355 West Queens Road
North Vancouver, BC V7N 4N5
604-990-2311 DNV.org

Technical Criteria for District Energy Ready Buildings

Master Requirement ENG 108

Building Department: 604-990-2480, building@dnv.org

Purpose

The purpose of this document is to provide details of the mechanical systems and other design requirements for buildings that are required to install hydronic systems for connection to a future district energy system (DES).

For buildings that must be "DE Ready" or where hydronic building heating systems are otherwise required, developers and their design team are required to review this document and ensure that appropriate provisions have been made in the building heating, ventilation, and air conditioning (HVAC) system and domestic hot water (DHW) system to allow the building to take advantage of the benefits of a future DES.

Developers should be aware that, through the development process, covenants may be required to secure future connection to the DES.

Background

The District of North Vancouver's Official Community Plan (OCP) states that: mechanical systems should be designed to enable interconnection to future district energy systems in those areas identified by the District as having potential for such systems[1].

To this end, larger new developments undergoing rezoning and located in the major town and village centres (Lions Gate, Lynn Creek, Lynn Valley, and Maplewood) are required to have hydronic heating and domestic hot water systems that are designed to be compatible with district energy.

This guide is provided to assist developers in designing their buildings with hydronic systems that are compatible with future district energy systems or other low-carbon alternative energy sources.

List of Abbreviations

BAS	Building Automation System
DES	District Energy System
DHW	Domestic Hot Water
DPS	Distribution Piping System
ETS	Energy Transfer Station
EMT	Electrical Metallic Tubing
HVAC	Heating, Ventilation, and Air Conditioning
HWS	Heating water supply
OAT	Outdoor air temperature
OCP	Official Community Plan (of the District of North Vancouver)
PMT	Pad Mounted Transformer
VRF	Variable Refrigerant Flow

[1] Guideline 8, page 273, Part 6, Schedule B of the Official Community Plan.

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District Energy Overview

What is a District Energy System?

A DES is a thermal energy distribution system that provides heating energy (and in some cases cooling energy) to connected customer buildings. The customer buildings use this thermal energy for space heating, domestic hot water heating, and (in some cases) space cooling.

A DES includes three main components:

Energy Centre – The thermal energy generation plant that produces thermal energy from renewable and/or traditional energy sources. Renewable sources may include effluent heat recovery, geoexchange, biofuels, or other heat recovery sources. Traditional energy sources typically consist of natural gas boilers.

Distribution Piping System (DPS) – A buried piping system in the street and on the customer property that carries the thermal energy to the customer building in the form of hot, warm, or cool water.

Energy Transfer Station (ETS) – A mechanical system that transfers energy between the DES and the customer building's space heating, space cooling, and/or DHW heating systems. The ETS equipment may include heat pumps, pumps, heat exchangers, controls, energy meters, and related mechanical assemblies. An ETS typically includes separate connections for the building's HVAC and DHW systems to maintain separation of potable and non-potable water and to maintain lower (more efficient) return temperatures from space heating loads. The final design of the ETS will be dependent on the building loads and the design parameters of the future DES.

"DE-Ready" Buildings

The objective of this guide is to provide builders the information they need so as to design their buildings to be ready to connect to a future DES when it becomes available. In preparation for future connection, DE Ready buildings are required to:

- Have mechanical designs that are compatible with the future DES as per the requirements of Section "DE Ready Building Technical Requirements" of this guide.
- Be designed to receive all thermal energy (other than on-site recovered waste heat) from the DES as per Section "DE Ready Building Technical Requirements" of this guide
- Provide a suitable space for future installation of the ETS equipment by the DES Utility operator as per the requirements of Section "Energy Transfer Station Requirements" of this guide.

Disclaimer: *The following sections provide technical requirements for the design of DES-compatible mechanical systems for space heating, cooling, and DHW. The design information provided in this guide should be regarded as general guidance only and used for the purposes of facilitating future connection to a DES, improving energy efficiency, and enhancing system performance. All design guidance in this document should be applied (where applicable) to the detailed building mechanical design by the engineering team. The developer's mechanical engineer shall be responsible for ensuring the final building HVAC and DHW distribution system designs are in compliance with all applicable aspects of the BC Building Code, ASHRAE standards, and good engineering practice.*

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DE Ready Building Technical Requirements

This section provides the technical requirements and design guidelines for the HVAC and DHW systems that must be provided to be compatible with a future DES. Details of the ETS room that must be provided by the builder are also provided. These requirements must be applied to both new construction and retrofit projects.

These requirements must also be applied to any future tenant improvement work that may occur in a "DE ready" building. Design and construction of the base building must make necessary provisions to ensure that future tenant improvement work can be done in compliance with this guide.

Space Heating System Design Requirements

***General Requirement #1*: Buildings must utilize a low-temperature hydronic HVAC system to meet all space heating and make up air heating loads in the building.**

> *Exception 1.1: Exceptions may be permitted on a case-by-case basis for use of electric resistance heaters in certain spaces where hydronic heating is not feasible[2] AND the expected energy use of all electric resistance heating is less than 2% of the building's annual space heating load as confirmed by a detailed energy model.*
>
> *Exception 1.2: Packaged mini-split air-source heat pump systems may be used in certain spaces when:*
>
> *(1) A hydronic cooling system is not required for the building, and*
> *(2) The space is an electrical room, communications room, or other small space requiring mechanical cooling and that has a larger annual cooling load than heating load.*

Efficient operation of the DES requires that high-efficiency, hydronic building HVAC systems are used to provide space heating and make up air heating. All space and make up air heating systems shall be designed to operate with low-temperature heating water with a maximum supply temperature of 49°C (120°F). Return water temperatures should be minimized and shall be limited to 38°C (100°F) or less at the winter heating design condition. These design temperatures are selected to substantially increase the efficiency of the future DES without being excessively restrictive on the selection of heating equipment.

Hydronic heating systems shall be designed to operate with reduced heating water supply temperatures during milder weather based on an outdoor air temperature (OAT) reset control strategy as shown in Figure 1 below. This reset curve shows the maximum allowable heating water supply (HWS) temperature relative to OAT.

Under this reset strategy, the HWS will be at design temperature (49°C) when OAT is below 0°C. As OAT rises from 0°C to 15°C, HWS temperature is reset down from 49°C to 30°C. Above 15°C, HWS temperature is maintained at 30°C.

HVAC designs that accommodate a more aggressive reset strategy with lower HWS temperatures are encouraged.

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[2] Permissible spaces for electric baseboard heaters include elevator machine rooms, electrical rooms, emergency generator rooms, or similar spaces where hydronic piping is prohibited or should be avoided. Rooms that are remotely located from the building hydronic system and where a small amount of heat is required for freeze protection purposes only, may be permitted to use electric heat at the discretion of the District.

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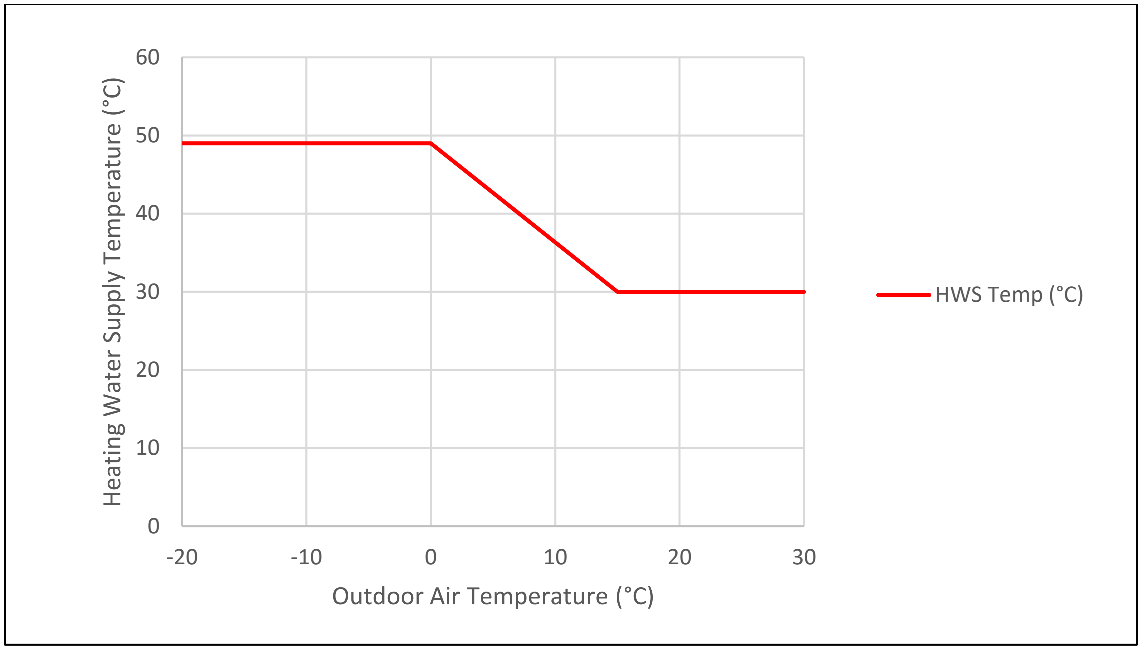
Figure 1: Maximum Heating Water Supply Temperature vs Outdoor Air Temperature



Many types of high-efficiency HVAC systems exist, and the choice of which system is up to the developer and their design team. Recommended HVAC system types that would be suitable for “DE-ready” buildings include:

- Hydronic, in-floor radiant
- Forced flow heater / fan coil
- Low-temperature hydronic radiators / radiant panels
- Water-source heat pump
- Hybrid heat pump
- Water-source variable refrigerant flow (VRF)

A complete mechanical system should be provided by the builder to meet the building loads until that time when a DES connection may be provided. The initial mechanical systems may include typical equipment such as boilers, chillers, cooling towers, heat pumps, etc. The use of renewable energy systems such as air-source heat pumps, geoexchange, and waste heat recovery as part of the building mechanical design is encouraged.

Space Cooling Systems Design Requirements

General Requirement #2*: *Where cooling is provided to over 25% of the conditioned floor area, a hydronic-based building cooling system must be used.

Heat recovery from cooling provides a useful opportunity for reducing building total energy use and lowering greenhouse gas emissions. For buildings with significant cooling loads, and in particular cooling from commercial or office spaces, a hydronic cooling system with heat recovery is encouraged.

Examples of hydronic cooling systems include:

- Chilled water fan coil
- Radiant cooling

- Hybrid heat pump
- Water source heat pump
- Water source VRF

For buildings where cooling will be provided to less than 25% of the conditioned floor area, or provided as an optional extra for residential units, a whole-building hydronic cooling system is not required. For these spaces, mini-split, variable refrigerant flow, or direct expansion rooftop units (with hydronic heat) may be used for space cooling. Heating for these spaces must still be provided by the building's hydronic heating system.

Provision shall be made to enable future tenant improvement work to be completed in accordance with this guide.

Prohibited HVAC Systems

Certain types of HVAC system are not compatible with future DES and are not in keeping with the guidelines of the District's OCP. The following HVAC system types are not permitted in "DE-ready" buildings:

- Electric resistance heaters, rooftop units, or baseboards (except as noted above)
- Gas unit heaters, furnaces, or rooftop units
- 'Ductless' or 'ducted' mini-split air-source heat pumps (except as noted above)

HVAC Hydronic System Temperature Differential

***General Requirement #3*: Hydronic systems must be designed to maximize supply/return temperature differential and prevent unnecessary bypassing of flow.**

Minimizing heating return water temperature is important for ensuring system efficiency and lowering operating cost. As such, hydronic heating and cooling systems must be designed to operate with a large temperature differential between supply and return water. For hydronic space heating systems, the winter design temperature differential from all types of terminal units must be at least 11°C (20°F). For hydronic space cooling systems, the summer design temperature differential from all types of terminal units must be at least 6°C (10°F).

All hydronic systems must be designed for variable flow operation with 2-way zone-level control valves to shut off flow when the terminal unit is not calling for heating or cooling. Three-way zone valves that allow flow to bypass the heating or cooling elements are generally not permitted—except where used as a low-flow bypass at the end of a long piping run.

Domestic Hot Water Design Guidelines

***General Requirement #4*: All domestic hot water for the building must be provided from a central mechanical room system with tie-in points for connection to a future DES.**

> *Exception: Electric point-of-use domestic hot water heaters may be permitted for small uses where connection to a whole-building DHW system is not feasible and annual DHW heating from all point of use systems is less than 2% of total building annual DHW heating load.*

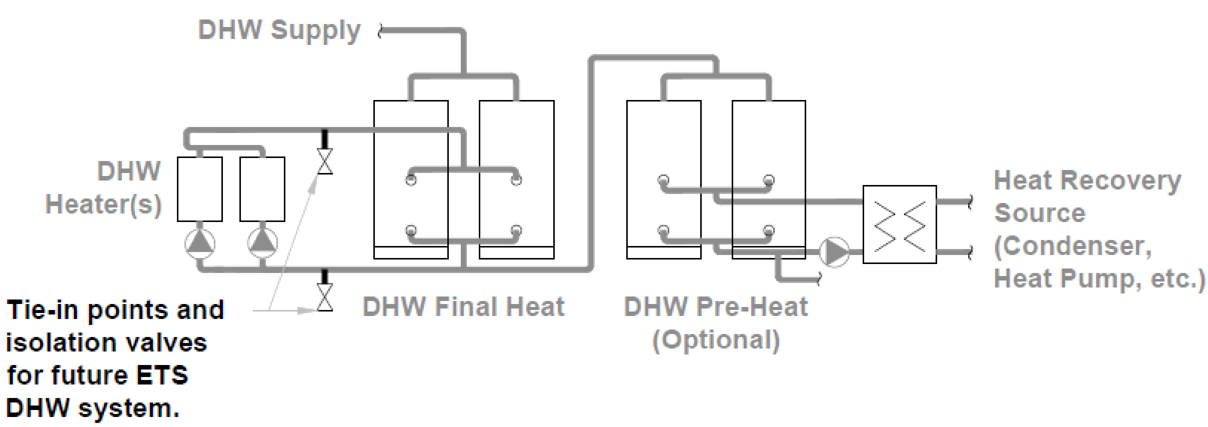
To facilitate connection to a future DES, all building DHW loads must be serviced from a DHW heating system in the central mechanical room. Domestic hot water systems should operate at no more than 60°C (140°F).

The preferable location for the DHW heating system is in the parkade or ground-level mechanical room. For buildings with DHW heating systems located in rooftop “penthouse” mechanical rooms, provision must be made to allow DHW heating water to be supplied to the penthouse from a parkade or ground-level energy transfer station.

If a DHW recirculation system is provided, DHW shall be returned to the mechanical room DHW system for re-heating.

Line-sized tees must be provided in the DHW heating system piping for future connection to the ETS in parallel with existing DHW heating sources. Tees must be located in an accessible location in the mechanical room and come with closed isolation valves and be capped with blind flanges until future connection to the ETS. Piping should be designed to deliver the lowest possible return water temperature to the DHW heaters.

Figure 2: Example DHW System Design and Tie-In Points



At the time of installing the DES, the future ETS would be designed to service the building’s DHW heating load. The future ETS will include a double wall heat exchanger dedicated for DHW heating. This heat exchanger would be connected in parallel to the existing domestic hot water heaters at which time the heaters would be made redundant.

Condenser heat recovery for domestic hot water pre-heating is a requirement of ASHRAE 90.1-2010 and NECB 2011 in certain circumstances. Even where not required by code, two stages of DHW heating (pre-heating & final heating) are encouraged. Domestic hot water pre-heating is a useful strategy for achieving energy savings when meeting BC’s Energy Step Code for buildings. Domestic hot water pre-heating may be accomplished through use of condenser heat recovery, waste heat recovery, pre-heating with space heating loop water, or various renewable energy options. An example DHW system arrangement with pre-heating storage tanks is shown in Figure 2 above.

Energy Transfer Station Requirements

An energy transfer station (ETS) is a mechanical system that transfers energy between the DES and the building mechanical systems. At the time of installation of the DES in the road, the DES utility will also design and install the ETSs in each customer building. The ETS equipment may include heat pumps, pumps, heat exchangers, controls, and related mechanical assemblies. The final design of the ETS will be dependent on the building heating loads, type of HVAC system in the building, and the design parameters of the future DES.

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The ETS equipment will be designed, constructed, and installed in the future by the DES utility in a space provided by the builder. The future installation will include the piping from the DES mains in the street into the ETS room, as well as piping from the ETS room to the tie-in points provided in the existing mechanical systems. The capital cost of these installations will be paid by the DES utility.

Energy Transfer Station Room Requirements

***General Requirement #5*: Each development must provide a dedicated room of sufficient size and for the exclusive use of the future DES utility to install and operate the energy transfer station equipment.**

The builder must provide a room for the exclusive use of the future DES utility to install and operate the ETS equipment.

The ETS room must be located on the first level of the parkade or the ground floor of the building. In flood prone areas, the ETS room should be located at grade level or higher to allow for flood protection.

It is preferable for the ETS room to be located adjacent to the building mechanical room and on an exterior wall facing the street with the highest road classification. Future DES service connections from the street, and pipework penetrations into the ETS room will be the responsibility of the future DES utility. The ETS room location should be chosen to allow reasonable access by the utility to install the service connections at a later date by trenching and coring through the building wall.

The ETS room size shall be dependent on the total conditioned floor area of the development. The ETS room size shall be as per Table 1.

Table 1: ETS Room Size Requirements

Development Conditioned Floor Area	Min ETS Room Floor Area	Approximate Interior ETS Room Dimensions[3]
< 2,800 m^2	26 m^2	4.0 m x 6.5 m
2,800 m^2 to 9,300 m^2	32 m^2	4.0 m x 7.5 m
9,300 m^2 to 18,500 m^2	40 m^2	4.0 m x 10 m
> 18,500 m^2	Coordinate room size with the District	

The ETS room shall have a clear floor to ceiling height of at least 3.0m (10ft) over at least 90% of the floor area.

A standard height double access door which opens to the outside or parkade must be provided to allow for future delivery and installation of ETS equipment. The ETS room doors must not open onto a narrow corridor. For doors opening to the outside, a suitably sized landing shall be provided.

The ETS room shall be provided with a mechanical ventilation system capable of 3.5 L/s/m^2 (0.7 cfm/sqft) ventilation rate with a source of clean make-up air. A heat source shall be provided to maintain the space at a minimum temperature of 10°C (50°F). A floor drain, hose bib, and lighting shall

[3] ETS room layouts should be rectangular in shape with a minimum room width of 4.0 meters.

be provided in the ETS room by the builder. The ETS room shall be provided with fire sprinklers in accordance with the BC Fire Code.

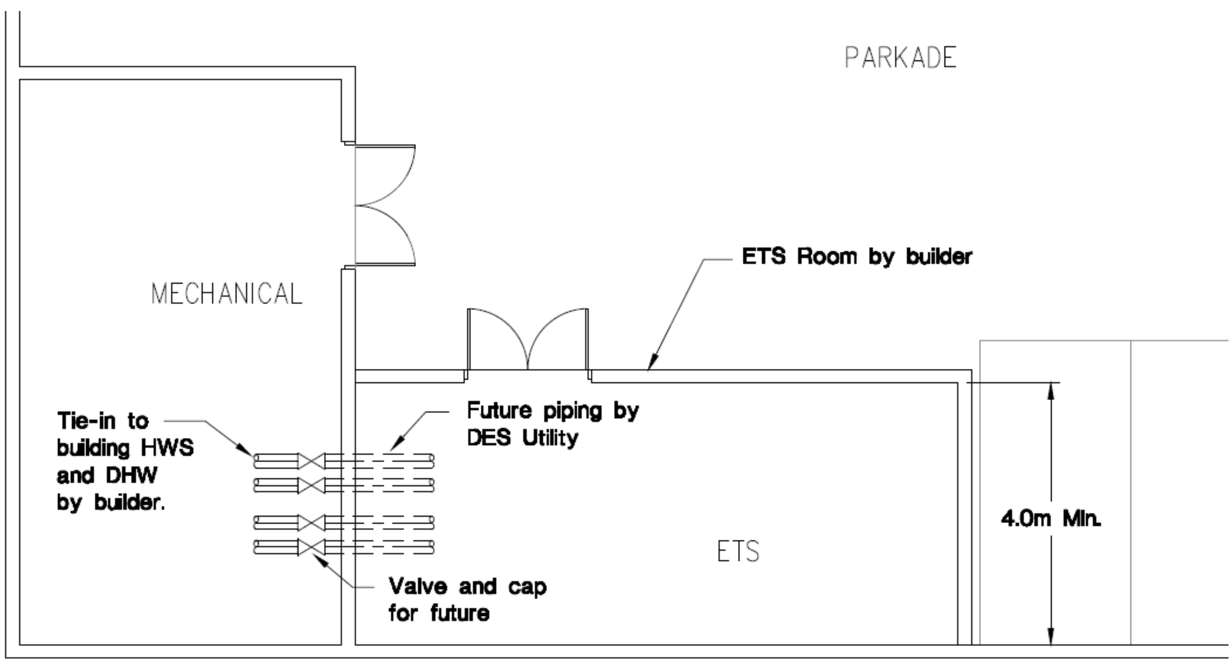
The ETS room may be used by the building owner for temporary storage purposes until such time that the room is required to be handed over to the DES utility operator. A covenant may be required to make purchasers aware that the ETS room, although used temporarily for storage purposes, is reserved long term for use by the DES utility.

In lieu of providing an ETS room of a size listed above, a developer may provide a sufficient number of parking spaces (beyond the number of parking spaces required in the development approvals) located on the first level of the parkade or within enclosed ground-level parking, that may be converted to an ETS room with the above listed dimensions in the future. Allowances for meeting the future ventilation, floor drain, and fire protection requirements of the ETS room must be provided. A covenant may be required to make purchasers aware that the additional parking spaces are reserved long term for use by the DES utility.

A caged area is not an acceptable provision for an ETS room.

An example layout for a future ETS room in the parkade of a building is shown in Figure 3 below.

Figure 3: Example Future ETS Room Size and Location



Building Mechanical Room Requirements

General Requirement #6: Equipment for the provision of thermal energy for all building space and DHW heating must be located in a central mechanical room, adjacent to the ETS room, and a tie-in point for a future ETS must be provided.

To facilitate future connection to a DES through the ETS, the building's heating system must be a single hydronic system servicing all conditioned spaces from one centrally located mechanical room inside the building. All buildings within a single development must be serviced from a single mechanical room located adjacent to the ETS room.

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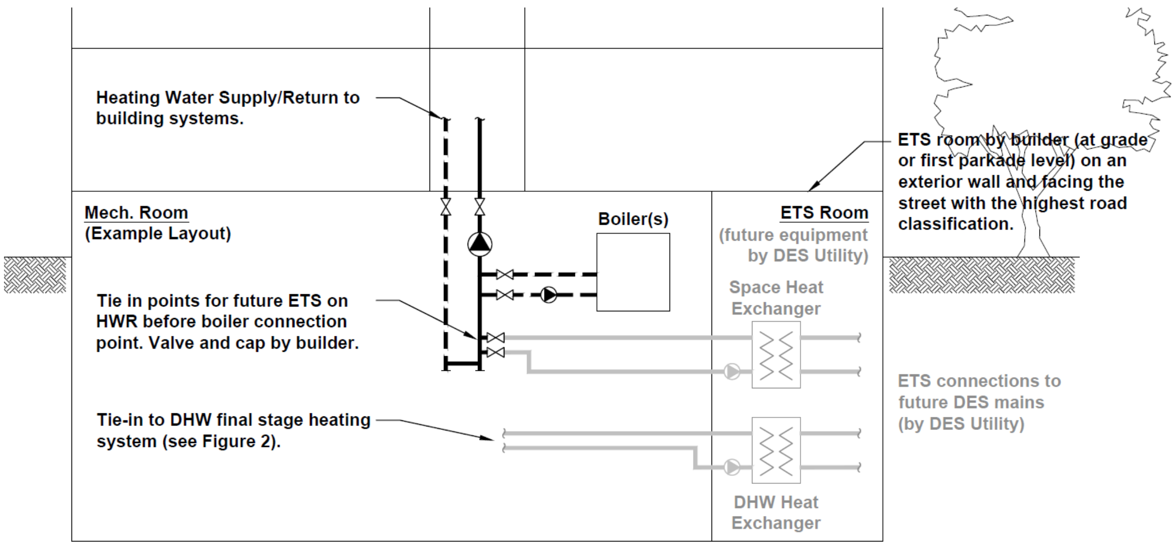
For developments with multiple buildings and more than 18,581 m^2 (200,000 ft^2) of conditioned floor area, two separate mechanical rooms may be provided (if required by the building design) for two separate hydronic systems servicing different parts of the development.

Line-sized tees must be provided in the primary heating loop supply and return piping for future connection to the ETS in series, before the existing boilers. Tees must be located in an accessible location in the mechanical room and come with closed isolation valves and be capped with blind flanges until future connection to the ETS.

Figure 4: Building Mechanical Room with ETS Sample Layout



For buildings where mechanical systems must be located in a rooftop "penthouse" mechanical room and equipment location is approved by the District, provision must be made to allow heating water to be supplied into the heating system from a parkade-level or ground level energy transfer station. This can be accomplished through reverse-return riser piping design or by providing equal-sized riser piping for the full height of the building. An example of reverse-return riser piping is shown in Figure 5.

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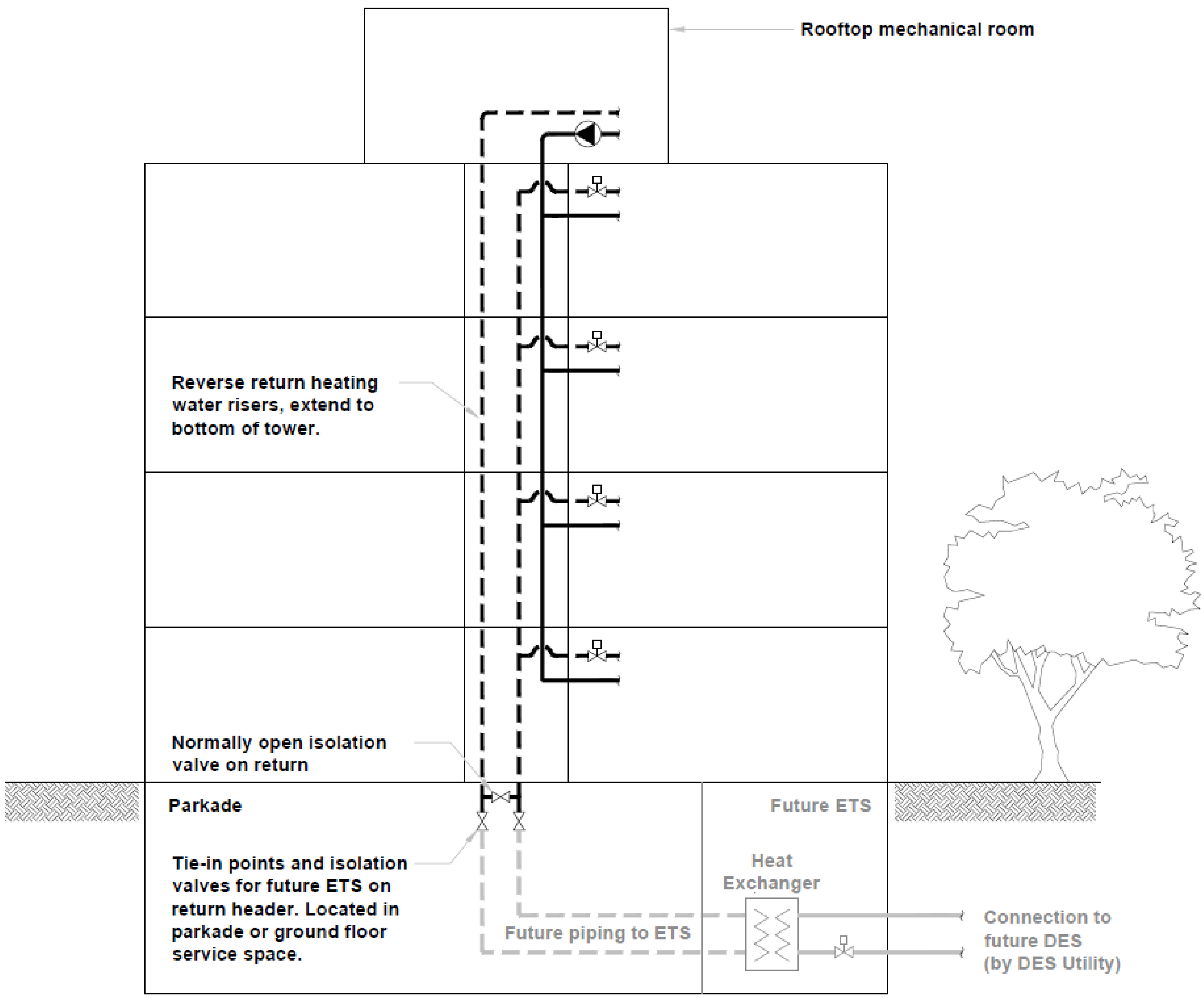
Figure 5: Penthouse Mechanical ETS Tie-in Sample Layout



ETS Electrical Requirements

***General Requirement #7*: The Building electrical service, transformer, and main panel must be designed to accommodate the future electrical load of the ETS equipment.**

To accommodate the future ETS electrical load, the builder's electrical engineer must account for an additional future electrical load in all of their electrical load calculations when doing the building design. This includes the building permit load calculation and the BC Hydro service application load statement. The additional electrical load for the ETS that must be accounted for is shown in the table below based on development's conditioned floor area. Interpolation between points to calculate ETS load based on actual conditioned floor area is acceptable.

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Table 2: ETS Electrical Power Requirements

Development Conditioned Floor Area		Future ETS Electrical Load
(sqft)	**(sqm)**	**(kW)**
30,000	2,788	115
50,000	4,647	165
75,000	6,970	240
115,000	10,688	315
150,000	13,941	415
175,000	16,264	525
210,000	18,587	650
For developments over 18,587 sqm (210,000 sqft), coordinate ETS power requirement with the District.		

When designing and coordinating a new power application the appropriate sized BC Hydro pad mount transformer (PMT) shall be requested or, in the case of a private unit substation transformer, this equipment shall be sized adequately as well.

This load will be carried within all aspects of the main electrical distribution. This includes upsizing the main power feed, main breaker(s) and the main distribution board where the anticipated ETS equipment will be fed from. Although the circuit breakers feeding the ETS do not need to be supplied in the design, it is imperative that they are identified as future spaces in the switch board or distribution. The space for the necessary electrical distribution and wiring shall be identified.

District Energy Ready Compliance Confirmation

The registered professional of record for the building mechanical systems must provide confirmation that the building HVAC and DHW systems comply with the requirements of this guide prior to issuance of a building permit. Confirmation shall be provided by completing and signing the *Confirmation of Compliance with DE-Ready Requirements* form included in Appendix A.

Contact Information

For questions or additional details, please contact the Building Department at building@dnv.org or 604-990-2480.

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Appendix A: Confirmation of Compliance with DE Ready Requirements

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Notes

1. This form must be submitted along with the Development Permit and Building Permit drawing packages for buildings that are required to be District Energy Ready ("DE Ready").
2. This form must be signed by the registered professional of record who is a member in good standing of Engineers and Geoscientists BC or the Architectural Institute of BC.

☐ Preliminary ☐ Final Rev. Date: ____________
(check one)

3. **Project Information**

Name of Project: ____________________________________

Permit Number: ____________________________________

Address of Project: ____________________________________

Legal Description of Project: ____________________________________

PART 1: DE Ready Technical Requirements Checklist

The undersigned hereby gives assurance that the building design for the above listed project has been designed in accordance with the *Technical Requirements for District Energy Ready Buildings* guide ("the *Requirements*") and meets the specific requirements as listed below.

(Initial next to each item to confirm compliance.)

Initial		Requirement
		SPACE HEATING
________	1)	The building uses a low-temperature hydronic HVAC system to meet all space heating and make up air heating loads in the building.
________	1.1)	Hydronic systems are designed to operate at the supply and return temperatures listed in the *Requirements*.
________	1.2)	The heating water system is designed to operate with reduced supply temperatures during milder weather as per the OAT reset curve shown in Figure 1 of the *Requirements*.
		COOLING
________	2)	Where cooling is provided to over 25% of the conditioned floor area, a hydronic-based building cooling system is used.

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Initial		Requirement
		TEMPERATURE DIFFERENTIAL
________	3)	Hydronic systems are designed to maximize supply and return temperature differential and prevent unnecessary bypassing of flow.
		DOMESTIC HOT WATER
________	4)	All domestic hot water for the building is provided from a central mechanical room system with tie-in points for connection to a future DES.
________	4.1)	The DHW system is designed to operate at no more than 60°C DHW supply temperature.
________	4.2)	The DHW recirculation system (if provided) returns recirculated water to the mechanical room for re-heating.
		ETS ROOM
________	5)	A dedicated room or space for the exclusive use of the future DES utility to install and operate the energy transfer station equipment is provided and sized as per Table 1 of the *Requirements*.
________	5.1)	The ETS room is provided with a ventilation system, floor drain, hose bib, lighting, and fire protection as per the *Requirements*.
________	6)	Equipment for the provision of thermal energy for all building space and DHW heating is located in a central mechanical room, adjacent to the ETS room, and a tie-in point for a future ETS is provided.
		ELECTRICAL
________	7)	The Building electrical service, transformer, and main panel are sized to accommodate the future electrical load of the ETS equipment.

PART 2: ETS DESIGN BASIS

In this section, the mechanical engineer of record for the building mechanical systems is to indicate the expected annual and peak thermal energy loads for the building.

Month	**Space Heating** (MWh)	**Space Cooling** (MWh)	**DHW Heating** (MWh)	**Month**	**Space Heating** (MWh)	**Space Cooling** (MWh)	**DHW Heating** (MWh)
January				**July**			
February				**August**			
March				**September**			
April				**October**			
May				**November**			
June				**December**			
				TOTAL:			

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Portion of Annual Space Heating Load by Electric Resistance: ________ MWh

Peak Space Heating Demand: ________ kW

Peak Space Cooling Demand: ________ kW

Peak DHW Heating Demand[4]: ________ kW

CERTIFICATION

I certify that the above mentioned building is designed in compliance with the requirements and details provided in the *Technical Criteria for District Energy Ready Buildings* and that the design basis information provided in Part 2 above represents the peak loads expected for this building.

I certify that I am a registered professional as defined in the BC Building Code.

____
(Registered Professional of Record's Name)

____
(Firm)

____
(Address)

____

____
(Phone No.)

(Professional's Seal, Signature, and Date)

[4] Peak DHW Heating Demand shall include the impact of DHW storage, where provided.