heating return water temperature requirements (as outlined in this Section).

Other than the energy sources noted above, all energy for space heating and DHW for Fully Compatible buildings must be served by SCE.

- END OF DOCUMENT -

APPENDIX A

Customer Building Design Review Checklist

City Center District Energy Minimum Requirements "Service Area A"		
	Requirement	Comments and Action required.
1.0 District Energy Right-of-Way and Covenant		
1.1	In order to connect to the District Energy (DE) Utility, the owner of the property being developed must agree to grant the city a blanket Statutory Right of Way and Covenant. These are necessary for the construction, operation and maintenance of the City's DE equipment. Provide a Section 219 Covenant Plan indicating the 6m wide area between the property line and entry to the mechanical room, with a title search (no more than 2 days old) and Survey Plan certification. The City will then prepare the SRW documents.	Owner shall Provide the following: One (1) digital copy of Covenant Plan under section 219 including: - Certified Survey Plan showing the extent of Section 219 Covenant. - One (1) current title search within two (2) days of receipt
1.2	A District Energy 6 meter ROW shall be indicated on the Civil, architectural and mechanical drawings. No services connections to the building shall be located in the 6 M ROW. Ensure there is no conflicts with other services, landscaping or building structural components. The exact location of the piping will be coordinated on site between the city and the general contractor during construction.	
2.0 Developers Disclosure Statements and Connection Fees		
2.1	The City requires that all developers of projects that will be connecting to the City's district energy system demonstrate that the disclosure statement filed for their project accurately reflects the costs of heating from the district energy utility.	Please submit the relevant sections form the disclosure statements for review.
2.2	Owner to pay the Connection Cost set out in Schedule E of the bylaw.	City will invoice developer based on the total peak capacity outlined in the district energy application for service.
3.0 Energy Transfer Station (ETS) and District Energy Room		
3.1	District Energy room shall be located on the first level of underground parking. The room shall face the street where the DE piping will service the building. The room shall have double doors.	District Energy rooms are normally located on the P1 parkade level. The room dimensions are approximately 4.9 m x 5.5 m.
3.2	Area demarked in the district energy room for Energy Transfer Station (ETS) equipment installation shall be clearly shown on drawings. This will include space for the installation of the ETS equipment and space for the service lines and interconnecting pipes. Approximate pad size is 8 to 10 m^2. The pad requirements will be confirmed after the registered professional has submitted the peak energy demands. Depending on the room size, location of room and size of the ETS, housekeeping pads may not be required if the ETS is premanufactured on a steel skid. This will be determined during construction.	Mechanical Engineering shall clearly indicate proposed location of ETS pad on drawings. Approximately (3m x 3 m). The pad shall be supplied by the general contractor and the exact location coordinated with the city during construction.
3.3	Minimum ceiling height of 2700 mm required above the pad. Do not locate any other equipment or piping in the area above the ETS pad or at the wall where the piping will enter the room that could cause conflicts with the installation and maintenance of the ETS equipment.	Mechanical Engineer to provide clarification on ceiling height in ETS room particularly above ETS space. Provide a section thru the room indicating all other equipment in the room and provide dimensions for clarification. Coordinate with the Electrical Engineer if any electrical equipment has been designed to be installed above the ETS (cable traps, etc.).
3.4	A floor drain is required near the ETS location and shall be connected to the sanitary system.	Mechanical Engineer shall indicate on drawings near the ETS pad.
3.5	A 20mm (3/4") hose bibb shall be provided near the ETS.	Mechanical Engineer shall indicate on drawings.
3.6	ETS space shall be ventilated as required by code.	Mechanical Engineer shall clearly indicate how the room is being ventilated.
3.7	ETS space shall be heated as required by code and maintained at a temperature above 15˚C.	Mechanical Engineer shall clearly indicate how the room is being heated. Electric heaters are acceptable.
3.9	No base building equipment shall be located in the district energy room.	
3.10	Exact location and size of district energy service connection piping (DES and DER) will be determined by CoS. Show generically the DE service connection entering the DEU.	Add note: "Wall penetration for DES piping to be provided by the general contractor. CoS DPS contractor will coordinate exact location of wall penetration with general contractor. GC to be responsible for coring and water sealing around CoS-installed piping."
4.0 Energy Transfer Station Controls & Communication		
4.1	A dedicated 15 amp 120V, 60 Hz, single phase electrical service with lockable breaker is required to power the ETS panel. Power shall be provided near the ETS pad. ETS control panel generally receives a hardwire connection (a receptacle is not required) This can be coordinated between the building electrical contractor and the ETS contractor during construction.	Electrical Engineer shall clearly indicate on the drawings. Exact location to be coordinated during construction.

City Center District Energy Minimum Requirements "Service Area A"		
	Requirement	**Comments and Action required.**
4.2	Dedicated 120 volt wall outlets are required in the district energy room. Allow for an outlet on the perimeter wall facing the street where the DE piping enters the building and 2 additional outlets on walls within the room.	Electrical Engineer shall clearly indicate on the drawings. All outlets shall be on a dedicated breaker and labelled.
4.3	Provide a 50mm (2)" conduit (with string) from the district energy room to the roof of the building for COS SCADA antenna.	Electrical Engineer to provide a conduit and label the string "For City of Surrey DE".
4.4	Provide a dedicated 15 amp 120V, 60 Hz, single phase electrical circuit at the rooftop near the 50mm (2") conduit location.	Electrical Engineer to provide power outlet on the roof near the conduit. Outlet to be labelled "For City of Surrey DE"
4.5	Provide a #6 gauge grounding wire at the rooftop near the 50mm (2") conduit location	Electrical Engineer to provide a grounding wire on the roof near the conduit.
4.6	Provide a 25mm (1") conduit (with string) from the district energy room to the Tel/Comm room.	Electrical Engineer to provide a conduit and label the string "For City of Surrey DE".
4.7	Provide a 25 mm (1") steel conduit from the district energy room to the north side of the building. A OAT sensor and wiring shall be installed by the City.	Electrical Engineer to provide a conduit and label the string "For City of Surrey DE".
4.8	District Energy will directly monitor the heating water circulation pumps (P-??) on/off status via a hardwire connection. These pumps circulate water to the city's heat exchanger when space heating is required in the building. Provide a 1" conduit from the heating water pump location to the District Energy room near the ETS PAD. City will pull wire through the conduit to the ETS control panel and install a current sensor in the pump control panel to achieve on/off status.	Electrical Engineer to provide a conduit to the district energy room. Label the string "P?? pump status conduit".
4.9	District Energy will directly monitor the domestic hot water (DHW) circulation pumps (P-??) on/off status via a hardwire connection. These pumps circulate water to the city's heat exchanger when DHW heating is required in the building. Provide a 1" conduit from the DHW pump location to the District Energy room near the ETS PAD. City will pull wire through the conduit to the ETS control panel and install a current sensor in the pump control panel to achieve on/off status.	Electrical Engineer to provide a conduit to the district energy room. Label the string "P?? pump status conduit".
5.0 Domestic Hot Water Design		
5.1	The domestic cold water (DCW) should tee into the DHWR (Domestic Hot Water Recirc) line upstream of the DHW heat exchanger. This configuration will allow for better system return temperatures and improved performance. If circulation pumps are being designed, ensure the cold water connection is on the pump suction side.	Mechanical Engineer shall indicate on drawing schematics.
5.2	Operating pressures, temperatures and flow rates at the City's ETS shall be clearly noted on the drawings and match those outlined in the application for service. Max customers supply is 60˚c (140˚F)	Mechanical Engineer shall indicate on drawing schematics.
5.3	Extent of city-provided equipment and owner equipment is at the flange edge of ETS skid for connection to customer piping. Piping and equipment on SCE side of the line to be shown in grey (city-provided).	
5.3	An allowance of 5 psi (35 kPa) pressure lose at the domestic hot water heat exchanger shall be accounted for in the selection of the base-building circulation pumps.	Mechanical Engineer shall confirm.
5.4	The maximum design flow rate of the buildings domestic hot water circulation system to the city's ETS is required by the city when selecting the DHW heat exchanger. If the engineer is designing the system with circulation pumps (see item 4.9) on the city's heat exchanger inlet or outlet, the building engineer is responsible to check the pump size (flow rate) and ΔT on the heat exchanger inlet/outlet equates to the peak load capacity noted on the application for service.	
5.5	Multiple pressure zones in a high rise buildings requiring heating of the recirculation main. Electric reheat tanks and brazed plate heat exchangers utilizing district energy for heating are permitted. The use of storage tanks with heating coils are not recommended as the temperature in the tank will fluctuate during off peak times and the tank is at risk for bacterial growth.	
5.6	Domestic hot water pumps P-?? should be provided with a means to modulate flow to allow ramping of flow on pump start, maintain stratification in the DHW storage tanks, and achieve lowest DHW return temperature to the ETS.	Refer to commissioning requirements for more information.
5.7	A flushing bypass and isolation valves are recommended on the building side which may be used by the mechanical contractor during system flushing, commissioning and future customer side maintenance. Locate isolation valves and bypass close to the energy transfer station for ease of commissioning during ETS startup.	Refer to commissioning requirements for more information.
5.8	Strainer on HWR to ETS skid will be provided by CoS as part of the ETS package.	

City Center District Energy Minimum Requirements "Service Area A"		
	Requirement	**Comments and Action required.**
5.9	Extent of city-provided and owned equipment is at the flange at edge of ETS skid for connection to customer piping. Piping and equipment on SCE side of the line to be shown in grey (city-provided). Typical of all ETS HEXs.	
6.0 Heating Water supply temperature and Delta T		
6.1	To meet DES requirements, the secondary side temperatures for the space heating ETS heat exchanger should be no greater than 60C (140 F) supply and 45C (113F) return at peak heating (design) conditions. These design parameters shall be clearly noted on mechanical drawings.	Mechanical Engineer shall indicate operating temperatures and pressures on drawings. Refer to section 3.1.2. for recommended maximum supply and return temperatures for typical terminal units.
7.0 Heating Water Supply Temperature Control		
7.1	The district heating system supply temperature will be reset based on outside air temperature conditions. A similar strategy should be employed in the secondary system. City requests information on your reset schedules and sequence of operation for all space heating equipment.	Mechanical Engineer shall indicate outdoor air temperature reset scale on drawings. The city will incorporate a outdoor reset schedule in the control of their energy transfer station which will control the buildings loop supply water temperature. This will be coordinated with the building's contractor during construction.
8.0 Heating Water Pumping		
8.1	The district heating system requires the building (secondary) hydronic system to be designed for variable flow utilizing 2-way control valves, and preferably configured with variable speed pumping. One logical approach would be to control the pump speed based on pressure or dP signal and modulate the control valve to achieve air temperature set point. However, it is not for the city to comment on any control strategies within the building (as long as hydronic circuits are variable-flow).	Mechanical Engineer shall indicate on drawings.
9.0 Heating Water Schematic Review		
9.1	A property balanced hydronic system (water balance) is one that consistently delivers the proper rate of heat transfer to each space served by the system. Location of balancing valves shall be clearly indicated on the drawings.	Mechanical Engineer to provide details on how the system will be balanced.
9.2	The maximum design flow rate of the space heating hot water circulation system to the city's ETS is required by the city when selecting the space heating heat exchanger. If the engineer is designing the system with circulation pumps (see item 4.8) on the city's heat exchanger inlet or outlet, the building engineer is responsible to check the pump size (flow rate) and ΔT on the heat exchanger inlet/outlet equates to the peak load capacity noted on the application for service.	
9.3	If the heating system operating pressure is in excess of 160 psi, the system would need to be registered with Technical Safety BC (TSBC).	The city requires one of the three conditions below to be met prior to approval of the building permit: 1. Written confirmation from TSBC that the system at its current operating pressure is not required to be registered; 2. Confirmation of registration with TSBC; or 3. Written confirmation that the operating pressure will not exceed 160 psi.
9.4	Commissioning, flushing, and initial and ongoing chemical treatment of the hydronic hot water heating circuit within the building is the responsibility of the customer. Drawings shall indicate a chemical pot feeder in the system which will allow a means to introducing chemicals to the hydronic hot water heating circuit.	Provide commissioning requirements for the secondary heating system including system flushing, chemical treatment details, cleaning of strainers, air/dirt devices installed in the system, side stream filters, etc. Provisions to prevent freezing of the MAU heating coil should be reviewed by the engineer
9.5	Extent of city-provided equipment and owner equipment is at the flange edge of ETS skid for connection to customer piping. Piping and equipment on SCE side of the line to be shown in grey (city-provided).	
9.6	An allowance of 5 psi (35 kPa) pressure lose at the domestic hot water heat exchanger shall be accounted for in the selection of the base-building circulation pumps.	Mechanical Engineer shall confirm.
9.7	A flushing bypass and isolation valves are recommended on the building side which may be used by the mechanical contractor during system flushing, commissioning and future customer side maintenance. Locate isolation valves and bypass close to the energy transfer station for ease of commissioning during ETS startup.	Refer to commissioning requirements for more information.
9.8	Strainer on HWR to ETS skid will be provided by CoS as part of the ETS package.	
10.0 Heating Water Distribution in building		
10.1	Hydronic heating risers shall be shown clearly on the drawings.	

City Center District Energy Minimum Requirements "Service Area A"		
	Requirement	Comments and Action required.
11.0 Hot Water Expansion		
11.1	Provisions for expansion of the heating water mains for the horizontal and vertical piping to be shown clearly on drawings.	
11.2	Provisions for expansion of the domestic hot water heating mains to be shown clearly on the drawings.	
12.0 Estimate of Loads		
12.1	Submit the Application for Service (attached) signed by the registered professional who is responsible for the design of the building mechanical system, estimating the following: peak heat energy demand for space heating (KW), peak heat energy demand for domestic hot water (KW), combined peak heat energy demand for any uses other than space and domestic hot water. (KW), annual heat energy demand for space heating. (KWh), annual heat energy demand for domestic hot water (KWh), system operating pressures, flow rates, operating temperatures, building occupancy data and the requested service date.	Complete the application for service.
13.0 Use of Heat Recovery from Cooling		
13.1	Developers that plan to employ cooling systems in their buildings may wish to utilize heat recovery systems. This practice is considered suitable under the following conditions: - Passive heat recovery systems (i.e. systems that do not use heat pumps) may be used continuously; - Active heat recovery systems (i.e. systems that use heat pumps to recover heat) should be used only when the building is in cooling mode; - Use of heat pump compressors in heating-only configurations is not acceptable; - use of heat recovery systems should not result in changes to the standard approach to servicing buildings from the COS and - Heat recovery systems should be used only to improve overall building energy performance, and not to displace heat that would otherwise be purchased from the district energy utility.	
14.0 Use of Other On-site Alternative Energy Systems		
14.1	Sources of on-site heating energy other than heat recovery from cooling are not acceptable, as these would displace energy that would otherwise be provided by the district energy utility. However, other types of non-thermal on-site energy production, including photovoltaic systems would be considered acceptable. Examples of systems that are not acceptable include, but are not limited to: - Gas or wood fireplaces; - 2-pipe water-source heat pumps for heating; - Sewer drain heat recovery devices that use heat pumps; - Biomass-fired boilers; - Air-source heat pumps; and - Geoexchange systems.	
15.0 Allowance for use of electric heat in limited areas		
15.1	The By-law currently requires that buildings utilize district energy for 100% of the space heat and domestic hot water demand, while allowing for the use of waste heat recovery and solar thermal systems. The purpose of this requirement is to secure low-carbon outcomes for buildings and maximize the cost-effectiveness of the district energy service. The use of electric heat in areas that may not be significant users of energy and are expensive to service with DES-based hydronic heat (e.g. stairwells, parkade bike and storage rooms) will be evaluated on a case to case basis.	In order for the city to evaluate the implications of allowing electric heat in these limited areas, and to determined if it would not negatively impact customer rates or GHG performance, the city requests that the engineer provide the annual usage (KWh) of the proposed electric baseboard being proposed in the design and the total building annual energy usage (KWh).

City Center District Energy Minimum Requirements "Service Area B"		
	Requirements	**Additional Comments**
1.0 District Energy Right-of-Way and Covenant		
1.1	In order to connect to the District Energy (DE) Utility in the future, the owner of the property being developed must agree to grant the city a blanket Statutory Right of Way and Covenant. These are necessary for the future construction, operation and maintenance of the City's DE equipment. Provide a Section 219 Covenant Plan indicating the 6m wide area between the property line and entry to the mechanical room, with a title search (no more than 2 days old) and Survey Plan certification. The City will then prepare the SRW documents.	Owner shall Provide the following: One (1) digital copy of Covenant Plan under section 219 including: - Application to Deposit Right-of-Way Plan - Survey Plan Certification - One (1) current title search within two (2) days of receipt
1.2	The Future District Energy 6 m ROW shall be indicated on the Civil, architectural and mechanical drawings and no services connections to the building shall be located in the 6 M ROW. Ensure there is no conflicts with other services and landscaping.	
2.0 Energy Transfer Station (ETS) & District Energy Room		
2.1	District Energy room shall be located on the first level of underground parking. The room shall face the street where the future DE piping will service the building. The room shall have double doors.	District Energy rooms are normally located on the P1 parkade level. The room dimensions are approximately 4.9 m x 5.5 m. A shared Mechanical/District Energy room will considered providing space and access to the district energy space is sufficient.
2.2	Area demarked in the district energy room for Energy Transfer Station (ETS) equipment installation shall be clearly shown on drawings. This will include space for the installation of the ETS equipment and space for the service lines and interconnecting pipes. Approximate pad size is 8 to 10 m². The pad requirements will be confirmed after the registered professional has submitted the peak energy demands.	Mechanical Engineering shall clearly indicate proposed location of a 75mm (3") concrete housekeeping pad on drawings. Approximately (3m x 3 m). The pad shall be supplied by the general contractor.
2.3	A typical ETS requires a minimum ceiling height of 2700 mm. DO not locate any other equipment or piping in the area above the ETS that could cause conflicts with the installation and maintenance of the ETS equipment.	Mechanical Engineer to provide clarification on ceiling height in District Energy room particularly above ETS pad. Provide a section thru the room indicating all other equipment in the room and provide dimensions for clarification. Coordinate with the Electrical Engineer if any electrical equipment has been designed to be installed above the ETS (cable traps, etc.).
2.4	A 4" floor drain is required near the ETS pad and shall be connected to the sanitary system.	Mechanical Engineer shall indicate on drawings near the ETS pad.
2.5	A 20mm (3/4") hose bibb shall be provided near the ETS.	Mechanical Engineer shall indicate on drawings.
2.6	ETS space shall be ventilated as required by code.	Mechanical Engineer shall clearly indicate how the room is being ventilated.
2.7	ETS space shall be heated as required by code and maintained at a temperature above 15°C.	Mechanical Engineer shall clearly indicate how the room is being heated. Electric heaters are acceptable.
3.0 Energy Transfer Station Controls & Communication		
3.1	A dedicated 15 amp 120V, 60 Hz, single phase electrical service with lockable breaker is required to power the ETS panel. Power shall be provided near the ETS pad. ETS control panel generally receives a hardwire connection (a receptacle is not required) Electrical Engineer to provide a dedicated 15 A/120/1phase circuit near the ETS pad.	Electrical Engineer shall clearly indicate on the drawings.
3.2	Dedicated 120 volt wall outlets are required in the district energy room. Allow for an outlet on the perimeter wall facing the street where the DE piping enters the building and 2 additional outlets on walls within the room.	Electrical Engineer shall clearly indicate on the drawings. All outlets shall be on a dedicated breaker and labelled.
3.3	Provide a 50mm (2)" conduit (with string) from the district energy room to the roof of the building for COS SCADA antenna. Electrical Engineer to provide a conduit and label the string "For City of Surrey DE SCADA". Terminate near ETS pad.	Electrical Engineer shall clearly indicate on the drawings. Exact location to be coordinated during construction.
3.4	Provide a dedicated 15 amp 120V, 60 Hz, single phase electrical circuit at the rooftop near the 50mm (2") conduit location.	Electrical Engineer to provide power outlet on the roof near the conduit. Outlet to be labelled "For City of Surrey DE"

City Center District Energy Minimum Requirements "Service Area B"		
	Requirements	**Additional Comments**
3.5	Provide a #6 gauge grounding wire at the rooftop near the 50mm (2") conduit location. Terminate near the 50mm (2") conduit.	Electrical Engineer to provide a grounding wire on the roof near the conduit.
3.6	Provide a 25mm (1") conduit (with string) from the district energy room to the Tel/Comm room. Electrical Engineer to provide a conduit and label the string "For City of Surrey DE Tel/Comm". Terminate near ETS pad.	Electrical Engineer to provide a conduit and label the string "For City of Surrey DE".
3.7	DES will directly monitor the heating water circulation pumps on/off status via a hardwire connection in the future. If the pumps are not located in the DE room, provide a 1" conduit from the heating water pump room to the District Energy room near the ETS PAD. City will pull wire through the conduit to the ETS control panel and install a current sensor in the pump control panel to achieve on/off status.	Electrical Engineer to provide a conduit to the district energy room. Label the string "P?? pump status conduit".
3.8	DES will directly monitor the domestic hot water circulation pump on/off status via a hardwire connection in the future. If the pumps are not located in the DE room, provide a 1" conduit from the domestic water pump room to the District Energy room near the ETS PAD. City will pull wire through the conduit to the ETS control panel and install a current sensor in the pump control panel to achieve on/off status.	Electrical Engineer to provide a conduit to the district energy room. Label the string "P?? pump status conduit".
4.0 Domestic Hot Water Design		
4.1	Utilize a domestic hot water heating system that is compatible with the district energy system for all domestic hot water requirements. Provide capped and valve connections in the system that will allow a seamless integration to the future district energy system. Clearly identify the connections on the drawing schematics.	Mechanical Engineer shall indicate on drawing schematics.
4.2	The Domestic cold water make-up shall be designed to connect to the inlet of future district energy heat exchanger. This configuration will allow for better system return temperatures and improved performance for DE. If circulation pumps are being designed, ensure the cold water connection is on the pump suction side.	Mechanical Engineer shall indicate on drawing schematics.
4.3	Operating pressures and temperatures shall be clearly noted on the secondary side of the system and match the design temperature parameters outlined in the DE bylaw. Max customers supply is 60˚c (140˚F)	Mechanical Engineer shall indicate on drawing schematics.
4.4	The pressure loss through the future district energy heat exchanger will be approximately 5 psi (35 kPa). If circulation pumps are designed and are intended to flow water through the future DE heat exchanger, all a pressure drop of 5 psi in the pump selection.	Mechanical Engineer shall confirm.
4.5	Domestic hot water pumps P-?? should be provided with a means to modulate flow to allow ramping of flow on pump start, maintain stratification in the DHW storage tanks, and achieve lowest DHW return temperature to the ETS.	Mechanical Engineer shall indicate on drawing schematics and equipment schedules.
5.0 Heating Water supply temperature and Delta T		
5.1	To meet DES requirements for a heating system with make-up air units only (100% outdoor heating coils), the secondary side temperatures for the space heating ETS heat exchanger should be <u>no greater than</u> 60C (140F) supply and 45C (113F) return at peak heating (design) conditions. These design parameters shall be clearly noted on mechanical drawings.	Mechanical Engineer shall indicate on drawing schematics.
6.0 Heating Water Supply Temperature Control		
6.1	The district heating system supply temperature will be reset based on outside air temperature (OAT) conditions. A similar strategy should be employed in the secondary system. Indicate OAT reset schedule and sequence of operation for all space heating equipment.	Mechanical Engineer shall indicate on drawing schematics.
7.0 Heating Water Pumping		
7.1	The district heating system requires the building (secondary) hydronic system to be designed for variable flow utilizing 2-way control valves, and preferably configured with variable speed pumping. One logical approach would be to control the pump speed based on pressure or dP signal and modulate the control valve to achieve air temperature set point. However, it is not for the city to comment on any control strategies within the building (as long as hydronic circuits are variable-flow).	Mechanical Engineer shall indicate on drawings.
8.0 Heating Water Schematic Review		
8.1	Utilize a space heating system that is compatible with the district energy system for all make-up air units and all common space heating. Provide capped and valve connections in the system that will allow a seamless integration to the future district energy system. Clearly identify the connections on the drawing schematics.	Mechanical Engineer shall indicate on drawing schematics.

City Center District Energy Minimum Requirements "Service Area B"		
	Requirements	**Additional Comments**
8.2	Capacity of the buildings heating water circulations pumps shall align with the requirements outlined in item 5.1 and the buildings peak heating load.	
8.3	If the heating system operating pressure is in excess of 160 psi, the system would need to be registered with Technical Safety BC (TSBC).	The city requires one of the three conditions below to be met prior to approval of the building permit: 1. Written confirmation from TSBC that the system at its current operating pressure is not required to be registered; 2. Confirmation of registration with TSBC; or 3. Written confirmation that the operating pressure will not exceed 160 psi.
8.4	Commissioning, flushing, and initial and ongoing chemical treatment of the hydronic hot water heating circuit within the building is the responsibility of the customer. Drawings shall indicate a chemical pot feeder in the system which will allow a means to introducing chemicals to the hydronic hot water heating circuit.	Provide commissioning requirements for the secondary heating system including system flushing, chemical treatment details, cleaning of strainers, air/dirt devices installed in the system, side stream filters, etc. Provisions to prevent freezing of the MAU heating coil should be reviewed by the engineer
8.5	The pressure loss through the future district energy heat exchanger will be approximately 5 psi (35 kPa) An allowance of 5 psi (35 kPa) pressure loss at the space heating heat exchanger shall be accounted for in the selection of the base-building circulation pumps.	Mechanical Engineer shall confirm.
8.6	A property balanced hydronic system (water balance) is one that consistently delivers the proper rate of heat transfer to each space served by the system. Location of balancing valves shall be clearly indicated on the drawings.	Mechanical Engineer to provide details on how the system will be balanced.
9.0 Heating Water Distribution in building		
9.1	Hydronic heating risers shall to be shown clearly on the drawings.	
10.0 Hot Water Expansion		
10.1	Provisions for expansion of the heating water mains for the horizontal and vertical piping to be shown clearly on drawings.	
10.2	Provisions for expansion of the domestic hot water heating mains to be shown clearly on the drawings.	
11.0 Estimate of Loads		
11.1	Clearly note the following on the drawings: peak heat energy demand for space heating (KW), peak heat energy demand for domestic hot water (KW), combined peak heat energy demand for any uses other than space and domestic hot water. (KW), annual heat energy demand for space heating. (KWh), annual heat energy demand for domestic hot water (KWh)	Mechanical Engineer to provide details on the hydronic schematics.

APPENDIX B

ETS Commissioning Process & Startup Checklists

Surrey City Energy (SCE) process for commissioning the building-side of utility-owned Energy Transfer Stations (ETSs) connected to the Surrey District Heating System. This memo provides the details of the proposed ETS and Customer Building commission process.

1.0 CITY PROCESS OVERVIEW

1. **Design Review**: SCE has reviewed the building permit drawings for compliance with SCE district energy requirements.
2. **Inspections**: To verify building mechanical system and District Energy room requirements are met prior to ETS installation and start up (See *Surrey Central District Energy Review for Service Area "A"* checklist).
3. **ETS Startup**: Once building is ready and City inspections are passed, ETS is started by the City and operated to provide commissioning heat to the building. Refer to checklist for "City requirements prior to ETS commissioning and startup".
4. **ETS-Building Commissioning**: Conducted by the Developer's commissioning agent to verify operation of building mechanical systems and verify compliance with SCE temperature requirements.
5. **Final Inspection**: A final walkthrough is scheduled once the building is complete. If installation is acceptable and building operating temperature meet SCE requirements, Occupancy Permit is approved. Final documentation (including Building-ETS commissioning results) must be provided to the City.

2.0 PARTIES INVOLVED

2.1 Developer's Team

- Building Prime Contractor
  - Building Mechanical Contractor
  - Building Controls Contractor
  - Building Electrical Contractor
  - Building Commissioning Agent
- Building Mechanical Consultant

2.2 Surrey City Energy's Team

- ETS Contractor
  - ETS Controls Contractor
- ETS Mechanical Consultant
- SCE Operational Consultant

3.0 ETS STARTUP

3.1 Documentation Required Prior to Startup

The following outlines the pre-startup actions and documentation that must be provided prior to startup of the ETS. This checklist is provided to ensure building mechanical systems are complete, functional, and ready to receive heat from the ETS.

Documentation to be Provided to SCE Prior to ETS Startup:

1. Confirmation building hydronic systems are installed as per the SCE-approved design and are substantially complete. Confirm specifically:
   a. 3-way bypass valves have not been used in a bypassing configuration.
   b. VFD drives have been installed on space heating water distribution pumps.
   c. Confirmation that expansion compensation for heating and DHW piping has been installed.
2. Confirmation of Building Hydronic Flushing completion signed by the Engineer.
3. Building hydronic systems pressure testing certificates signed by the Engineer.
4. Building hydronic systems Water Quality test reports including inhibitor concentration and chemicals used.
5. Primary HWS and DHW ETS circulation Pump Startup Reports. These pumps flow water directly to the City's heat exchangers.
6. Building Domestic Hot Water system pressure testing certificates signed by the Engineer.

3.2 Developer Responsibilities – ETS Startup Stage

The developer must submit a request for SCE to schedule ETS startup a minimum of seven (7) days prior to the requested ETS startup date. SCE will confirm the ETS startup date with the Developer.

The following must be completed by the Developer's contractor at the time of ETS startup.

- Open isolation valves to bring heating and domestic water to the ETS skid ('contract boundary') valves prior to ETS startup. Bleed air from piping.

  NOTE: ANY VALVES ON THE ETS PACKAGE MUST ONLY BE OPERATED BY SCE.

- Close customer-owned flushing bypasses to direct flow through the ETS.
- Operate primary HWS and DHW circulation pumps and 3-way blending valve (if applicable) so SCE can confirm feedback status at the ETS controls.

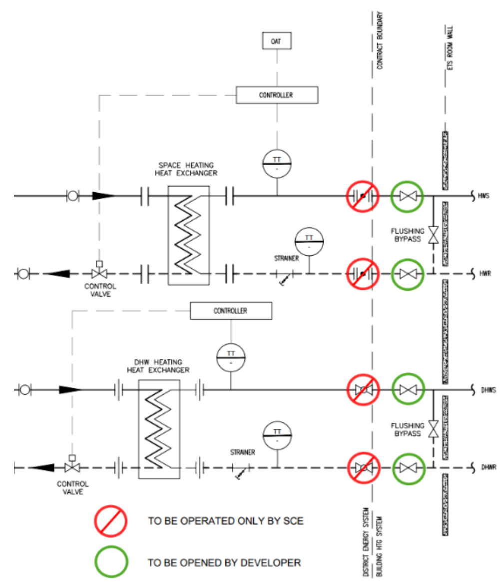


Figure 1: ETS Boundary Valves

3.3 SCE Responsibilities – ETS Startup Stage

- Commission and test the ETS package including ETS controls, valves, energy meter, and DES-side flow to the heat exchangers.
- Test functionality of heating water setpoint OAT reset logic.
- Startup of the ETS package to provide commissioning heat to the building:
  - SCE will set the ETS to provide a static temperature to the building HVAC systems (seasonally dependent) to assist with customer-side HVAC systems commissioning.
  - SCE will set the ETS to provide DHW at 60 °C for DHW system start-up and commissioning.
- Inspection of customer-side space heating and DHW systems to verify compliance with Utility requirements and the approved design package.
- Configure ETS trend logs for measurement and verification.

4.0 ETS-BUILDING COMMISSIONING

The ETS, like any other heat producing equipment, must be included as part of the building commissioning process. Proper commissioning of building systems is critical to ensure successful operation of the ETS. A properly commissioned building system-ETS interface operates with the intended performance and return water temperature making them compliant with the City's DES Bylaw and Utility requirements.

Commissioning of the ETS-Building Interface is to be completed after ETS startup but before building occupancy. Commissioning reports that demonstrate successful operation of the building—meeting the ETS supply and return temperature requirements—must be submitted to SCE prior to granting an Occupancy Permit.

The following commissioning steps must be completed by the Developer's commissioning agent and will be reviewed by SCE. SCE will work with the Developer's commissioning agents ensure fully commissioned mechanical (hydronic) systems connected to the ETS—typically space heating and DHW heating.

4.1 Documentation Required Prior to Commissioning

- Commissioning plan.
- Copies of latest commissioning meeting minutes with open deficiencies noted.
- (If applicable) Copy of TSBC registration for hydronic heating system if it was a requirement at BP review stage.

4.2 SCE Responsibilities During Commissioning

- Maintain operation of the heating supply and ETS.
- Adjust ETS setpoints as requested by the Developer.
- Review commissioning results provided by the building commissioning agent.

4.3 Developer Responsibilities During DHW SYSTEM Commissioning

The developer's commissioning agent is responsible for confirming the following items pertaining to the building domestic water heating system as part of commissioning:

- Confirm customer-side DHW system is installed and ready for operation.
- Confirm customer-side DHW circulation pumps are installed, operating as per design, and balanced to the design flow rate. Variable speed DHW pumps are to be balanced, or speed limited in the VFD, to their design flow rate.

- Confirm the sequence of operation for control of DHW circulation pumps is completed and functional testing has been completed by the control's contractor.
- Confirm DHW building recirculation system is complete, started up, and has been balanced to achieve design return water temperature.

The building commissioning agent is to test the DHW heating system under simulated load to demonstrate operation is in compliance with the DES return water temperature requirements. Test DHW heating systems as follows and report on the results:

- Begin with the DHW storage tanks charged and at setpoint. There is little or no load on the system because the building is unoccupied.
- Record the DHW recirculation temperature from the building prior to testing. Confirm it is 45 °C or less.
- Simulate a small DHW load (approximately 0.1 GPM per suite) by opening several fixtures or drain valves in the building DHW system.
  - Record the approximate DHW flow rate generated (# fixtures x fixture flow rate in GPM).
  - Record the incoming DCW temperature.
  - Record the operation of the DHW heating system through a heating cycle. Points to record include:
    - DHW system tank temperature(s) and setpoint,
    - ETS circulation pump(s) speed status. The pumps should operate at low speed during a low DHW load event.
    - Record the temperature of DHW return to the ETS. Confirm it is 43 °C or less.
    - Record the temperature of the DHW supply from the ETS. Confirm it matches setpoint.
- Simulate a larger DHW load (approximately 0.4 GPM per suite) by opening several fixtures or drain valves in the building DHW system.
  - Record the approximate DHW flow rate generated (# fixtures x fixture flow rate in GPM).
  - Record the incoming DCW temperature.

- Record the operation of the DHW heating system through a heating cycle. Points to record include:
  - DHW system tank temperature(s) and setpoint,
  - ETS circulation pump(s) speed status. The pumps should modulate up to higher speed during a higher DHW load event.
  - Record the temperature of DHW return to the ETS. Confirm it is 43 °C or less.
  - Record the temperature of the DHW supply from the ETS. Confirm it matches setpoint.

- Include trend logs of the above information in the building commissioning report and provide a copy to SCE minimum 1 week prior to final walkthrough.

4.4 Developer Responsibilities During HEATING SYSTEM Commissioning

The Developer's commissioning agent is responsible for confirming the following items pertaining to the building space heating system prior to commissioning:

- Confirm customer-side hydronic system is installed and ready for operation.
- Confirm building hydronic system balancing has been completed.
- Confirm customer-side primary HWS pumps are installed, started up, and operating as per design.
- Confirm sequence of operation for control of the primary HWS pumps, 3-way blending valve(s), and secondary heating water pumps (as applicable) is completed, and functional testing has been completed by the control's contractor.

The commissioning agent is to conduct the following testing of the hydronic heating system to demonstrate the customer heating system is operating in compliance with the DES return water temperature requirements:

- Low heating load testing:
  - Simulate a low heating load by enabling heating of some spaces.
  - Confirm HWS temperature from the ETS and to the building meets design.
  - Confirm HWR temperature to the ETS meets design.

- High heating load testing:
  - Request SCE to temporarily provide max design HWS temperature from the ETS.
  - Simulate a high heating load by enabling thermostats in 50%+ of spaces.
  - Confirm HWS temperature from the ETS to the building meets design.
  - Confirm HWR temperature to the ETS meets design.
- Confirm final OAT reset schedule as provided in the mechanical design.
  - Any under-heated areas should be resolved with changes on the building-side design. Increases to HWS temperature setpoint or OAT reset schedule are only allowed after other reasonable avenues (water re-balancing, air re-balancing, controls changes, or supplemental heating) have been exhausted.

5.0 PRE-OCCUPANCY REQUIREMENTS

5.1 Final Documentation

The following final documentation must be submitted to Surrey City Energy prior to building Occupancy.

- Balancing report including for heating water loop and domestic hot water circulation pump.
- Commissioning report including results of ETS-Building Commissioning process.
- As-built drawings of hydronic and domestic hot water piping schematics
- Shop drawings of all hydronic heating components and domestic hot water pumps.

6.0 POST-OCCUPANCY REQUIREMENTS

6.1 Performance Monitoring

It is the responsibility of the building owner to operate the building hydronic heating systems in compliance with the requirements of Surrey's *District Energy System Bylaw* including meeting return water temperature requirements stipulated in this guide.

Surrey City Energy will monitor building performance at the Energy Transfer Station. Non-compliant performance—such as elevated return water temperatures, or peak demands in excess of the nominated capacity on the application for service—may require follow up review and action by the building operator.