Richmond City Centre

District Energy Utility Service

A Design Guide for Connection to District Energy

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Definitions

BAS	Building Automation System
CCDEU	City Centre District Energy Utility
CEP	Central Energy Plant
DCP	Discrete Cooling Plant
DE	District Energy
Delta T; ΔT	Temperature Difference
DEU	District Energy Utility
DHW	Domestic Hot Water
DPS	Distribution Piping System
ETS	Energy Transfer Station
FDC	Future DEU Connection
Four-Pipe Radiator	A type of fan radiator that allows for both heating and cooling via hot and chilled water distribution; e.g. Jaga brand (http://jaga-usa.com/).
GHG	Greenhouse Gas
HVAC	Heating, Ventilation & Air-Conditioning
LCEP	Low Carbon Energy Plant
LCES	Low Carbon Energy System, consists of LCEP, DPS, ETS, and FDC. Please refer to the *CCDEU – A Guideline for On-Site Low-Carbon Energy Systems* document for further details.
LIEC	Lulu Island Energy Company
MAU	Makeup Air Unit
OAT	Outdoor Air Temperature
VAV	Variable Air Volume; a HVAC system involving a central air handling unit that distributes air through the building for ventilation and space conditioning. Air flow rate is varied to serve the loads.
VRF	Variable Refrigerant Flow; a HVAC system that uses refrigerant as the cooling and heating distribution medium and allows one condensing unit to be connected to multiple fan-coil units.

1 Document Purpose

The Lulu Island Energy Company (LIEC) is the district energy utility service provider for the City Centre District Energy Utility (CCDEU) service area located in Richmond, BC. LIEC is committed to providing energy that is more sustainable and reduces environmental impact. To this end LIEC has partnered with Corix Utilities Inc. (Corix) to plan, design, install, maintain, and operate the district energy system for CCDEU. The system will serve space heating, space cooling, and domestic hot water needs for the CCDEU service area.

This document provides preliminary information to developers, building owners, engineers, and architects to tailor their designs to district energy operational conditions, thereby optimizing the benefits of the District Energy Utility (DEU). Corix and LIEC will work closely with developers of new buildings and their Heating, Ventilation & Air-Conditioning (HVAC) engineers to ensure good design integration between buildings and the DEU. The information in this document applies to all building types and uses, including residential, office, retail, and industrial.

In accordance with City of Richmond Bylaw 9134 and 9895, it is mandatory that the developer collaborate with Corix and LIEC to ensure the design and operation meet the technical specifications of the Service Provider (LIEC) and Operator (Corix) prior to issuance of the Building Permit.

These guidelines apply to both the Oval Village District Energy Utility (heating only) and the CCDEU (heating and cooling).

2 District Energy in the City Centre

2.1. What is District Energy?

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

The DE system consists of three main components:

1. Central Energy Plant (CEP) – the energy source
2. Distribution Piping System (DPS) – the distribution network
3. Energy Transfer Stations (ETS) – the building interface

2.2. Benefits of District Energy to Developers & Building Owners

EASE OF OPERATION, LESS MANAGEMENT, LESS COSTS

Individual buildings connected to the DE do not require major equipment for space heating, cooling, and DHW. The Utility Service Provider operates this type of equipment in central Central Energy Plants. This results in reduced ongoing operating, maintenance, and labour costs for stratas and avoided replacements in the future.

IMPROVED EFFICIENCY/RELIABILITY

DE technology is proven and reliable, has built-in backup systems and performance is monitored continuously. DE technology optimizes energy-use efficiency by identifying thermal demands and supplying the appropriate amount of energy to the customer. DE systems increase community energy resiliency by reducing reliance on external energy sources.

ENVIRONMENTAL

DE systems enable building owners to conserve energy and improve operating efficiency, thus protecting the environment. By prioritizing low-carbon energy sources DE systems lead to a reduction in GHG emissions.

COMFORT AND CONVENIENCE

DE provides more affordable energy for their customers. Hydronic heating and cooling are generally considered more comfortable than other forms of space conditioning.

FUEL FLEXIBILITY

DE systems are adaptable to future technologies and sustainable energy sources such as ground source heat, ground water heat, sewer heat, biomass and solar.

2.3. DEU Owner

In 2013, the Lulu Island Energy Company (LIEC) was established as a wholly-owned corporation of the City for the purposes of managing district energy utilities on the City's behalf. Oval Village District Energy Utility Bylaw No. 9134 and City Centre District Energy Utility Bylaw 9895 (the Bylaw) was established as the regulatory framework for the CCDEU service area. Customer rates are determined by City Council on an annual basis.

LIEC is in partnership with Corix Utilities to design, build, finance, operate and maintain the DEU in the CCDEU area. As such, LIEC is the utility service provider with Corix acting as the utility operator. Customers will interact with Corix regarding DEU design, construction, and operational concerns.

2.4. Energy Sources for the DEU

DEU customer buildings are heated by hot water, and cooled by chilled water, supplied by one or more CEPs. The CEPs may employ different technologies to produce hot and chilled water; this will likely evolve over time in response to changing market conditions, technologies, and social concerns.

Renewable energy sources, such as sewer heat recovery or geo-exchange, are prioritized as thermal energy sources for the DEU customers. High efficiency natural gas-fired boilers are used in the interim for neighbourhoods not yet connected to renewable energy sources and are also used for peak demand and back-up purposes.

2.5. Cost of District Energy

DEU capital costs are financed through rate recovery from customers. Charges will be competitive with conventional heating or cooling costs for the same level of service. DEU charges will be more stable and less sensitive to changes in electricity and natural gas prices, because the DEU is more efficient and it uses alternate energy sources and sinks. As with conventional systems, the developer/building owner is responsible for the in-building hydronic system costs. See Section 5 for details on customer and DEU responsibilities.

2.6. Building HVAC & DHW System Design Requirements

Developers are required to use the DEU as energy source and sink for heating and cooling their buildings, but have flexibility in designing the building internal heating and cooling systems in accordance with their preferences and specific requirements. The building hydronic space heating winter design temperatures cannot exceed 60°C supply and 40°C return, and are encouraged to be lower. The domestic hot water supply temperature supplied from the DEU's ETS shall be 60°C maximum year round. The building's DHW supply system shall be designed with this maximum considered.

Developments in the City Centre will receive cooling services from one of:

1. CCDEU – off-site,
2. Discrete Cooling Plant (DCP) – on-site,
3. or a Low Carbon Energy System (LCES) – on-site.

Regardless of the LIEC cooling system type, each building will have a hydronic cooling system connected to a cooling ETS. The buildings connected to the cooling service are required to be indirect connections, via the installation of a chilled water heat exchanger at the ETS. The building hydronic space cooling summer design temperatures cannot be lower than 7.2°C supply and 15.6°C return, and are encouraged to be higher.

Corix will provide technical assistance to developers to improve integration of the customer building with the DEU and review conformance to technical requirements set out by the Service Provider. See Section 6 for more details.

2.7. Energy Transfer Station Space Requirements

Corix will design and install the necessary pipes, heat exchangers, associated controls, and energy meters to interface with the building heating and cooling systems. This equipment, referred to as the Energy Transfer Station (ETS), is owned by LIEC and operated by Corix, and located inside the customer's building.

All heating ETSs and cooling ETSs for buildings connected to the CCDEU shall be located in the lowest level above the Flood Plain Construction Level according to the Flood Plain Designation and Protection Bylaw No. 8204, and shall be located on an exterior wall. Cooling ETSs for buildings connected to a DCP or LCES may be located at a higher elevation to suit the plant location. An ETS typically occupies approximately 20% of the space of a conventional boiler and chiller plant. The ETS can be located within the same mechanical room as the building heating, cooling, and domestic hot water system equipment. Figure 1 below shows a typical heating ETS and Figure 2 shows a typical cooling ETS. See Section 5 for more details on mechanical room and Developer provided requirements (Appendix A).

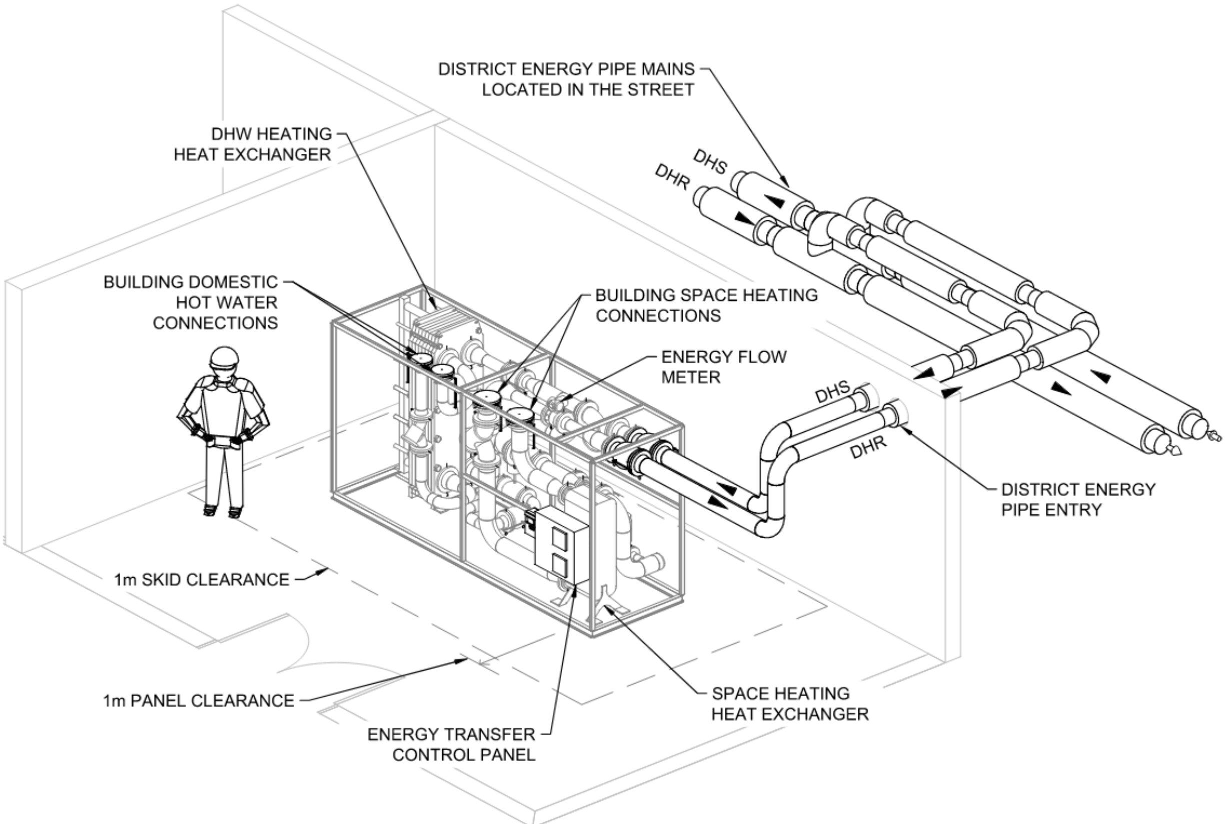

FIGURE 1: TYPICAL HEATING ETS INSTALLATION IN BUILDING

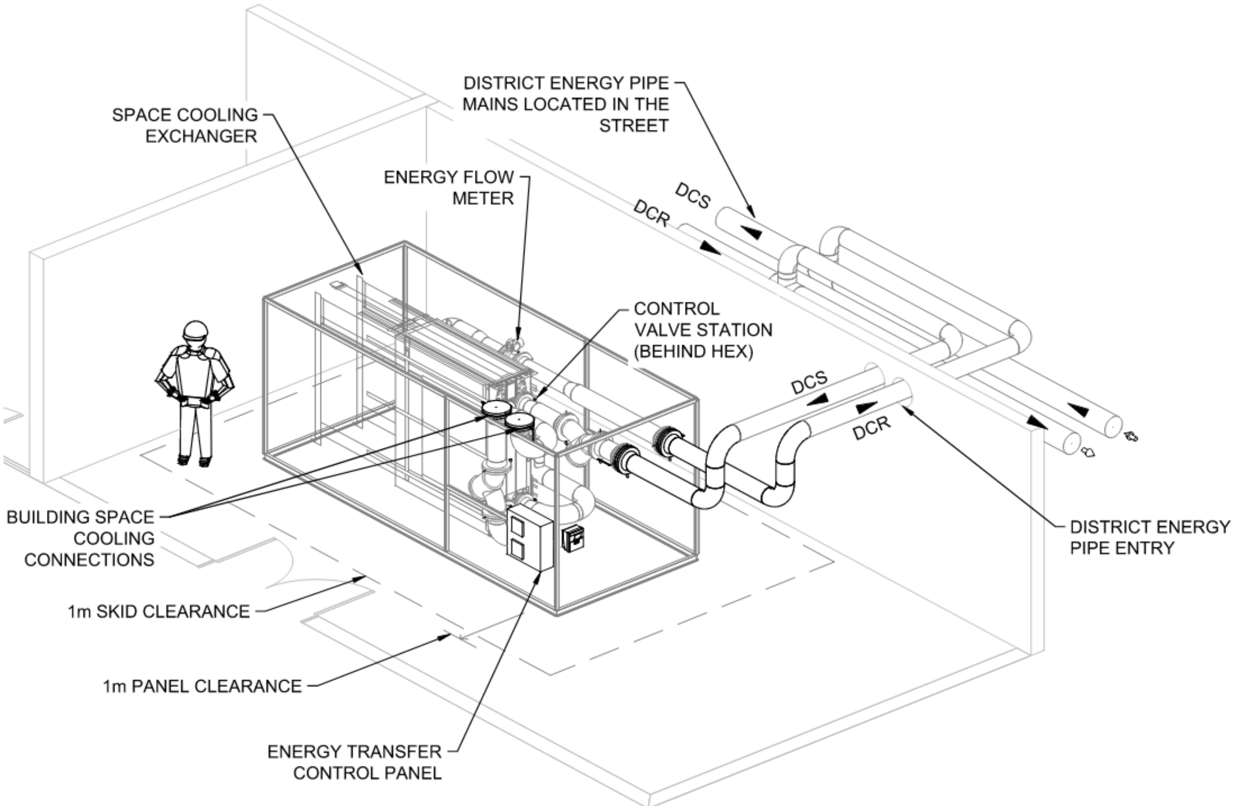

FIGURE 2: TYPICAL COOLING ETS INSTALLATION IN BUILDING

2.8. DEU Contact Information

For more information on the DEU service and requirements for customer building connections, please contact Corix Utilities Inc. at energy.utilities@corix.com.

3 DEU Description

3.1. Central Energy Plant (CEP)

As with many other recent DE systems, the CCDEU will be implemented in phases. An alternative energy source (e.g., sewer heat recovery) is expected to be introduced when warranted by development density. This alternative energy source will serve base load requirements for the system and likely deliver the majority of annual heating energy. Natural Gas boilers will continue to provide peak heating and reliable backup capacity to ensure full and uninterrupted service to customers.

Similarly, centrifugal chillers will be installed in the CEP to produce chilled water to meet the space cooling demand of the system. Low-carbon technologies, such as sea water cooling and heat recovery chillers (simultaneous heating and cooling), will be investigated as the system develops.

Production equipment and controls will be based on current industry proven technology. Sewer heat recovery technologies will be continually evaluated in light of new opportunities and changing circumstances. The DE infrastructure will be designed to facilitate the future use of new renewable energy sources for heating and cooling. The CCDEU will have the ability to switch fuel and energy sources over time as the system and regulations require.

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

The DEU will have a higher level of reliability than is generally provided by standalone heating and cooling systems in individual homes or commercial and multi-use residential buildings.

3.2. Distribution Piping System (DPS)

Thermal energy is delivered to customers with a closed loop two-pipe (supply and return) hot water distribution network: the same water is heated in the CEP, distributed to the buildings, through the ETS, and returned back to the CEP to be reheated and redistributed. No water is drained or lost in the system, and no additional water is required during normal operation. A separate closed loop two-pipe chilled water distribution system is used when centralized cooling is provided, and the chilled water undergoes a similar process as described above for heating.

The heating DPS is composed of an all-welded, pre-insulated direct buried piping system. The cooling DPS is composed of direct buried HDPE and/or epoxy coated steel pipe. The DPS is designed based on the size and location of customer buildings and CEPs. Distribution network modeling is completed to optimize system performance and efficiency, and to ensure that all customers will always receive sufficient thermal energy.

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

In hot water-based heating systems, low secondary return temperatures from the connected buildings allow for large temperature differentials (delta T; ∆T) to be achieved in the DPS, resulting in low pumping requirements and high efficiency, smaller diameter pipes, minimized capital costs, reduced thermal losses, and the optimal use of renewable and low-grade heat sources. For cooling systems, the same principles apply, where high secondary return temperatures allow for large temperature differentials and high system efficiency. District heating/cooling return temperature is a function of the design and performance of HVAC and DHW systems in customer buildings; hence, it is essential for the Utility Service Provider to ensure that buildings connected to the system meet performance requirements, and it is imperative that building designers are conscious of and adhere to the DES temperature requirements, specifically the secondary return temperatures listed in Section 6.3.1.

3.3. Energy Transfer Stations (ETS)

Each customer's building houses a heating ETS, and a cooling ETS when applicable, that is owned by the DEU. The key components of an ETS include:

- DE supply and return pipes from the building penetration (interface with distribution system). Two pipes for heating service only, four pipes for heating and cooling service;
- Heat exchangers for heat transfer between the DEU and the building's hydronic heating, cooling, and DHW systems;
- Controls to regulate the flow required to meet the building's energy demand and maintain DEU return temperatures; and,
- Energy meters to monitor the energy used by each customer for billing and system optimization purposes. See Section 4 for a discussion of DE metering.

As shown in Figure 3 below, flow through the primary (DEU) side of the ETS is controlled to achieve the building's supply temperature set point.

[1] i.e., without requiring other heat sources to supplement or elevate the temperature to meet the building's requirements.

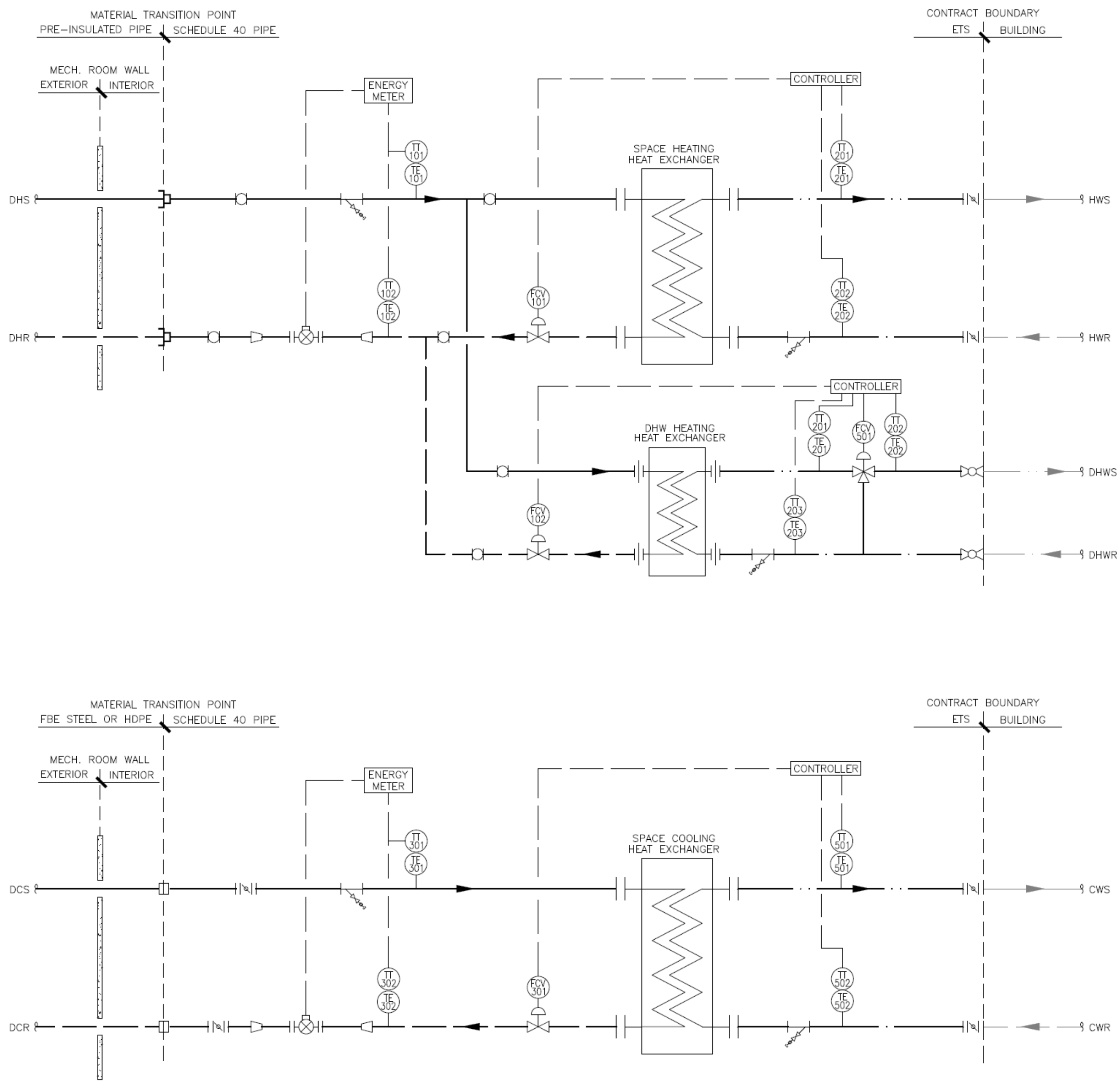

FIGURE 3: TYPICAL HEATING AND COOLING ETS FLOW SCHEMATIC

Heating ETSs generally have two heat exchangers: one for space heating, and a second to directly serve DHW. This is good industry practice for hot water DE in North America and around the world. There is a vast amount of experience and data regarding DE performance and reliability with this configuration. Cooling ETSs generally have a single heat exchanger to serve the space cooling system. Heat exchangers are very reliable (with no moving parts) and it is not necessary to have redundant units in an ETS. Additional heat exchangers may be required where capacity or system configurations dictate.

Corix will be responsible for the maintenance and reliable operation of the ETS, including the heat exchangers.

3.4. LCES Developments

Low Carbon Energy System (LCES) Developments are developments that will not be immediately connected to the DEU. In this case, they will have an on-site, Low Carbon Energy Plant (LCEP) that produces heating and cooling energy for the development site. This thermal energy is delivered to the customer buildings within the development by development-scale DPS, and each Strata has its own ETS. The LCES shall have a provision for a Future DEU Connection (FDC), such that energy can be supplied by the CCDEU when the service is available to the development site.

LCES components, including the LCEP, DPS, and ETS shall be provided by the developer and transferred to LIEC for ownership and operation. For more details, refer to the *CCDEU – A Guideline for On-Site Low-Carbon Energy Systems* document.

4 Billing and Cost of DE Service

4.1. Energy Metering

Thermal energy meters consist of high quality and accurate components installed in the ETS: a flow meter, temperature sensors on both supply and return pipes, and an integrator/calculator. The energy meter collects data on water flow, cumulative energy, peak demand, and temperatures. Data from each meter is transmitted to a central DEU computer for utility billing purposes and to monitor and optimize performance of the DEU and customer buildings. The meters are utility-grade integrated thermal energy meters that achieve high accuracy and performance, conforming with existing international (OIML R75 and EN1434) standards, meeting Canadian (CSA C900) standard, and approved by Measurement Canada for thermal energy metering.

4.2. DEU Bill Structure

Customers are billed to rates determined by the Council on an annual basis and defined in the Bylaws 9134 and 9895.The total cost of DE service to customer buildings is competitive with heating and cooling costs for a conventionally heated and cooled building. DE rates are expected to be more stable than gas and electricity costs over time.

Tariffs consist of two components:

- Volumetric Charge, based on thermal energy use in the period.
- Capacity Charge, based on the heating capacity required by the customer.

Volumetric Charges cover variable costs, which are primarily energy inputs (i.e., fuel and electricity costs). Accordingly, the cost will vary with consumption and the local prices for any fuel consumed by the DEU. As with natural gas and electricity, energy use and charges should be less in summer months than in winter for heating service.

The Capacity Charge covers DE fixed costs (non-commodity operation, maintenance and capital recovery costs, taxes, etc.). This charge is a function of the thermal capacity required by the customer and/or size of the building (i.e., floor area).

In order to minimize unnecessary additional capacity and cost, it is important that building developers do not overestimate building capacity requirements**.** Overestimation of peak demand results in higher fixed capacity charges for customers. Corix will work closely with building developers to establish realistic system demand requirements. Similar to other energy utilities in B.C., tariffs will be adjusted periodically based on changes in costs over time.

4.3. Sub-Metering

All energy billing from the CCDEU to the building is governed by the ETS energy meters. The building is responsible to install any required submetering on the secondary systems between subdivisions, individual units, suites or sub-systems to support allocation of CCDEU charges in the building. These sub-meters are the sole responsibility of the customer, and will not affect the obligation of the customer to pay the DEU bill based on the ETS thermal energy meter for the whole building. Sub-meters are generally not utility grade and therefore less accurate. In the event of discrepancy between the readings of the CCDEU meter and the secondary side submeters, the CCDEU meter readings will prevail.

4.4. Net Metering

Net metering (i.e., sale of thermal energy back to LIEC) will not be considered; all energy generated by supplemental energy sources in customer buildings must be used within the building. See section 6.5 for more details on allowed supplemental energy sources.

4.5. LCES Developments

As ownership and operation of LCES is by LIEC, energy metering and billing shall be based on the thermal energy meters installed at the connected buildings' ETSs, similar to other CCDEU-connected buildings, as described in Section 4.1, 4.2, 4.3, and 4.4 above. For more details, refer to the *CCDEU – A Guideline for On-Site Low-Carbon Energy Systems* document.

5 Responsibilities of Customer and DEU

The following section outlines the responsibilities of the developer and LIEC/Corix to ensure efficient and seamless integration of DE service, and to ensure full compatibility for buildings connected to LCES.

5.1. Developer's Responsibility

5.1.1. HVAC and Plumbing System

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

The following conventional building elements are not required for customer buildings:

- Boilers, furnaces, domestic hot water heaters, electric baseboards, or any other heat production equipment, except as exempted in Section 6.5.
- Auxiliaries to heating systems such as stacks and breeching.
- Natural gas service for space and domestic hot water heating.
- Chillers, cooling towers, and associated chilled water production equipment, except as exempted in Section 6.5.

The building will require internal thermal distribution systems, including:

- Internal distribution pumps and piping (i.e., hydronic space heating and cooling distribution loops).
- Heating and cooling elements such as fan-coil units, air handling units, and/or perimeter (baseboard) or in-floor radiant heating or chilled beam systems.
- Normal building controls and control systems.
- Make-up water, pressure regulation, a means to manage the expansion of water (e.g., expansion tanks), and over-pressurization protection (e.g., pressure relief valves).

The following are some design conditions that are specific to DE:

- Customer buildings host branch (service) lines from the DPS. The DEU branch lines enter the building, similar to other utilities, and transfer energy through the ETS.
- The building owner, Corix and LIEC agree on a suitable location for the ETS. The ETS

invariably requires less space than comparable heating and cooling production equipment (e.g., boilers, chillers, cooling towers) that it replaces. To reduce DEU piping inside the building, the ETS shall be located on an exterior wall as close as possible to the DEU branch pipeline entering the building.

- The DEU operates most effectively and efficiently with the use of low temperatures in the building heating systems, and high temperatures on the building cooling systems.

Section 6 discusses specific requirements of the hydronic space heating, cooling, and DHW systems for compatibility with the district energy system. Corix reviews the HVAC and plumbing design of each building, but is not responsible for the design (which is executed by the builder). Corix may make suggestions as necessary to ensure appropriate integration with the DEU.

5.1.2. Installation and Operation Contract Boundary

The customer is responsible for all piping and other components necessary to connect the hydronic heating, cooling, and DHW systems to the ETS at the stipulated demarcation point for the service boundary on the secondary side of the heat exchangers. This demarcation point will be clearly marked on the DEU engineering drawings for the ETS, downstream of the main isolation valves on the secondary (building) side of the ETS, as shown in Figure 3.

LCES-connected buildings contract boundaries follow the same convention as a typical CCDEU connection, at the isolation valves at the secondary side of the ETS. For more details on the requirements of the LCES itself, refer to the *CCDEU – A Guideline for On-Site Low-Carbon Energy Systems* document.

5.1.3. Preparation of Building for DE Service

All customers 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 with sufficient access opening for the ETS. The ETS shall be located at an exterior wall facing the street, in the lowest level above the Flood Plain Construction Level according to the Flood Plain Designation and Protection Bylaw No. 8204. Cooling ETSs for buildings connected to a DCP or LCES may be located at a higher elevation to suit the plant location.

The building shall provide the following to accommodate the ETS:

- Concrete coring or pipe sleeves for all DE service lines and communication conduits penetrations through building and foundation walls.
- Sealing of penetrations after DEU installation, including building envelope waterproofing.
- Double door access from building entry to ETS installation location to facilitate delivery and maintenance of the ETS.
- Required clearances on all sides of the ETS at the installation location.
- Conduit, pull string, and wire from the ETS installation location to the approved Outside Air Temperature (OAT) sensor location. OAT sensor shall be provided by Corix.

- Conduit, pull string, and wire from dedicated current sensors or VFD contacts for each pump that flows through the ETS. Corix shall provide and install the current sensors and complete final connections.
- Dedicated 15A, 120V, 60hz single-phase electrical service to the ETS at the installation location.
- A domestic water service connection hose bibb at the installation location.
- A floor drain.
- ETS room ventilation and temperature control.
- Dielectric connections to the ETS's secondary DHW piping.
- Bypass piping immediately adjacent to the ETS secondary piping connections to facilitate building piping flushing and cleaning without circulating through the ETS.
- Certification under seal from the building engineer of building system conformance.

Refer to Appendix A for additional details for the above items. The Developer shall thoroughly review Appendix A in conjunction with the items listed above when designing the building to ensure all DE service requirements are met.

The ETS controls are standalone, and shall not have any connection to the customer building control system.

Corix will require uninterrupted access to the ETS and service line within a customer's building for installation, regular maintenance and repairs. This will be defined by an easement with the City of Richmond.

5.1.4. Hydronic System Water Quality

Building owners are responsible for filling and managing their own building hydronic space heating and cooling systems. The DEU requires that water treatment for the building's hydronic system meet the minimum criteria set forth below:

Chloride:	< 30 ppm
Corrosion Inhibitor	
Hardness:	< 2 ppm
pH Level:	9.5-10
Iron	< 1 ppm

The customer shall 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. ETS 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. Cleaning and flushing test reports shall be provided to Corix for review and acceptance, prior to DEU connection and commissioning.

The cleaning and flushing process shall be completed by the building, but shall generally consist of a chemical clean, followed by a clean water flush to drain, then fill and treatment of the system service water. Flushing velocity shall be adequate to ensure removal of debris from the system; recommended values are:

- Pipe sizes NPS 6 and smaller: 1.5 meters per second (4.9 ft/s).
- Pipe sizes NPS 8 and larger: 0.9 meters per second (3.0 ft/s).

Upon request by the customer, and with suitable compensation, the ongoing water quality may be maintained by Corix.

5.1.5. ETS Commissioning

The ETS secondary isolation valves shall be opened to the building piping systems and commissioned only after Corix is satisfied with the building's cleaning and flushing process and results. The customer is responsible for commissioning all equipment and systems on the building side of the demarcation point prior to requesting ETS commissioning by Corix. During ETS commissioning, the building operator is responsible for the building's internal hydronic and DHW systems.

A checklist for the customer building's responsibilities and requirements prior to and during ETS commissioning is included in Appendix A.

5.1.6. Changes to the Building System

The Customer shall not materially change the design or substitute any pertinent equipment during installation without LIEC's and Corix's approval, in conformance with the Bylaws. After commissioning, any changes to the Building's (or Strata's) mechanical systems that may impact DEU performance shall be reported to and approved by LIEC and Corix prior to installation and shall be in a manner that ensures adherence to the agreed-upon final Thermal Energy Delivery Parameters as set out in the Energy Services Agreement Schedule C.

The ETS is owned by LIEC and maintained by Corix. 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 altering the controls and control panel.

5.1.7. LCES-Connected Buildings

For more details on the requirements of the LCES itself, refer to the *CCDEU – A Guideline for On-Site Low-Carbon Energy Systems* document.

5.2. DEU Responsibility

5.2.1. DEU Equipment within Customer Buildings

Corix designs, installs, operates, and maintains the ETS on behalf of LIEC at the agreed-upon location, as well as the primary (DE) distribution pipes to the ETS. Branch pipelines are generally direct buried from the mainline to the building penetration. From that point, DE piping runs inside the building to the ETS.

Corix provides strainers on the DE and building side at each heat exchanger in the ETS, which are cleaned as necessary. Corix services the energy metering equipment and verifies accuracy at regular intervals per manufacturer recommendations.

Corix provides temperature transmitters, pressure gauges, temperature gauges, thermowells, control valves, energy meters, and a control panel for the ETS. Temperature transmitters for the secondary side of the heat exchangers are also provided to facilitate monitoring and ETS control of the secondary side heating, cooling, and DHW systems. The ETS controls are standalone, and do not require any connection to the customer building control system. The ETS controls regulate primary (DEU) water flow rates to maintain secondary (building) supply water temperatures; the ETS does not control any other aspects of the buildings hydronic space heating, cooling, and DHW systems.

Corix provides pressure relief valves on the secondary side of the ETS heat exchangers, within the bounds of the ETS. These relief valves are solely to protect the ETS heat exchangers, piping, and components from over-pressurization from thermal expansion if the ETS isolation valves are closed. Pressurization and over-pressure protection of the building's hydronic and domestic hot water systems, as well as registration with TSBC if applicable, remain the responsibility of the customer building. The building developer shall communicate the building systems' design and maximum operating pressures at the inlet of the ETS, in order for Corix to coordinate relief valve selections.

5.2.2. District Energy Side Water

The DEU provides the make-up water requirements for the DE system side. All necessary water treatment is accomplished at the CEP. Thermal expansion of water in the DE system is accommodated at the CEP.

5.2.3. Commissioning

Corix will commission the ETS and is responsible for commissioning all components up to the DE service demarcation point. Commissioning includes verifying measurement points and testing the controls under various operating modes. The building operator is required to support the commissioning process, as described in Section 5.1.5. A Corix approved commissioning checklist shall be filled out and signed by the appropriate parties listed on the form.

6 Requirements for Building HVAC and DHW Systems

This section summarizes technical requirements for hydronic heating, cooling, and domestic hot water systems for new developments within the CCDEU and OVDEU service areas. The information provided in this document shall be regarded as a general guideline only, and the developer's Engineer shall be responsible for the final building-specific design. Corix will provide technical assistance to developers to improve integration of the customer building with the DEU. Heating and cooling system schematics, layouts, equipment schedules and sequence of operation or control strategies are required to assist in the DEU review process.

6.1. Design Strategies

The following Table 1 identifies the key elements or strategies that shall be followed when designing the building hydronic systems.

TABLE 1: COMPATIBLE DESIGN STRATEGIES

Strategy	Rationale
Centralized hydronic system	• Water has four times the specific heating capacity of air. • Benefits from system load diversification. • Reduces utility interconnect costs. • Minimizes noise from mechanical systems.
Low[2] hot water supply temperatures / High chilled water supply temperatures	• Improves DE efficiency. • Allows use of lower grade energy sources.
Large temperature differentials	• Reduce piping capital cost. • Reduce pumping capital & operating costs.
Variable flow with variable frequency drives	• Reduces pumping operating costs. • Improves system control.
Two-way control valves	• Necessary to achieve variable flow and a large temperature

[2] "Low" relative to traditional building HVAC design, which historically had >80°C on the building side of the ETS. The DEU is referred to as a "medium" temperature water system since it supplies water from 65°C up to 95°C and needs to be higher than the building side temperature.

	differential.
Seasonal reset of supply temperatures	• Improves energy efficiency. • Improves system control.
Return temperature limiting	• Improves energy efficiency. • Ensures large temperature differentials.
Direct Digital Control System	• Allows more accurate control and greater control flexibility. • Potential opportunities for energy savings.
Night setback settings & recovery times	• Minimize equipment sizes by allowing reasonable recovery times. • Maximize recovery times from unoccupied to occupied mode.
4-pipe fan coils, 4-pipe radiators, VAV, etc.	• More efficient operation, with significantly reduced electricity consumption. • Quieter operation.

6.2. Pumping and Control Strategy

The building hydronic systems shall be designed to minimize hot water return temperatures, and maximize chilled water return temperatures, across all operating conditions.

The building heating and cooling systems shall be designed for variable hydronic flow (preferably with variable speed pumps to minimize pumping energy), using 2-way modulating (or on/off) control valves at small terminal units (radiators, fan coil units, etc.). Alternatively, 3-way mixing valves at sub-systems and terminal units may be used.

Bypass valves (e.g., 3-way bypass valves at terminal units) are not permitted. One allowable exception to the bypass valve restriction is the use of a controlled bypass flow path to ensure minimum pump speeds can be maintained without deadheading the pumps; in this case, the bypass valves must be programmed to remain closed at all times that circulating pumps are operating above minimum settings. Bypass valves shall be sized to minimize the rate of bypassed flow, only providing that as sufficient to maintain minimum pump speeds.

Pumps shall be selected for the diversified demand (with a reasonable margin) in order to avoid oversizing and consequential impacts to the ETS heat exchanger sizing. The allowable pressure drop between ETS tie-in points from the secondary side return piping tie-in to the secondary side supply piping tie-in, including the pressure drop through the secondary side of the ETS heat exchanger, needs to be carefully considered so as to not affect pumping and flows to secondary side end devices. Table 2 shall be followed when sizing the hydronic system and DHW pumps:

Table 2: ETS Maximum Allowable Secondary Side Pressure Drop

System	ETS total pressure drop[3]	HX pressure drop
Space Heating	Maximum 70 kPa	Maximum 50 kPa
Space Cooling	Maximum 70 kPa	Maximum 50 kPa
Domestic Hot Water	Maximum 70 kPa	Maximum 50 kPa

See Figure 4 below for typical hydronic heating system configurations.

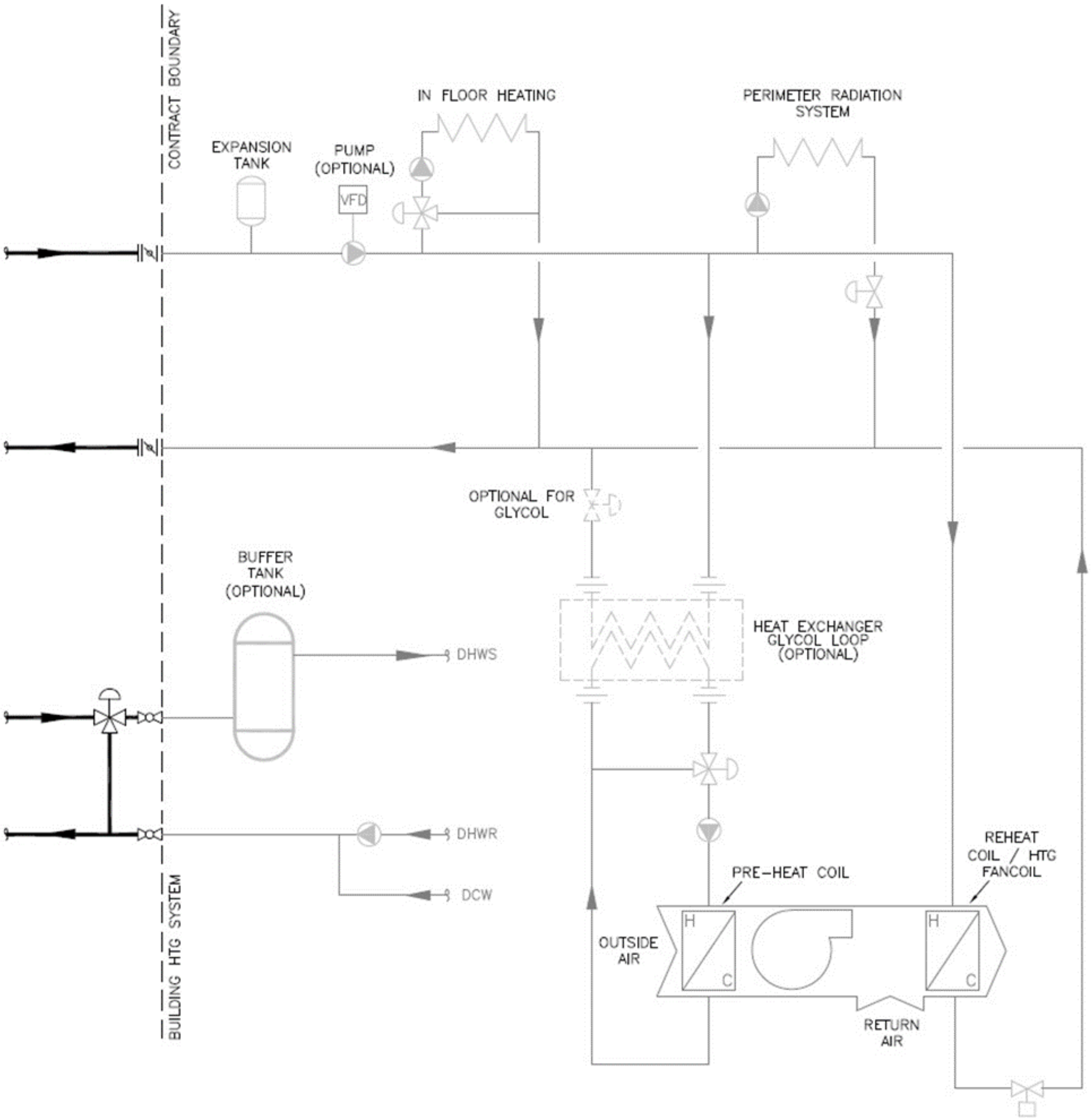

FIGURE 4: EXAMPLES OF TYPICAL BUILDING HEATING SYSTEMS

[3] Certain configurations may require higher overall secondary side pressure drop, e.g. if three-way mixing valves are included. Such configurations will be discussed with the building developers if required.

6.3. Hydronic Heating and DHW System Minimum Requirements

Optimization of the hydronic heating system return temperature is critical to the successful operation of the DEU. The ETS controls the supply water temperature to the hydronic circuit (i.e., the temperature of the water leaving the space heating piping of the ETS) based on an outside air temperature reset schedule. This is the maximum temperature available to the building hydronic circuit. A sample hydronic heating circuit supply and return temperature reset curve is shown in Figure 5 below. It is the building's responsibility to ensure that their system can meet demand at intermediate supply temperatures and OATs.

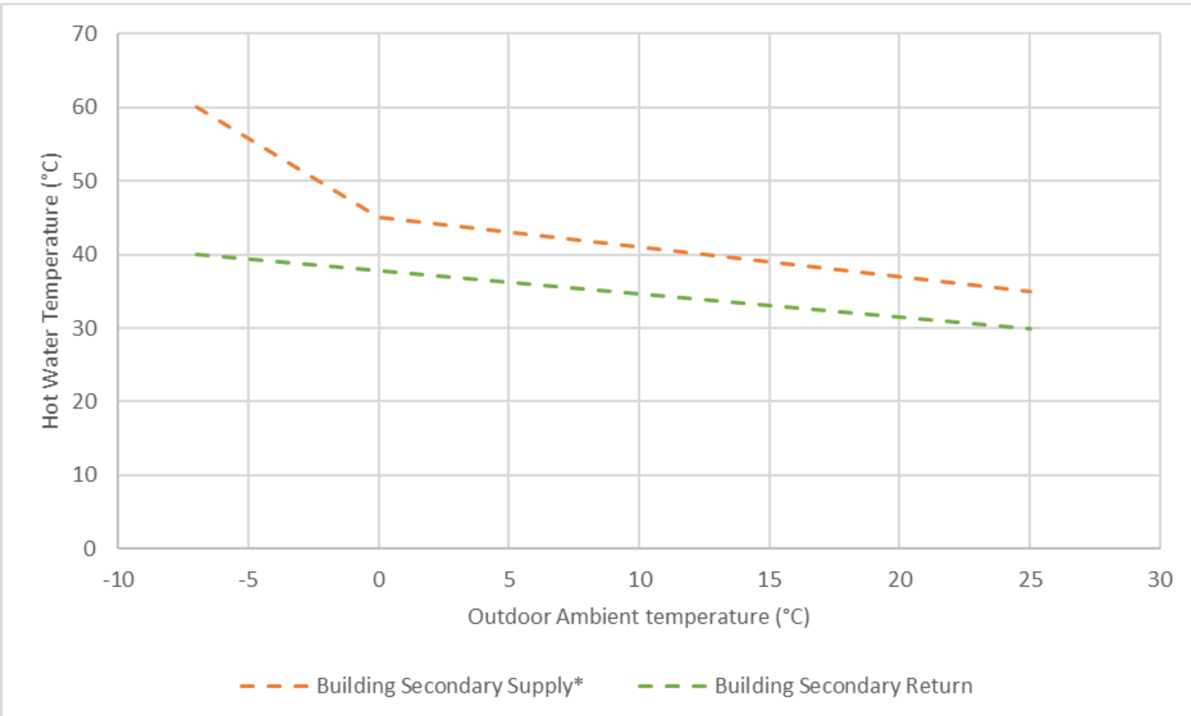

FIGURE 5: TYPICAL TEMPERATURE RESET CURVE FOR METRO VANCOUVER AREA.

*Space Heating Only. DHW supplied separately from ETS, heated to max. 60°C.

6.3.1. Hydronic Space Heating

The hydronic heating system shall be designed to provide all space heating and ventilation air heating requirements for the whole building, supplied from a central ETS. Gas-fired or electric-resistance heating or ventilation equipment (roof top units, air handling units, electric coils, electric baseboards, etc.) are not permitted, except as described in Section 6.5.

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 (secondary) heating system must be designed for temperatures no greater than those specified in Table 3 and Table 4 below. Temperature differential between supply and return shall exceed 10°C.

TABLE 3: HYDRONIC SPACE HEATING SYSTEM TEMPERATURES (BUILDING SIDE)

	Peak Winter	*Summer*
Supply Temperature, **Max.**	60°C	35°C
Return Temperature, **Max.**	40°C	30°C
Design Pressure	≤1600 kPa	≤1600 kPa

TABLE 4: DOMESTIC HOT WATER HEATING SYSTEM TEMPERATURES (BUILDING SIDE)

	Winter	*Summer*
Supply Temperature (with storage), **Max.**	60°C	60°C
Supply Temperature (no storage), **Max.**	55°C	55°C

The specified temperatures shall be regarded as maximum requirements; lower temperatures are desirable. The building return temperatures shall be minimized to allow the DEU to take advantage of alternate energy technologies.

Specific types of heating systems (i.e., terminal units) can operate at lower temperatures. The terminal units must be selected based on temperatures as low as can be reasonably expected. Table 5 below outlines **maximum** hot water supply (HWS) and hot water return (HWR) temperatures for which terminal units shall be designed and selected.

TABLE 5: TERMINAL UNIT MAXIMUM OPERATING TEMPERATURES

Type of Terminal Unit	**Maximum HWS**	**Maximum HWR**
Radiant in-floor heating	50°C	38°C
Perimeter radiation system	60°C	40°C
Fan coil units & reheat coils[4]	60°C	40°C
Air handling pre-heat coils[5]	55°C	35°C

[4] Unit heaters and forced flow heaters shall follow the fan coil design criteria.
[5] Make-up Air Units (MAU) shall follow the air handling pre-heat coil design criteria.

6.3.2. Domestic Hot Water

The Domestic Hot Water (DHW) system shall be designed to provide all DHW requirements for the building, supplied from a dedicated DHW heat exchanger from the ETS. It is understood that DHW systems require supply temperatures as high as 60°C; the DEU is able to supply this temperature from the ETS to the building at all times. It is the owner's responsibility to ensure their system design meets all maximum and minimum temperature and anti-scalding requirements per the latest editions of the local Plumbing Code and ASHRAE Standard 188 and Guideline 12, depending on the DHW configuration chosen.

DHW systems may be designed in various configurations, each with their own benefits and draw backs. The allowable configurations are:

- Instantaneous
- Semi-Instantaneous
- Charging

Instantaneous

A fully Instantaneous DHW system has no storage tanks; domestic water is heated on demand. This results in the smallest footprint and lower maintenance and capital costs. Additionally, the ETS experiences the lowest return temperature, benefiting the DEU. However, as the heating is on demand, the ETS heat exchanger must be sized for the peak DHW draw flow, resulting in the largest capacity heat exchanger of the three options. Instantaneous DHW systems are configured with DHW recirculation lines connected in parallel to the DCW supply line, to the inlet of the ETS heat exchanger. Refer to Figure 6 for a typical Instantaneous schematic.

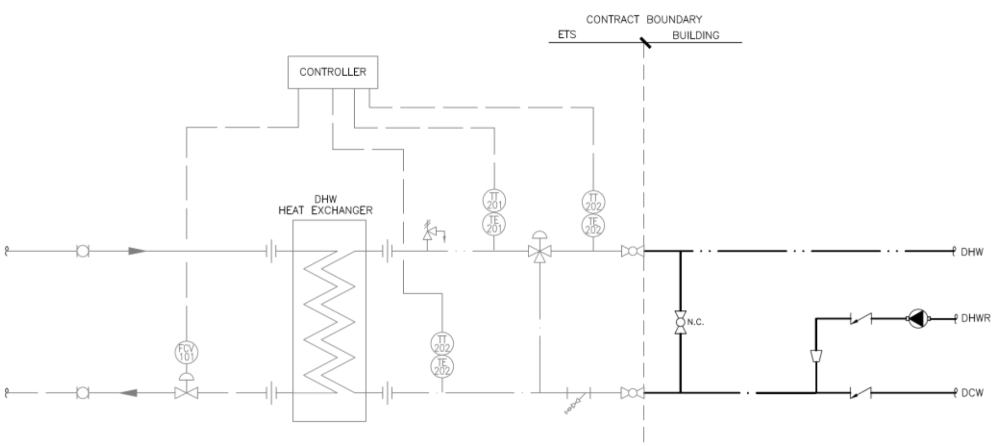

FIGURE 6: TYPICAL INSTANTANEOUS DHW CONFIGURATION

Semi-Instantaneous

A Semi-Instantaneous DHW system has a small amount of storage capacity, where storage tanks act as "buffer tanks" only; there is no recirculation from the DHW storage tanks directly back to the heat exchanger. The buffer volume allows for a drain down of DHW during atypical or critical demand periods, while potentially reducing the heat exchanger capacity. Semi-Instantaneous DHW systems are configured with DHW recirculation lines connected in parallel to the DCW supply line, to the inlet of the ETS heat exchanger, and the buffer tank(s) connected off the supply from the heat exchanger. Refer to Figure 7 for a typical Semi-Instantaneous schematic.

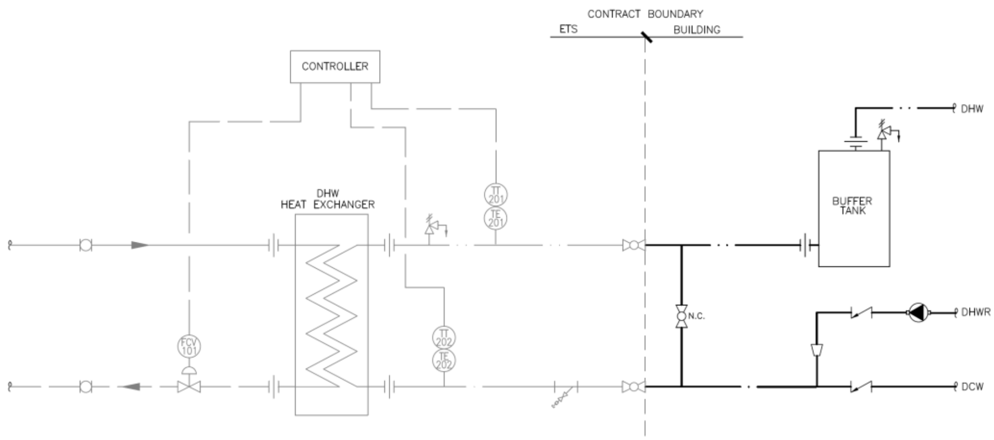

FIGURE 7: TYPICAL SEMI-INSTANTANEOUS DHW CONFIGURATION

Charging

A Charging DHW system can have a significantly reduced heat exchanger capacity compared to Instantaneous or Semi-Instantaneous, but requires the addition of charging pumps and ample storage volume to suit the DHW demands. Due to the presence of larger storage volumes and increased residence times, the risk of Legionella growth is higher than for the other configurations, and must be prevented appropriately. Additionally, Charging configurations require careful consideration of piping connections, charging flow rates, and DHW recirculation flow rates in order to return acceptable temperatures to the ETS. Charging configurations must meet the following requirements:

- Charging circulation connection on the storage tank(s) returning to the ETS shall be as low as possible on the tank(s).
- DCW make-up connection must connect to the charging piping returning to the ETS.
- DHW supply piping from the ETS shall connect to the storage tank(s) as high as possible.
- DHW supply to the building shall connect to the storage tank(s) as high as possible.
- DHW recirculation piping from the building shall connect either to the mid- or upper-

section of the storage tank(s)[6] or to the charging circulation piping returning to the ETS[7].

  - If connected to the charging circulation piping returning to the ETS, the charging pump capacity must be larger than the recirculation pumps from the building, or proper charging of the tank(s) will not be possible when both pumps are running simultaneously.

- Charging pumps shall be variable flow, and/or able to maintain a minimum constant flow to prevent temperature overshooting at the ETS.

- Charging pump flow rates shall be less than the peak DHW draw flow rate, and shall be sized to provide reasonable recovery time of the storage tank(s) to suit the application. Unreasonably high flow and recovery rates impacts the ETS heat exchanger capacity. ASHRAE HVAC Applications Handbook (2019), Chapter 51 provides guidance on recovery vs input rate for different applications.

Tanks and pumps must be selected and installed to meet the above requirements. While these items are checked during the DEU review of the building system, it is common for tanks to be supplied with incorrect connections during the construction phase of a project; therefore, Corix shall be provided with the proposed tank shop drawing and piping isometrics/spool drawings submittals for comment prior to purchase and delivery.

Refer to Figure 8 for a typical Charging system schematic.

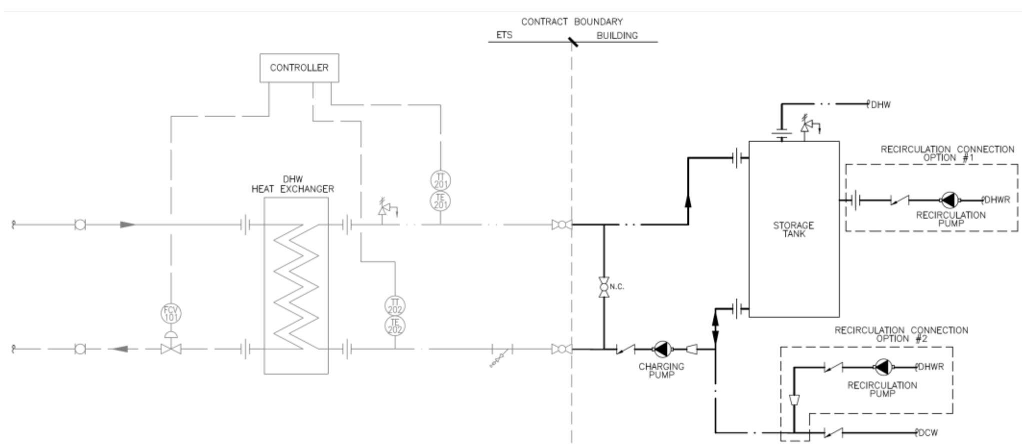

FIGURE 8: TYPICAL CHARGING DHW CONFIGURATION

[6] i.e., 4-pipe tank connection configuration

[7] i.e., 3-pipe tank connection configuration

6.4. Hydronic Cooling System Minimum Requirements

The CCDEU will provide heating and cooling where available (i.e. district heating and cooling); or heating only with discrete cooling when district cooling is not available. Regardless of the strategy adopted for the building, the cooling system shall be designed to provide all space cooling and ventilation air cooling requirements for the whole building, supplied from a central hydronic system connected to an ETS. Chillers, VRF systems, or simultaneous heating and cooling heat pump units are not permitted within the building's secondary system, except as described in Section 6.5.

Optimization of the hydronic cooling system return temperature is critical to the successful operation of the DEU. The ETS controls the supply water temperature to the hydronic circuit (i.e., the temperature of the water leaving the space cooling piping of the ETS) based on an outside air temperature reset schedule. This is the minimum temperature available to the building hydronic circuit.

Chilled water generated by the ETS shall be distributed via a 2-pipe system to the various cooling elements (terminal units) throughout the building. The building (secondary) cooling system must be designed for temperatures no lower than those specified in Table 6 below.

TABLE 6: HYDRONIC SPACE COOLING SYSTEM TEMPERATURES (BUILDING SIDE)

	Peak Summer	*Winter*
Supply Temperature, **Min.**	7.2°C	11°C
Return Temperature, **Min.**	15.6°C	19°C
Design Pressure	≤1600 kPa	≤1600 kPa

The specified temperatures shall be regarded as minimum requirements; higher temperatures are desirable. The building return temperatures shall be maximized to allow the DEU to take advantage of alternate energy technologies.

6.5. Supplemental Energy Sources in Customer Buildings

At the discretion of LIEC, some heating energy can be served by supplemental energy sources within the building. Solar heating systems are typically acceptable, as are other waste heat sources. Use of a supplemental energy source does not change the hydronic heating return water temperature requirements outlined in Section 6.3.

Gas-fired or electric-resistance heating or ventilation equipment (boilers, roof top units, air handling units, electric coils, electric baseboards, etc.), air or water source heat pumps to provide heating and/or cooling are not acceptable. Heat recovery chillers in the secondary system for a building provided with cooling from the CCDEU or DCP are not permitted; heat recovery will be implemented at the CEP or DCP as applicable. All thermal energy for space heating, cooling and

DHW shall be supplied by the DEU. Exceptions can be made for remote spaces within the building not practical to be serviced by the hydronic system, and/or electrical rooms, and are reviewed and approved by LIEC on a case-by-case basis.

The following exemptions to the supplemental heat sources restrictions are permitted:

- Electric baseboard heaters for freeze protection only, at stairwells, egress vestibules, electrical rooms, and isolated mechanical rooms only.
- Electrical heat tracing of piping in areas subject to freezing.
- Exterior heating (e.g. gas-fired radiators or fireplaces) where hydronic heating is impractical.
- Commercial exceptions for specific gas ranges and fireplaces, BBQs, outdoor heaters (IR).

Any supplemental heat sources must be reviewed and approved by LIEC. Any alternative and/or supplemental energy sources approved by LIEC and implemented by the Customer are the sole responsibility of the Customer.

Appendix A. Developer-Provided Requirements for District Energy Connection

Refer to following pages.

Developer Requirements for Connecting to District Energy

District Heating Only

Revision	Description	Revision Date (YYYY-MM-DD)
0	Original version	2023-07-28

1. PURPOSE

This document provides Developers with a detailed checklist of requirements for connecting to district energy. The intent of this document is to clarify and provide additional information to Schedule "E" – *Building Requirements for Energy Transfer Station* – to the City Centre District Energy Utility (CCDEU) and Oval Village District Energy Utility (OVDEU) Energy Services Agreement.

2. APPLICATION

This document applies to Developers connecting to **district heating only**.

3. WHO IS CORIX?

Corix Utilities Inc. (referred to as Corix in this document) is an affiliate of the City Centre Energy Limited Partnership (CCELP), which entered into a Project Agreement with the Lulu Island Energy Company Ltd. (LIEC), dated September 22, 2022, pursuant to which Corix and its affiliate will design, construct, finance, operate, and maintain a District Energy Utility (DEU) owned by LIEC to provide long-term, cost-competitive thermal energy to the residents and businesses of the service areas defined in the CCDEU and OVDEU Bylaws No. 9895 and 9134, respectively.

4. DEVELOPER DESIGN DOCUMENTS

The Developer will design the Building Mechanical System according to the latest version of the Design Guide for Connection to District Energy.

Prior to and as part of the Developer's building permit application process, Corix will conduct a review of the Building Mechanical System to verify that the Building Mechanical System:

- Is compatible with the District Energy Utility Infrastructure;
- Complies with the Design Guide for Connection to District Energy; and
- Meets the Building Requirements for Energy Transfer Station.

Prior to and as part of the Developer's building permit application process, the Developer will provide the following drawings, specifications, and documents listed in Table 4, in both PDF and CAD (where applicable) format.

Table 4. List of required design documents provided by the Developer to Corix.

ID	Description	Developer	Corix	Complete
4.1	Architectural plans and sections ☐ Provide gross floor area. ☐ Include plan and section views of the mechanical or DEU room. ☐ Indicate room dimensions and ceiling height of mechanical/DEU room. ☐ Provide dimensions for the access opening (typically double doors) to the mechanical/DEU room.	•		☐
4.2	Structural drawings	•		☐
4.3	Civil plan and profile drawings	•		☐
4.4	Mechanical drawings showing: ☐ Peak energy demand for space heating ☐ Peak energy demand for domestic hot water (DHW) ☐ Space heating supply and return temperatures to the Energy Transfer Station (ETS) at peak conditions ☐ DHW supply and return temperatures to the ETS at peak conditions ☐ Space heating supply temperature reset schedule ☐ Space heating flowrate through the ETS ☐ DHW flowrate through the ETS ☐ Building mechanical schematics ☐ Pipe sizes and material of piping connecting to the ETS ☐ Bypass lines on all building piping connections to the ETS to accommodate flushing and chemical cleaning of building piping ☐ Mechanical or DEU room location, indicating the ETS footprint and minimum clearance around and above the ETS ☐ Space heating loop design pressure ☐ Space heating loop pressure relief valve setting ☐ Domestic hot water loop design pressure ☐ Domestic hot water loop pressure relief valve setting ☐ Pump schedule for all pumps installed on lines connecting to the ETS. Include pump flow, head, starter type, and location. ☐ Mechanical equipment schedules of all equipment used for heating and cooling ☐ Building and DEU scope delineation at the isolation valves, on the ETS, separating the Building Mechanical System and the ETS	•		☐
4.5	Mechanical specifications	•		☐
4.6	Building energy modelling report ☐ Total heated floor area ☐ Peak energy demand for space heating ☐ Peak energy demand for domestic hot water ☐ Combined peak heat energy demand for any uses other than space heating and domestic hot water	•		☐

ID	Description	Developer	Corix	Complete
	☐ Annual heating energy consumption ☐ Hour by hour consumption of energy for space heating and domestic hot water heating			
4.7	Electrical drawings demonstrating Section 12 below	•		☐
4.8	Geotechnical report	•		☐
4.9	Arborist report	•		☐
4.10	Landscape drawings	•		☐

5. DEU COMPATIBILITY REVIEW

Corix will review the documents provided in Table 4 to verify that the Building Mechanical System is compatible with the DEU. Corix will proceed to conduct the compatibility review process outlined in Table 5.

Table 5. Description of the DEU compatibility review process.

ID	Description	Developer	Corix	Complete
5.1	Corix will produce an initial compatibility review memo. This initial memo will identify aspects of the Building Mechanical System design that do not meet DEU requirements, or that require more information, clarification, or coordination.		•	☐
5.2	The Developer will address all comments in the initial compatibility review memo. Comments that require changes to Developer design drawings must be accompanied by an updated drawing.	•		☐
5.3	Once Corix determines that the Developer has satisfactorily addressed all comments and incorporated the required design changes, Corix will issue a final compatibility review memo confirming that the Developer's Building Mechanical System conforms to DEU requirements.		•	☐

The compatibility review is completed as part of the Building Permit Application process and is also used to establish the Final Thermal Energy Delivery Parameters in Schedule "C" of the CCDEU or OVDEU Energy Services Agreement.

6. ON-SITE DISTRIBUTION PIPING SYSTEM (DPS)

District heating from the DEU's energy plant is delivered to buildings by means of a buried network of pre-insulated piping, known as a Distribution Piping System (DPS). To connect a new development to the DEU, Corix designs and constructs new buried DPS extensions from the existing DPS network to the exterior wall of the building. The DPS extension consists of two pre-insulated pipes – one for supply and one for return. Corix will also install two 53-mm PVC communication conduits in the same trench as the DPS pipes.

A portion of the DPS will be constructed **within** the Developer's Property Line, and this segment of DPS is referred to as On-Site DPS.

Table 6. Design coordination for On-Site DPS on the Developer's Property.

ID	Description	Developer	Corix	Complete
6.1	The Developer will coordinate with Corix to determine the on-site DPS alignment.	•		☐
6.2	The Developer will provide a site topographical survey to allow Corix to develop its civil base plan. If possible, provide a survey point file.	•		☐

7. EXTERIOR WALL DPS PENETRATION

Once the buried pre-insulated pipes arrive at the exterior building wall, the pipes will penetrate the exterior building wall to enter the building. The DPS typically penetrates the building at the foundation or parkade wall.

Table 7. DPS penetration through the building exterior wall.

ID	Description	Developer	Corix	Complete
7.1	The Developer will coordinate with Corix to determine the building DPS penetration location and elevation. ☐ The exterior wall penetration shall be at the highest elevation possible due to the high water table in Richmond.	•		☐
7.2	The Developer will provide, at the penetration location for the DPS pipes, one of the following: ☐ A rectangular blockout encompassing both supply and return pipes; or ☐ Two round blockouts with a smooth interior surface; or ☐ Two concrete-encased pipe sleeves, whose sizes and specifications will be provided by Corix; or ☐ Two holes cored through the concrete wall, if the penetration location is not determined before the concrete wall has been poured and cured. The Developer must ensure that the interior surface of the cored holes is smooth.	•		☐
7.3	The Developer will provide, adjacent to the DPS penetration location, two additional pipe sleeves, round blockouts, or cored holes for two 53-mm PVC communications conduits.	•		☐
7.4	Corix will provide the Developer with the proposed exterior wall penetration detail for both the DPS pipes and the communication conduits.		•	☐
7.5	The Developer, its architect, and its building envelope consultant will review Corix's proposed exterior wall penetration detail to ensure that it is compatible with the foundation waterproofing design.	•		☐

ID	Description	Developer	Corix	Complete
7.6	The Developer will coordinate with Corix to finalize the exterior penetration detail, which will be incorporated into Corix's DPS drawings.	•	•	☐
7.7	The final penetration sizes will be coordinated with and confirmed by Corix prior to installation.	•	•	☐

8. DPS CONSTRUCTION

This section only applies to construction works within the Developer's site property line.

Table 8. Construction of DPS piping on the Developer's Property.

ID	Description	Developer	Corix	Complete
8.1	The Developer will coordinate with Corix on scheduling the DPS construction works.	•	•	☐
8.2	Corix will excavate the trench for the DPS pipes and communication conduits on the Developer's Property. If the Developer chooses to excavate the DPS trench instead, this can be coordinated with Corix prior to trenching.	•	•	☐
8.3	The Developer will complete the blockout or openings in the concrete wall, per items 7.2 and 7.6.	•		☐
8.4	Corix will verify that the blockout/holes are ready for pipe installation.		•	☐
8.5	Corix will install the pre-insulated pipes and communication conduits through the blockout or holes in accordance with the exterior wall penetration details agreed to under item 7.6. This includes a mechanical seal and grouting the blockout/holes.		•	☐
8.6	The Developer will install the foundation waterproofing around the pre-insulated pipes and communication conduits.	•		☐
8.7	After completing required tests and inspections on the installed DPS pipe, Corix will backfill over the pre-insulated pipes and communication conduits to achieve the minimum required cover. Corix will also compact the backfill as required by Corix's DPS design.		•	☐
8.8	The Developer will complete any remaining backfill to finished grade, including surface finishing according to the Developer's civil and landscaping design.	•		☐

9. INTERIOR DEU PIPING

Once inside the building, Corix will install isolation valves onto the DEU pipes. From there, Corix will install insulated steel piping from the DPS penetration point to the mechanical/DEU room. This run of insulated steel piping is referred to as interior DEU piping.

A communications pull box (12” L x 12” H x 4” D min.) will be installed directly over the conduit penetration point. Corix will install 27-mm (1”) EMT conduits and junction boxes to run optic fibre cable from the DPS penetration point to the mechanical/DEU room. The communications conduit route will run adjacent to the interior DEU piping route.

Table 9. Interior DEU piping requirements.

ID	Description	Developer	Corix	Complete
9.1	The Developer will coordinate with Corix to determine the interior DEU piping route. The Developer is responsible for ensuring that the chosen interior DEU piping route will maintain sufficient headroom and clearances as required by relevant codes and standards.	•		☐
9.2	The Developer will provide and maintain access to isolation valves and communications pull box. The Developer will also ensure that the isolation valves and communications pull box are mechanically protected from vehicles, using high visibility bollards or steel cages, for example.	•		☐
9.3	If penetrations through interior walls or floor slabs are required, the Developer will coordinate with Corix on such penetration details.	•		☐
9.4	If penetrations through interior walls or floor slabs are required, the Developer will provide the required penetration openings according to the penetration detail, including pipe sleeves, if applicable, as agreed to under item 9.3. The Developer will also be responsible for concrete scanning. Corix will not core openings into any building interior walls or floor slabs.	•		☐
9.5	Corix will install the interior DEU pipes through the wall or floor penetration. Corix will insulate the interior DEU pipes after all pipe testing and inspections are complete.		•	☐
9.6	The Developer will seal the penetration opening in the wall or floor according to the penetration details.	•		☐

10. MECHANICAL/DEU ROOM REQUIREMENTS

The Developer will provide a location within the building – usually a mechanical room or standalone DEU room – for the Energy Transfer Station (ETS). The location provided by the Developer will meet the following requirements listed in Table 10:

Table 10. Mechanical/DEU room requirements for the DEU Energy Transfer Station.

ID	Description	Developer	Corix	Complete
10.1	Provide a location to install an ETS skid with the following dimensions: **4,110 mm L x 1,750 mm W x 2,000 mm H**.	•		☐
10.2	Minimum **1,000 mm** of clearance on all sides of the ETS skid.	•		☐

ID	Description	Developer	Corix	Complete
10.3	Minimum **1,000 mm** of clearance in front of the electrical panel installed on the ETS skid.	•		☐
10.4	Minimum **610 mm** of clearance above the ETS skid.	•		☐
10.5	Minimum room or access opening of **1,800 mm W x 2,032 mm H**.	•		☐
10.6	Clear path of **1,800 mm W x 2,032 mm H** to the mechanical or DEU room to deliver the ETS to its final location. This path must be maintained after the building has been constructed to allow future removal of the ETS skid, if required.	•		☐
10.7	A floor drain within **1,000 mm** of the ETS location, in the same room. There will be no floor drains underneath the ETS skid.	•		☐
10.8	One **19-mm (3/4")** water service connection (hose bib) inside of mechanical room for initial filling of the ETS and operational system make-up on ETS when required.	•		☐
10.9	Mechanical/DEU room shall be ventilated as required by Code and heated during the winter to a minimum of **15°C** and cooled during the summer to a maximum of **35 °C**.	•		☐
10.10	Housekeeping pads are not typically required because all the ETS equipment is skid-mounted. A housekeeping pad may be required if the floor slope is too great, and this will be coordinated with the Developer and Corix prior to ETS installation.	•		☐

11. ETS PIPING CONNECTIONS

After Corix has delivered and installed the ETS on the Developer's site, the Developer may install piping to connect the Building Mechanical System to the ETS according to the requirements listed in Table 11.

Table 11. Requirements for building mechanical piping connections to the ETS.

ID	Description	Developer	Corix	Complete
11.1	Piping connections to the ETS skid are typically at the top of the ETS skid.	•		☐
11.2	All piping connections to the ETS skid will be flanged connections. The Developer will supply all gaskets, bolts, nuts, and all other hardware to ensure leak-tight connections.	•		☐
11.3	Piping flange connections to the DHW side of the ETS must utilize flange isolation kits that include a dielectric gasket, dielectric bolt isolation sleeves, dielectric isolation washers, and metallic washers. This is to prevent galvanic corrosion across dissimilar pipe materials.	•		☐

ID	Description	Developer	Corix	Complete
11.4	Bypass lines must be installed immediately before all piping connections to the ETS to accommodate flushing and chemical cleaning of building piping. Flushing and chemical cleaning is not permitted through the ETS and must be completed prior to commissioning the ETS with the ETS valves remaining closed.	•		☐

12. ELECTRICAL REQUIREMENTS

The Developer will provide the following electrical items listed in Table 12.

Table 12. Requirements for building electrical connections for the ETS.

ID	Description	Developer	Corix	Complete
12.1	One dedicated **15 A, 120 V, 60 Hz, single-phase** electrical service, c/w **wall-mounted lockable disconnect switch**. The Developer will terminate the electrical service onto the **line side** of the disconnect switch. Do not mount the disconnect switch to the ETS skid.	•		☐
12.2	Corix will install electrical wiring from the **load side** of the disconnect switch to the ETS control panel.		•	☐
12.3	The Developer will coordinate with Corix to determine a suitable location for the Outside Air Temperature (OAT) sensor: ☐ On an exterior North-facing wall in a serviceable location accessible by foot or by step ladder; ☐ Located in a location with good airflow and out of direct sunlight for the majority of the day; ☐ At a height of 6' above finished grade; and ☐ The location must be clear of foliage, exhaust from vents, equipment and vehicles, heat sources, and remain outside of landscape irrigation zones. ☐ Avoid mounting to chimney walls, above windows, above vents, near doors, or near dampers.	•	•	☐
12.4	One dedicated 20-mm (3/4") EMT conduit (c/w pull string and #18 AWG TP Stranded 600V cable) from the mechanical/DEU room to the OAT sensor location.	•		☐
12.5	In the mechanical/DEU room, connect the EMT conduit to a junction box (supplied by Developer) and leave enough slack wire to allow Corix to terminate the OAT sensor wire into the ETS control panel.	•		☐
12.6	At the OAT sensor location: ☐ Extend the conduit beyond the finished face of the exterior wall.	•		☐

ID	Description	Developer	Corix	Complete
	☐ Reduce conduit size to **16 mm (1/2")** to allow direct installation of the OAT sensor. ☐ The Developer is responsible for penetrating the conduit through the exterior wall. ☐ Coordinate with Corix prior to installation.			
12.7	Corix will supply and install the OAT sensor on the outside wall of the building.		•	☐
12.8	Corix will terminate the OAT sensor wires into the ETS control panel in the mechanical/DEU room.		•	☐
12.9	The Developer will complete the building exterior finishing around the OAT sensor and ensure that the OAT sensor is not damaged. Building finishes shall not interfere with the performance of the OAT sensor.	•		☐
12.10	Provide conduit and wire for either: ☐ Corix-supplied current switches installed on motor lead, or ☐ VFD contact confirming run status. Run the conduit and wire to a junction box and leave enough slack wire to allow Corix to terminate wires into the ETS control panel.	•		☐
12.11	Corix will supply and install current switches to monitor the statuses of the building pumps providing flow to the ETS skid.		•	☐
12.12	Corix will terminate the current switch or VFD control wiring into the ETS control.		•	☐

13. REQUIRED DOCUMENTS PRIOR TO ETS COMMISSIONING

The documents in Table 13 are required prior to ETS commissioning.

Table 13. List of required documents to be submitted to Corix prior to ETS commissioning.

ID	Description	Developer	Corix	Complete
13.1	Building piping flushing and cleaning reports from the building pipe flushing and cleaning vendor. Provide the completed City of Richmond Certificate of Chlorination with accompanying lab analysis results.	•		☐
13.2	Certification under seal from the building engineer in letter format confirming the building system has been designed, constructed and installed in full compliance with the specifications approved and agreed to in the Final Thermal Energy Deliver Parameters schedule.	•		☐
13.3	Signed and executed Schedule “C” (Final Thermal Energy Delivery Parameters) to the Energy Services Agreement between the Developer and Lulu Island Energy Company.	•		☐

14. BEFORE ETS COMMISSIONING

Table 14. List of required items prior to scheduling ETS commissioning.

ID	Description	Developer	Corix	Complete
14.1	Building space heating and DHW systems must be connected to the ETS and ready to receive heat from the DEU, including safety devices. If possible, the building will be able to draw space heating and DHW loads from the DEU. (This will allow more precise controls tuning of the ETS).	•		☐
14.2	Corix will conduct a pre-commissioning walkthrough to confirm that all Developer-required items are complete (Sections 6-13). The Developer will complete all required items before Corix schedules the commissioning date.	•		☐

15. ETS COMMISSIONING

Corix will schedule a date to commission the ETS once all pre-commissioning items are deemed complete. A copy of Corix's ETS commissioning procedure may be provided upon request. The following parties listed in Table 15 are required to be present during the commissioning of the ETS:

Table 15. List of required personnel to be present on site during ETS commissioning.

ID	Description	Developer	Corix	Complete
15.1	Corix Project Manager		•	☐
15.2	Corix Operations		•	☐
15.3	Corix Mechanical Contractor		•	☐
15.4	Corix Controls Contractor		•	☐
15.5	Building Mechanical Contractor	•		☐
15.6	Building Mechanical Controls Contractor	•		☐

16. AFTER ETS COMMISSIONING

After the ETS has been successfully commissioned, Corix will require the following items listed in Table 16.

Table 16. List of requirements after ETS commissioning has been completed.

ID	Description	Developer	Corix	Complete
16.1	Access to the Developer's building and mechanical/DEU room. Provide access fobs, keycards, and/or keys as required.	•		☐

ID	Description	Developer	Corix	Complete
16.2	Corix will conduct a second commissioning visit when the building is completed, and during the cold winter season, to fine tune the performance of the ETS.	•		☐

17. REFERENCE DOCUMENTS

- City Centre District Energy Utility Bylaw No. 9895 and Amendment Bylaws
- Oval Village District Energy Utility Bylaw No. 9134 and Amendment Bylaws
- City Centre District Energy Utility Energy Services Agreement
- Oval Village District Energy Utility Energy Services Agreement
- District Energy in Richmond Oval Village: A Design Guide for Connection to District Energy
- District Energy in Richmond City Centre: A Design Guide for Connection to District Energy

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