



# District Energy at UTown@UBC

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## *Design Guide for Compatibility with District Energy*

Version	Prepared	Approved	Date
Original	FVB Energy Inc	Orion Henderson (UBC)	April 30, 2013
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## Definitions

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BAS	Building Automation System
CEC	Central Energy Centre
DE	District Energy
DE-Connected	Buildings that are connected to DE immediately (prior to commissioning).
Delta T; $\Delta T$	Temperature Difference
DE-Ready	New buildings that are designed and constructed to be compatible with DE, but do not initially receive DE service. DE-Ready buildings become DE-Connected upon connection to the DEU.
DEU	District Energy Utility
DHW	Domestic Hot Water
DPS	Distribution Piping System
ETS	Energy Transfer Station
GHG	Greenhouse Gas
HVAC	Heating, Ventilation & Air-Conditioning
UBC	University of British Columbia

# 1 Document Purpose

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The University of British Columbia (UBC) is committed to sustainability using District Energy (DE) to serve space heating and the domestic hot water needs of buildings in UTown@UBC.

This document provides preliminary information to developers, building owners, engineers and architects to tailor their designs to DEU conditions, thereby optimizing the benefits of the District Energy Utility (DEU). Corix and UBC will work closely with the developers of new buildings and their Heating, Ventilation & Air-Conditioning (HVAC) engineers to ensure good design integration between buildings and the DEU.

The developer and developer's mechanical engineers must collaborate with UBC and Corix on the HVAC and plumbing design in accordance with this document prior to issuance of the Building Permit.

Version 1 changes,

- Acceptable return temperature is 45C (section 2.4 and 5.3.1)
- Additional guidance on developers responsibilities (section 4.1.1)
- Guidance on heat recovery from cooling (section 4.1.1.1) and guidance on use of on-site alternative energy systems (section 4.1.1.2)
- Guidance on semi instantaneous Domestic Hot Water system design (section 5.3.2)

## 2 Introduction to District Energy

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### 2.1 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 DEU interfaces indirectly via heat exchangers with the buildings' space heating and domestic hot water systems. No other heat sources are required.

The DEU will generally supply heat for all space heating and hot water demands in new buildings in UTown. The DEU may also connect existing buildings within UTown.

The DEU consists of three main systems:

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

### 2.2 Benefits of District Energy

#### ***Sustainability***

DE is the result of a cooperative effort between local communities and developers to provide heating for a community in an efficient and sustainable way, balancing factors such as cost, exposure to fuel price fluctuations, reliability, and local Greenhouse Gas (GHG) emissions. This ultimately benefits society as a whole.

#### ***Reducing Reliance on Fossil Fuels***

Over the past 50 years, many communities around the world have realized significant reductions in fossil fuel consumption as a result of district energy. This is achieved by supplementing or replacing fossil fuel with renewable sources, sometimes later in a DE system's development.

#### ***Stable Energy Costs***

The capability of DE to access alternate and renewable energy is a crucial advantage. The business-as-usual approach locks building owners into long-term dependency on fossil fuels and electricity for their heating. In contrast, fuel switching and the implementation of the latest, most efficient technologies are far simpler, more accessible and more cost effective for a DEU.

### ***Direct Advantages of DE Service to Developers & Building Owners***

1. Simplified building design & reduced building capital and operating cost (relative to stand-alone hydronic heating).
2. Buildings are free from fired heat sources and combustible fuels, and less water treatment chemicals are required.
3. More floor space is available due to the smaller footprint of the heating equipment, plus no boiler stacks will be required.
4. Eliminating heating equipment from the building eliminates risks associated with operating and maintaining that equipment.
5. The risks associated with delivering heat are transferred to the DEU, while the Owner benefits from the assured cost of reliable service from the DEU.
6. DE is more reliable than in-building or in-suite mechanical systems and is quieter, safer and more resilient.
7. Mechanical system service calls are less frequent with no boilers or heat pumps on site.
8. Electrical service can be downsized compared to electrical resistance heating.

## **2.3 Energy Sources for the DEU**

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

Alternate energy technologies with reduced environmental impact are targeted for the UTown DEU. Once a baseload alternate energy source is implemented, natural gas boilers will provide peak heating and reliable backup capacity to ensure full and uninterrupted service to customers.

## **2.4 Cost of District Energy**

Capital costs of DE are financed through rate recovery from customers. Upon commencement of service, charges are expected to be competitive with conventional heating costs. In the medium and longer term, DEU charges will be more stable and less sensitive to changes in electricity and natural gas prices.

As with conventional systems, the Developer / building owner is responsible for the in-building hydronic system.

See Section 4 on page 11 for more details on customer requirements.

## **Building Heating System Design Implications**

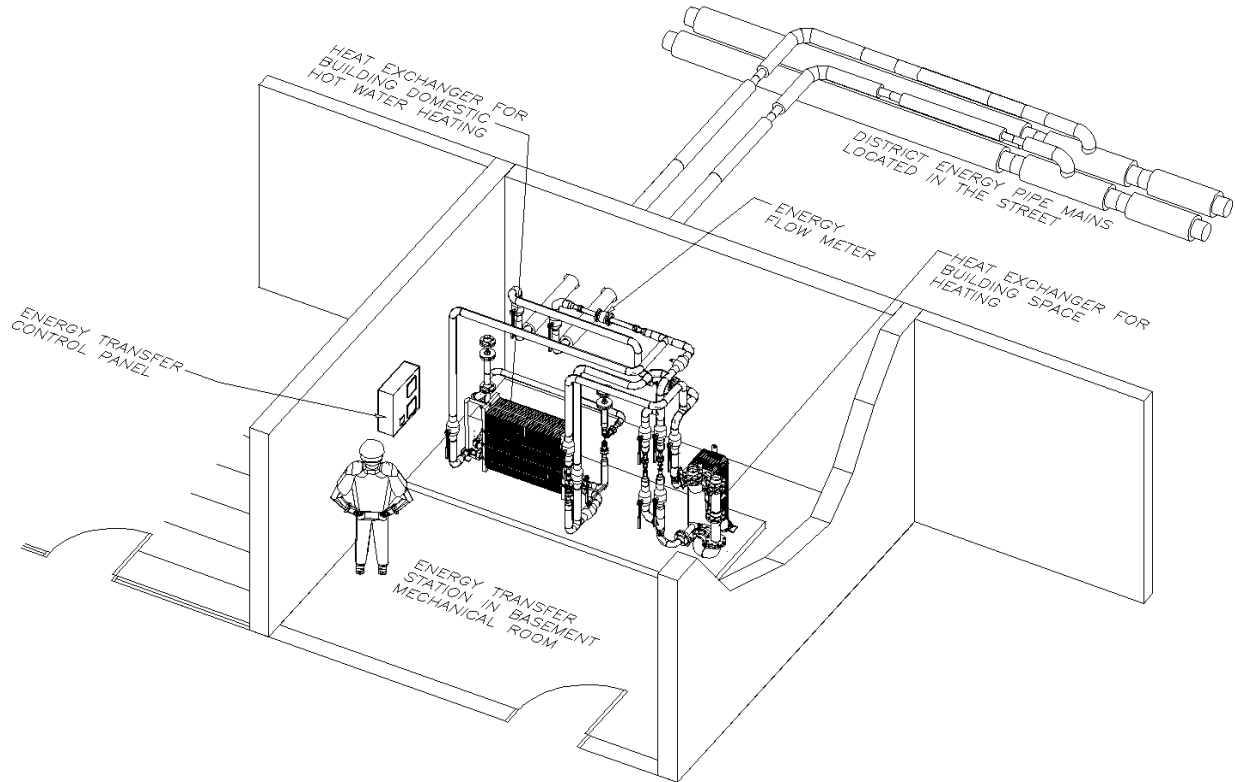
Developers are required to heat their buildings using hot water only, but have flexibility in designing the building internal heating systems in accordance with their preferences and specific requirements. The building hydronic space heating winter design temperatures cannot exceed 70°C supply and 45°C 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 UBC in designing their HVAC systems to derive the most benefit from the DES. See Section 5 on page 16 for more details.

### **2.5 Energy Transfer Station Space Requirements**

The DEU designs and installs 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), is owned and operated by the DEU and located inside the customer's building. ETS's are preferably located in the basement or parkade, and typically occupy approximately 20% of the space of a conventional boiler plant. The ETS can be located within the same mechanical room as the building heating and domestic hot water system equipment. See Figure 1 below as an example of a typical ETS located at an exterior wall near the DPS mains in the street. See Section 4 on page 11 for more details on mechanical room requirements.

The DEU distribution pipelines are buried in the roads throughout UTown. Branch lines from the DEU distribution pipelines connect to each building's ETS.

FIGURE 1: TYPICAL ETS INSTALLATION IN BUILDING BASEMENT



## 2.6 DE-Ready Buildings

Some buildings in UTown@UBC will not be immediately connected to the DEU, but must still be compatible with the system. These “DE-Ready” buildings require their own natural gas boilers to serve space heating and DHW requirements. DE-Ready buildings are designed such that they can readily connect to the DEU in the future, which includes compatibility of the HVAC and plumbing systems and provision for future installation of DE equipment and interface with the building mechanical systems.

## 3 DEU Description

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### 3.1 Central Energy Centre(s)

As with many other recent DE systems, the UTown DEU will be implemented in phases. An alternative energy source is expected to be introduced when justified by system development. This alternative energy source will serve base load requirements of the system and likely deliver the majority of the annual heating energy. Natural gas boilers will continue to provide peak heating and reliable backup capacity to ensure full and uninterrupted service to customers.

Production equipment and controls will be state-of-the-art, based on the best of today's commercially proven technology. Alternative energy conversion 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 power.

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 found in standalone heating systems in individual homes or commercial and multi-use residential buildings.

### 3.2 Thermal Distribution Piping System

The DEU involves a closed loop two-pipe hot water distribution network: the same water is heated in the CEC, distributed to the buildings, through the ETS, and returned back to the CEC 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 composed of an all-welded, pre-insulated direct bury piping system in UTown streets. The DPS is designed based on the size and location of customer buildings and CEC's. Distribution network modelling 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 CEC control flow through the DPS 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 65°C, such that it can always serve all domestic hot water (DHW) loads directly<sup>1</sup>.

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<sup>1</sup> I.e. without requiring other heat sources to elevate the temperature to meet the requirements of the building.



Achieving a large temperature difference (delta T;  $\Delta T$ ) between DEU 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 a function of the HVAC systems in customer buildings; hence, it is crucial for the utility to ensure that buildings connected to the system meet performance requirements.

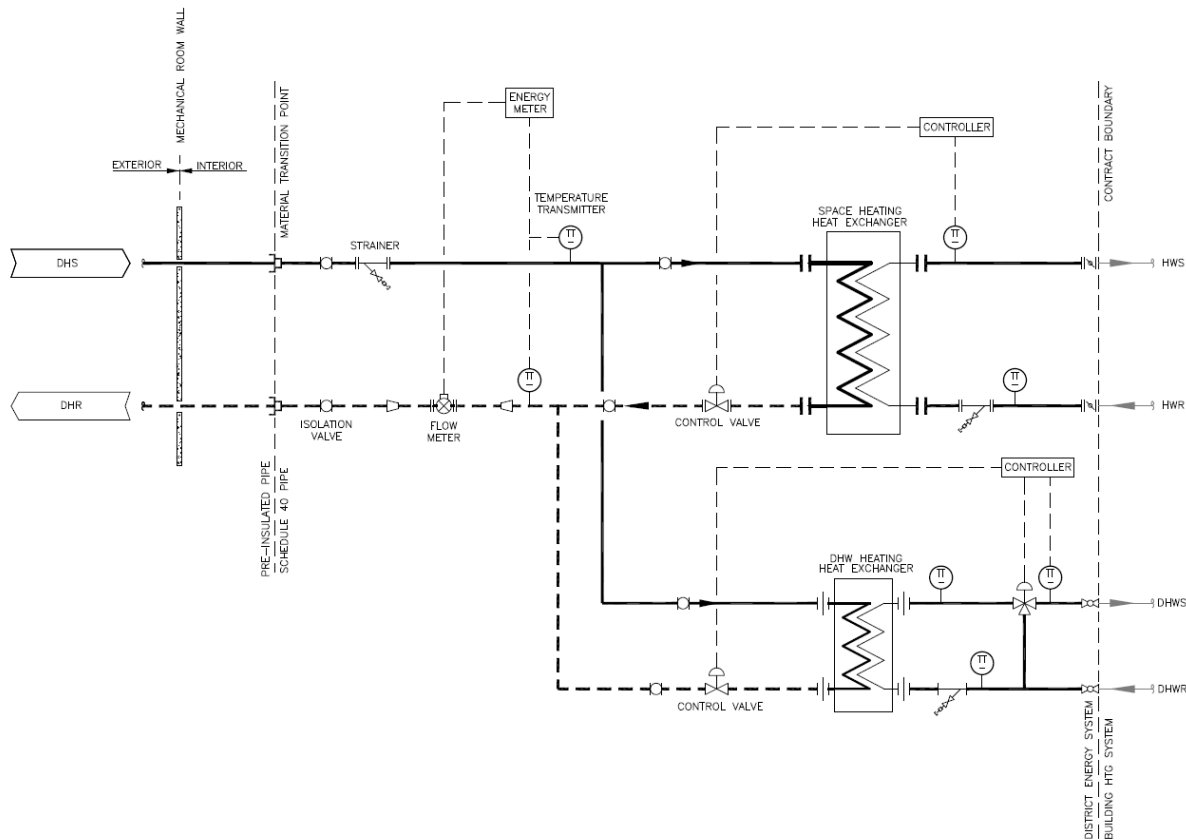
### **3.3 Energy Transfer Stations**

Each DE-Connected building houses an ETS 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);
- Heat exchangers to transfer heat to the building's hydronic heating 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.

ETS's generally have two heat exchangers: one for space heating, and a second to directly serve DHW. As shown in Figure 2 on page 10, flow through the primary (DE) side of the ETS is controlled to achieve the building's supply temperature set point.

FIGURE 2: TYPICAL ETS FLOW SCHEMATIC



### 3.3.1 Thermal Energy Metering

Thermal energy metering is an important component of the ETS. Thermal energy meters consist of high quality and accurate components that meet current Canadian and international thermal energy metering standards: 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.

## 3.4 DE-Ready Buildings

DE-Ready buildings are not connected to the DEU. 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 using natural gas boilers. This equipment is the sole responsibility of the building. UBC will provide guidance and support to ensure that DE-Ready buildings meet all DE compatibility requirements.

## 4 Division of Responsibility

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The following section outlines the responsibilities of the Developer and the District Energy utility to ensure efficient and seamless integration of the DEU into the customer building, and to ensure full compatibility for DE-Ready buildings.

### 4.1 Developer's Responsibility

#### 4.1.1 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<sup>2</sup>:

- 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.
- All building heating requirements are to be supplied by DEU. Exceptions will be reviewed on a case-by-case basis.

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

- DE-Connected buildings host branch (service) lines from the DPS. The DEU branch lines enter the building, similar to other utilities, and transfer heat to the ETS.
- The building owner and DEU agree on a suitable location for the ETS. The ETS invariably requires less space than comparable heat production equipment (e.g. boilers) that the ETS displaces. To reduce DEU piping inside the building, the ETS should be located as close as possible to the DEU branch pipeline entering the building – generally

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<sup>2</sup> DE-Ready buildings will require this equipment to serve space and DHW heating requirements. However, heat pumps are not permitted in DE-Ready buildings.

on an exterior wall in the basement of the building, nearest to the main district energy pipe.

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

Section 5 on page 16 discusses specific requirements of the hydronic space heating and DHW systems for compatibility with hot water district heating.

The DEU reviews the HVAC and plumbing design of each building, but is not responsible for the design (which is executed by the builder). The DEU may make suggestions as necessary to ensure appropriate integration with the DEU.

#### **4.1.1.1 Use of Heat Recovery from Cooling**

Developers that plan to employ cooling systems within 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 NDES; 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.

#### **4.1.1.2 Use of Other On-Site Alternative Energy Systems**

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
- Geexchange systems.

#### **4.1.2 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 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. A typical example is shown in Figure 2 on page 10.

DE-Ready buildings are responsible for all equipment within their building, including boilers for space heating and DHW; there is no DE demarcation point. Delineation from the DEU will be determined at time of connection to DE. DE-Ready buildings must provide full-size tees and isolation valves for future connection of the hydronic heating and DHW system to an ETS.

#### **4.1.3 Preparation of Building for DE Service**

All customers (including both DE-Connected and DE-Ready buildings) 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. The ETS should generally be located at an exterior wall facing the street, in the first underground level (parkade).

The ETS room shall be ventilated and maintained at a temperature between 10°C and 35°C. A floor drain connected to the sanitary sewer system should be provided in the ETS room, as well as a domestic water source. A dedicated 15A 120V electrical service, with a lockable breaker, is required to power the ETS control panel. Allowance should be made in the Building Automation System (BAS), if applicable, to provide heating pump on/off status to the ETS control panel. If a BAS is not planned for the building then the DEU will directly monitor the heating pump on/off status via a hardwire connection. As well, one 20mm electrical metallic tubing (EMT) conduit from the ETS room to a north facing exterior wall is required for the outdoor air temperature sensor wiring.

The footprint of an ETS 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. Generally, a typical ETS requires between 4 and 10 m<sup>2</sup> of floor space, with a minimum ceiling height of 2.7 m. The customer should provide a concrete housekeeping pad of the required size, on which the ETS heat exchangers are installed.

The customer is responsible for the DE service line building or foundation penetration, which meets the requirements of the DEU (size of opening, etc.) The exact location of the penetration will be agreed upon by the customer and DEU. The DEU will produce a penetration drawing during the detailed design stage. DE-Connected building penetrations may be core drilled (after foundation construction) or sleeved (during foundation construction). DE-Ready buildings will have cored penetrations installed at the time of DE connection. The DE utility installs the service line and seals the opening.

The DEU may also install one or more plastic (PVC or PE) conduits into the customer building to facilitate remote communication with the ETS. Communication allows for remote controls and monitoring of the ETS, as well as remote reading of the energy meter. The customer is also responsible for providing and maintaining the penetration for communication conduit(s).

The DEU will require uninterrupted access to the ETS and service line within a customer's building for installation, regular maintenance and repairs. This may be defined by an easement with UBC or a service contract directly with the DEU.

#### **4.1.4 Hydronic Heating Water Quality & Expansion**

Building owners are responsible for filling and managing their own building hot water heating system. The DEU requires that 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 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 start-up 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.

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

Building owners will manage the expansion of the water in their own hot water system(s).

#### **4.1.5 Commissioning**

Prior to commissioning of the ETS, the building owner shall flush and clean the building's internal hot water system. During commissioning, the building operator is responsible for the building's internal hot water system.

#### **4.1.6 Changes to the Building System**

The Customer shall not materially change the design or substitute any pertinent equipment during the installation without approval from the DEU. After commissioning, any changes to the

building's hydronic or DHW system that may impact DEU performance shall be reported to the DEU.

#### **4.1.7 DE-Ready Buildings**

DE-Ready buildings are responsible for design, installation, commissioning, operation, and maintenance of all systems within their building, including all boilers. The DEU has no responsibilities within DE-Ready buildings.

## **4.2 DEU Responsibility**

### **4.2.1 DEU Equipment within DE-Connected Buildings**

The DEU designs, installs, operates and maintains the ETS at the agreed-upon location. The DEU installs and maintains the primary (DE) distribution pipes up to the ETS. Branch pre-insulated pipelines are generally direct buried from the mainline to the building penetration. From that point, DE piping runs inside the building to the ETS.

The DEU provides strainers on the DE and building side at each heat exchanger, which are cleaned as necessary. The DEU services the energy metering equipment and verifies accuracy at regular intervals per manufacturers' recommendations.

The DEU provides temperature transmitters, pressure gauges, temperature gauges, thermowells, control valves, energy meters, and a control panels for the ETS. Temperature transmitters for the secondary side of the heat exchangers are also provided to facilitate monitoring and control of the building side heating and DHW systems.

### **4.2.2 Make-up Water - District Energy Side**

The DEU provides the make-up water requirements for the DE system side. All necessary water treatment is accomplished at the CEC.

### **4.2.3 Commissioning**

The DEU personnel, together with the building operator, commission the ETS. This includes flushing of the distribution system until clean as judged by DEU's water treatment contractor and start-up of control equipment.

## 5 Requirements for Building Heating Systems

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This section summarizes technical requirements for hydronic space heating and domestic hot water systems for new developments at UTown. This section applies to both DE-Connected and DE-Ready buildings. 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 DEU will provide technical assistance to developers to improve integration of the customer building with the DEU. Heating system schematics, layouts, equipment schedules and sequence of operation or control strategies are required to assist in the DEU review process.

### 5.1 Design Strategies

The following table identifies the key elements or strategies that should be followed when designing the building heating system.

Strategy	Reason
Centralized hydronic system	<ul style="list-style-type: none"><li>• Water has four times the specific heating capacity of air.</li><li>• Benefits from system load diversification.</li><li>• Reduces utility interconnect costs.</li><li>• Minimizes structural borne noise.</li></ul>
Low <sup>3</sup> supply temperatures	<ul style="list-style-type: none"><li>• Allows use of more energy efficient options to be employed.</li><li>• Allows use of lower grade energy sources.</li></ul>
Large temperature differentials	<ul style="list-style-type: none"><li>• Reduce piping capital cost.</li><li>• Reduce pumping capital &amp; operating costs.</li></ul>
Variable flow with variable frequency drives	<ul style="list-style-type: none"><li>• Reduces pumping operating costs.</li><li>• Improves system control.</li></ul>

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<sup>3</sup> "Low" relative to traditional building HVAC design, which is typically >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.



Two-way control valves	<ul style="list-style-type: none"> <li>• Necessary to achieve variable flow and a large temperature differential.</li> </ul>
Seasonal reset of supply temperatures	<ul style="list-style-type: none"> <li>• Improves energy efficiency.</li> <li>• Improves system control.</li> </ul>
Return temperature limiting	<ul style="list-style-type: none"> <li>• Improves energy efficiency.</li> </ul>
Direct Digital Control System	<ul style="list-style-type: none"> <li>• Allows more accurate control and greater control flexibility.</li> <li>• Potential opportunities for energy savings.</li> </ul>
Night setback settings & recovery times	<ul style="list-style-type: none"> <li>• Minimize equipment sizes by allowing reasonable recovery times.</li> <li>• Maximize recovery times from unoccupied to occupied mode.</li> </ul>

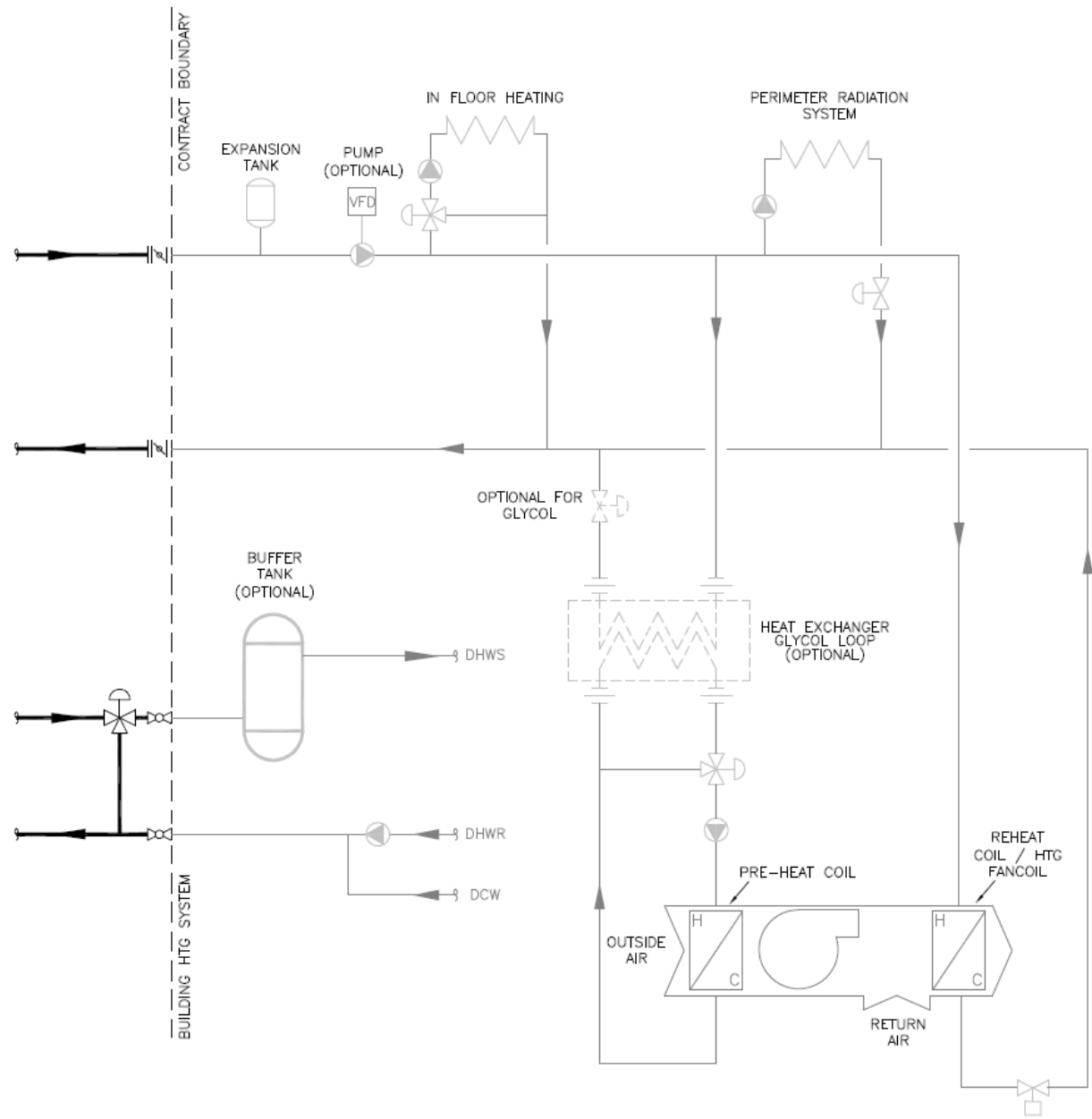
## 5.2 Pumping and Control Strategy

The building hydronic heating system shall be designed to maximize  $\Delta T$  and minimize hot water return temperatures over all conditions.

The building heating system should 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 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. See Figure 3 below for typical hydronic heating system configurations.

DE-Ready buildings may employ a primary-secondary system with a lower  $\Delta T$  (i.e. higher flow rate) and constant-speed pumps on the boiler loop. Any primary boiler loop will be abandoned when the building is connected to the DEU; the ETS will be connected directly to the hydronic secondary loop.

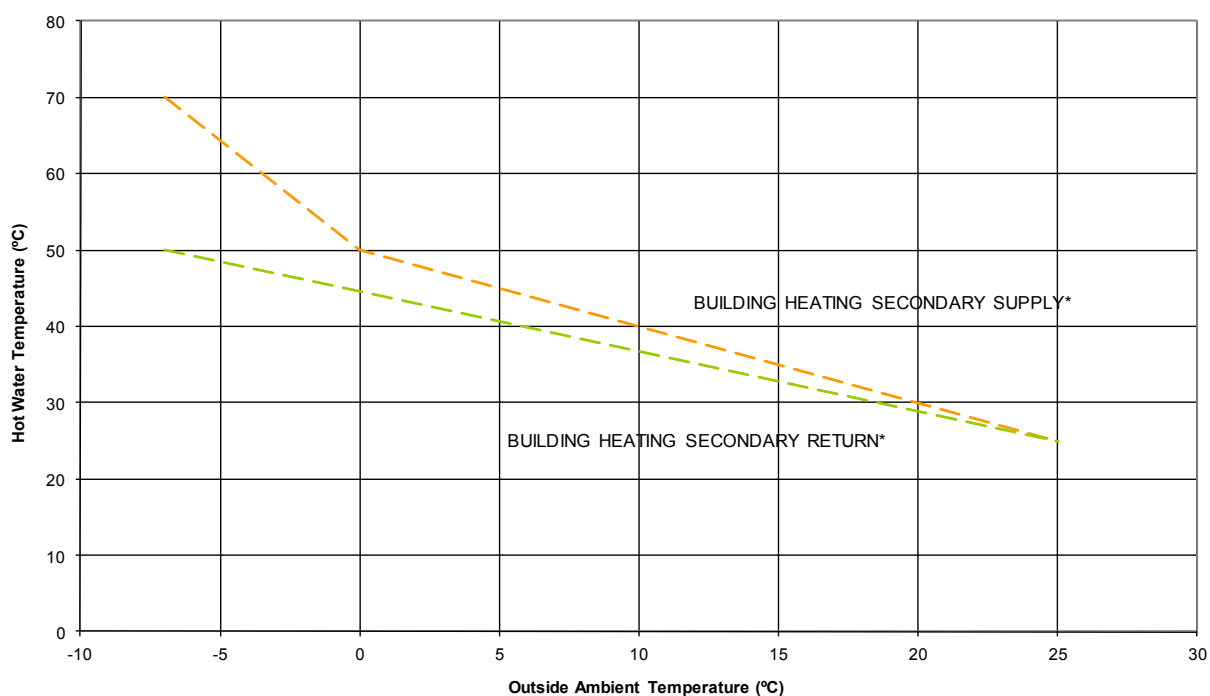
FIGURE 3: TYPICAL BUILDING HEATING SYSTEMS



## 5.3 Hydronic Space Heating and Domestic Hot Water Systems (Minimum Requirements)

Optimization of the hydronic heating system temperature difference or  $\Delta T$  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 heat exchanger) 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 4 below.

FIGURE 4: TYPICAL TEMPERATURE RESET CURVE FOR VANCOUVER



\* - Space heating only, direct primary DHW heating with Max. 60°C DHWS.

### 5.3.1 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 (or boilers, for DE-Ready buildings). Gas fired ventilation equipment (roof top units, air handling units, etc.) and electric baseboards are not permitted.

Hot water generated by the ETS (or boiler for DE-Ready buildings) 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 below.

<b>Hydronic Space Heating System Temperatures (Building Side)</b>		
	<i>Peak Winter</i>	<i>Summer</i>
Supply Temperature, <b>Max.</b>	70°C (160°F)	45°C (113°F)
Return Temperature, <b>Max.</b>	45°C (113°F)	40°C (105°F)
Min. Difference ( $\Delta T$ )	20°C (40°F)	5°C (10°F)
Design Pressure	≤1600 kPa	≤1600 kPa
<b>Domestic Hot Water Heating System Temperatures (Building Side)</b>		
	<i>Winter</i>	<i>Summer</i>
Supply Temperature (with storage), <b>Max.</b>	60°C (140°F)	60°C (140°F)
Supply Temperature (no storage), <b>Max.</b>	55°C (130°F)	55°C (130°F)

The specified differential temperature ( $\Delta T$ ) shall be regarded as a minimum requirement, and larger  $\Delta T$  and/or lower return temperatures are desirable. The building return temperatures must be kept to a minimum to allow the DEU to take advantage of alternate 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. The table below outlines maximum hot water supply (HWS) and hot water return (HWR) temperatures for which terminal units should be designed and selected.

<b>Type of Terminal Unit</b>	<b>Maximum HWS</b>	<b>Maximum HWR</b>
Radiant in-floor heating	50°C (120°F)	38°C (100°F)
Perimeter radiation system	70°C (160°F)	45°C (113°F)
Fan coil units & reheat coils <sup>4</sup>	70°C (160°F)	45°C (113°F)
Air handling pre-heat coils	65°C (150°F)	45°C (113°F)

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<sup>4</sup> If unit heaters or forced flow heaters are considered, these should follow the fan coil design recommendations.

### 5.3.2 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 in the building. The DE utility understands that DHW systems generally must operate at 60°C (140°F) and the utility is able to supply this temperature to all buildings at all times.

DHW systems should be designed in a semi-instantaneous configuration. All domestic cold water (DCW) should enter the DHW system immediately before the ETS heat exchanger. Reducing storage capacity and recirculation requirements results in space and cost savings. Capital costs for the system are lower, maintenance requirements are reduced, and replacement costs when equipment reaches end of life are lower. With less storage capacity, the DHW has shorter residence time in the building, reducing the chance of bacteria growth such as Legionella.

In a semi-instantaneous system, the storage capacity is small. In such a system, storage tanks act as “buffer tanks” only; and there is no recirculation from DHW storage tanks directly back to the heat exchanger. This configuration requires 60°C (140°F) supply temperature.

DE-Ready buildings may employ alternate DHW configurations, as long as it is served from the same mechanical room as the space heating boilers (i.e. the future ETS room). However, provision shall be made for semi-instantaneous DHW service by the DE heat exchangers when the building is connected to the DEU. This includes providing full-size tees and isolation valves for future connection to the DE heat exchanger in a semi-instantaneous configuration.

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