City Centre District Energy Utility

A Guideline for On-Site Discrete Cooling Plants

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Abbreviations

ASHP	Air-Source Heat Pump
CCDEU	City Centre District Energy Utility
CEP	Central Energy Plant
DCP	Discrete Cooling Plant
DES	District Energy System
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
GHG	Greenhouse Gas
HEX	Heat Exchanger
HVAC	Heating, Ventilation & Air-Conditioning
LIEC	Lulu Island Energy Company
OAT	Outdoor Air Temperature
PLC	Programmable Logic Controller

Definitions

Building (or Strata)	The shared owners of the common property and assets, on which the owner's possess individual lots.
City	The City of Richmond, including subsidiary Lulu Island Energy Corporation (LIEC) and the district energy service area City Centre District Energy Utility (CCDEU).
Customer	Refer to Building (Strata).
Developer	The party is responsible for providing the majority of professional engineering work in the overall development of the DCP.
Discrete Cooling Plant (DCP)	A cooling plant located onsite that serves the single development.
District Energy (DE)	See section 2.1.
Energy Transfer Station (ETS)	The interface between the DCP or the CCDEU and the Building (or Strata) HVAC.
Low-Carbon System	An energy system that provides at least 70% of annual energy from a renewable source while incorporating heat recovery or energy sharing.
Renewable	Energy sources that will be naturally renewed at a rate that is sustainable for continuous human exploitation.
Service Provider	The person or company contracted by the City to operate, maintain, and manage the DEU on behalf of the City.

1 Document Purpose

The City of Richmond (City) is committed to sustainability and reduced environmental impact. To this end, the City has created a new district energy service area in the City Centre neighbourhood. The new City Centre District Energy Utility (CCDEU) provides space heating, space cooling, and domestic hot water heating for buildings within the service area. Based on the address of the building and target connection date, LIEC will advise the developer on the required connection type. The CCDEU is owned and operated by the City's wholly owned subsidiary and district energy service provider, Lulu Island Energy Company Ltd. (LIEC).

Eventually, all buildings within the service area will be required to connect to the CCDEU to satisfy their thermal energy needs. To this end, the City requires that any new developments must be compatible with the CCDEU. Developments will have one of the following connection types:

1. **Offsite District Heating and District Cooling Connection**: For developments whose heating and cooling services are supplied entirely from an off-site plant and transferred through an ETS for heating and cooling. Refer to the *Richmond City Centre District Energy Utility Service: A Design Guide for Connection to District Energy.*

2. **DCP Cooling, Offsite District Heating Connection:** For developments whose cooling services are supplied from an on-site Energy Generation Plant but heating services are supplied from an off-site plant and transferred through an ETS for heating only. Refer to the *District Energy in Richmond City Centre: A Design Guide for Connection to District Energy* for ETS requirements and refer to this guideline for the DCP requirements.

3. **Energy Generation Plant for Space Heating, DHW Heating, and Space Cooling:** For developments whose heating and cooling services are supplied entirely from an Energy Generation Plant located within the development. Refer to the *CCDEU Guideline for Onsite Low-Carbon Energy Systems* and *CCDEU Technical Requirements for Onsite Low-Carbon Energy Systems*.

The purpose of this document is to provide preliminary information to Developers, engineers, and architects to tailor their designs for optimal compatibility with LIEC's guidelines. The Developer is responsible for the design, construction and commissioning of the plant. Corix and LIEC will work closely with developers to ensure good design integration between buildings and the DEU. The information in this document applies to all building types within the service area. It should be read in conjunction with the *CCDEU Technical Requirements for Onsite Discrete Cooling Plants*.

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

2 City Centre District Energy Utility

2.1 What is District Energy?

District Energy (DE), also known as Community Energy, Neighborhood Energy, or District Heating and Cooling, is a system that produces thermal energy from a central location, typically in the form of hot/chilled water, and distributes the energy through a network of piping to individual customer buildings. The energy transfer is controlled and metered at the point where the DE system interfaces with the building HVAC system through a heat exchanger.

2.2 Benefits of District Energy

EASE OF OPERATION, LESS MANAGEMENT, LOWER 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 is 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 Discrete Cooling Plant

LIEC is developing a new district energy utility within the City Centre neighbourhood. Depending on the building's location within the service area, the system will either be a 2-pipe system providing district heating, with cooling supplied from a Discrete Cooling Plant (DCP) on site or a 4-pipe system providing heating and cooling from the district. This guideline addresses the requirements for the DCP.

The DCP is an Energy Generation Plant and will provide cooling services to meet the development's space cooling energy demand. The developer is responsible for designing, constructing and commissioning the DCP in accordance with the technical specifications determined by LIEC. The heating ETS will be paid for by the Developer, but designed and constructed by LIEC. Ownership and operation of the DCP will be transferred to LIEC prior to occupancy. The DCP must be compatible with the future CCDEU cooling network and in conformance with LIEC's technical and operational requirements. A DCP is essentially a small-scale district cooling system servicing one or more Strata within a single development. The DCP uses centralized equipment to generate chilled water for the development, which is then distributed to each Building (or Strata) through a hydronic piping network.

Inclusion of a future connection to the CCDEU is also required as part of the DCP. Refer to Section 3.5 for additional details on the FDC. Upon taking ownership of the DCP, LIEC will be fully responsible for operation and maintenance of the system as well as Customer billing.

For more information about the heating ETS, refer to the *District Energy in Richmond City Centre: A Design Guide for Connection to District Energy.*

3 Discrete Cooling Plant

3.1 DCP Components

A DCP is a small-scale district energy system limited in service to one or more Buildings (or Stratas) within a single development. The DCP must satisfy all cooling demands of the development. The DCP will be owned and operated by LIEC and must include an allowance for a future connection to the CCDEU. In addition, the DCP and building HVAC systems must be hydronic and designed such that all cooling demands can be satisfied by the future CCDEU connection once it is implemented.

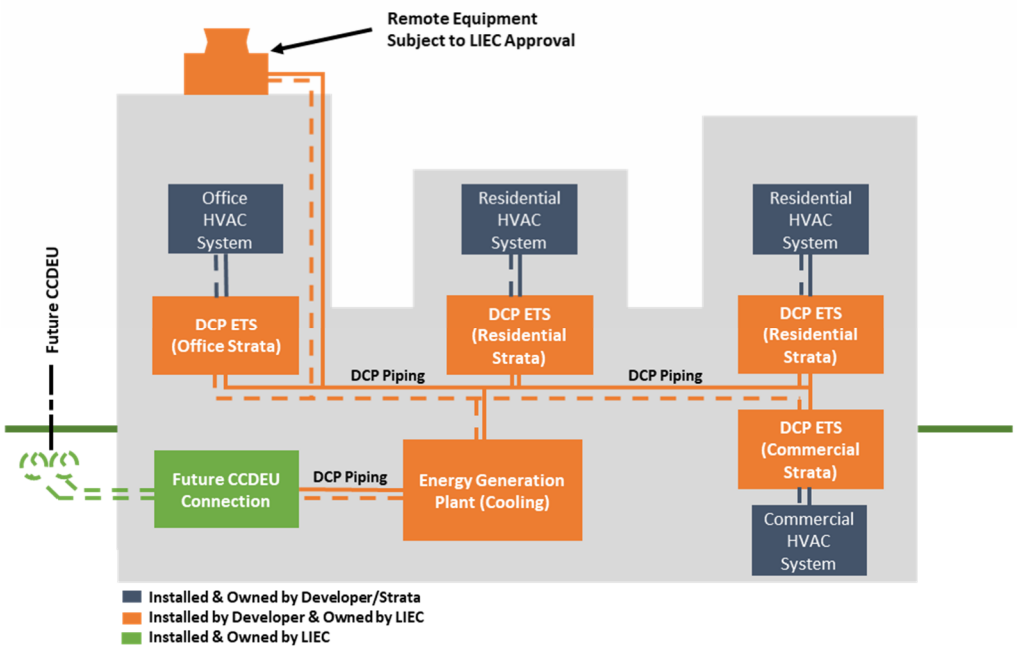
A DCP is comprised of four major components:

1. Energy Generation Plant (Cooling) – the energy source for the system chilled water supply;
2. DCP Piping – interior piping network to distribute chilled water from the DCP to the ETS and between the FDC and the DCP;
3. DCP Energy Transfer Station (ETS) – the interface between the cooling plant and the building HVAC system; and
4. Future DEU Connection (FDC) – the future interface between the DCP and the CCDEU.

These four components will be fully owned by LIEC. The ownership of the DCP will transfer to LIEC following system start-up and prior to occupancy. The ownership demarcation point between the Building system and the DCP is at the outlet of the ETS. In the future, the CCDEU will connect to the Building DCP via the FDC, which will be designed, built, and fully owned by LIEC.

A high-level diagram for a theoretical development incorporating a DCP is illustrated in Figure 1. The heating ETS is not shown.

FIGURE 1: TYPICAL DISCRETE COOLING PLANT CONNECTION SCHEMATIC



This theoretical development contains a commercial stratum, two residential Strata, and an office Strata. Each individual Strata is serviced by an ETS, and in general all cooling equipment should be located in a centralized location. The ETS acts as the interface between the Strata's HVAC system and the DCP providing hydronic separation between the systems and a billing point. The FDC will be installed by LIEC at a later date, when the building is connected to the CCDEU, but the Developer is required to allow space for the future FDC connection.

Each of these components are discussed in more detail below.

3.2 Energy Generation Plant (Cooling) Overview

The energy generation plant provides all cooling energy for the building. This is where the hydronic fluid is cooled before being distributed throughout the development.

The energy generation plant has the following characteristics:

1. It supplies 100% of the space cooling requirements of the entire building. The key components include:

    - Thermal energy equipment used to cool the system's hydronic fluid;
    - Pumps used to distribute hydronic fluid throughout the development or to feed individual pieces of equipment;
    - Supply and return piping connecting each piece of equipment and distributing the system's hydronic fluid;
    - Various types of valves (isolation, control, balancing, check, etc.) used to control the flow of the system's hydronic fluid;

- Various instrumentation (temperature sensors, pressure sensors, flowmeters, etc.) and gauges (pressure, temperature, etc.) to monitor operation of the plant and trigger alarms or equipment shutdown/start-up. This includes an outdoor air temperature sensor for temperature reset;

- Expansion tanks, chemical addition equipment, corrosion monitoring, and hydronic fluid make-up system;

- Motor control centre and electrical distribution equipment;

- Central control panel (PLC) used to control overall operation of the plant. This is separate from the Building control system. The PLC must be capable of communicating with LIEC's VTScada based central operations centre. Refer to the *Corix District Energy Utility SCADA and Controls Design Standards and Guidelines*;

- Dedicated electricity connections, including dedicated BC Hydro meters, and dedicated network / internet provider account with static IP address for the DCP; and

- Sound barriers for all outdoor equipment.

2. All equipment must meet the requirements of the CCDEU DCP Technical Guidelines;

3. All equipment is installed in one, centralized location. This location must be above the floodplain elevation as per Richmond Bylaw 8204. Where equipment has specific space requirements, such as outdoor equipment or sewage heat recovery equipment, LIEC may grant an exception for remotely installed equipment if it can be shown that the equipment and plant cannot be located adjacent to each other. By centralizing all the equipment in one location, the plant is easier to operate and maintain, larger equipment can be used which typically has higher operating efficiencies, and there only needs to be one set of redundant equipment; and

4. Heat rejection into the building heating or DHW system is not permitted, as the heating system will be served by the CCDEU heating network.

3.3 DCP Energy Transfer Station (ETS) Overview

Each individual Building (or Strata) within the development shall be serviced by an ETS. As the ETS is the interface between the energy generation plant and building HVAC and plumbing system, the ETS also reflects the change in ownership of equipment. LIEC shall own and operate the thermal energy equipment upstream and including the ETS, and the Building is responsible for all equipment downstream of the ETS. The ownership demarcation point shall be clearly indicated on the ETS mechanical drawing. The ETS must be sized to handle the full thermal energy demand of the Strata. The key components of an ETS include:

1. Supply and return piping with pressure and temperature gauges;
2. One heat exchanger for space cooling to reject heat from the Building (or Strata) HVAC systems to the energy generation plant;
3. Control valves and temperature sensors to regulate the flow to the Building (or Strata); and
4. Energy meter package complying with CSA C900.1/EN1434-1, including a flow meter, temperature sensors, and an energy calculator, for billing and system optimization purposes. The energy meter should be installed on the energy generation plant side of the heat exchanger.

Energy delivery to the customer is managed by controlling the flow through the energy generation plant side of the ETS to achieve the Customer supply temperature set point. Flow through the Building (or Strata) side of the ETS is controlled by the Building (or Strata) HVAC system's distribution pumps. The energy meter package records how much energy is delivered for billing purposes.

3.4 DCP Piping Overview

A closed-loop distribution piping network is used to deliver chilled water from the energy generation plant to each ETS. The hydronic fluid can be water or a water-glycol mixture to suit the designer's preferences. The fluid is cooled in the energy generation plant, distributed to an ETS at each Building (or Strata), and returned to the energy generation plant where it is cooled again. No water is drained or lost in the system, and no additional hydronic fluid is required during normal operation.

In addition, supply and return piping must be provided by the Developer to connect the FDC to the energy generation plant. This piping must be installed as part of the DCP installation and serve the future purpose of conveying chilled water from the FDC to the ETS to provide cooling services for the development. This interconnecting piping must be isolated and nitrogen-blanketed by the Developer prior to asset transfer. The piping must be connected to the energy generation plant in such a way that when the CCDEU system connects to the FDC in the future, these connections will be able to supply chilled water to the Building ETS.

3.5 Future DEU Connection (FDC) Overview

Each DCP requires space for a Future DEU Connection (FDC) to facilitate connection to the future CCDEU. The FDC will be designed and installed at a future date by LIEC. The intent is the CCDEU to be able to supply the full cooling demand of the building from this connection when an offsite cooling network is available in the area.

The Developer is required to provide the following to ensure the FDC space can accommodate the equipment:

1. Space to accommodate the following equipment. At minimum, an area 4 m x 6 m is required. A minimum room height clearance of 2.5 m is required. This space shall be located in a location agreed with LIEC and be clear of other equipment and piping. The FDC must be located above the floodplain, but at an elevation of no more than 4 m to avoid hydraulic issues with the CCDEU.
    - Space cooling heat exchanger, to connect the CCDEU to the DCP;
    - Pumps to circulate fluid between the FDC and the energy generation plant;
    - Controls as required, including control valves, temperature sensors and energy meters, to regulate the flow on the CCDEU side and the DCP side of the system; and
    - Associated piping, valves, fittings, and instrumentation as required.
2. Lockable breaker and disconnect switch. The size must be reviewed by the Developer engineer and LIEC during the building permit stage, so that an estimate of pump power can be developed;
3. Two pipes connecting between the FDC and the energy generation plant, as noted in the DCP Piping section; and
4. 1x 50 mm communication conduit with pull wire between the FDC and the energy generation plant.

3.5.1 Foundation Penetration

The Developer shall coordinate with LIEC to determine the exact size and location of the foundation penetration for the future CCDEU service connection. The preference is to provide sleeves or blockouts for the penetrations during construction of the foundations. However, as an alternative, the penetrations can be cored in the future if the foundation reinforcement is designed to accommodate the future cores and an indent is provided on the foundation exterior to precisely indicate the penetration location.

In addition, two 50 mm communication conduits shall penetrate the exterior foundation wall. One of these conduits will penetrate the exterior wall adjacent to the CCDEU service connection and will be utilized for a direct connection between the DCP and LIEC's central operations centre. The other conduit will be connected to an outdoor air temperature sensor, shall be located on a north facing side of the development. Only one OAT sensor is required for the DCP and the heating ETS.

Isolation valves (for the CCDEU service connection) and pull boxes (for the communication conduits) are typically required immediately after the penetration into the development. Access to these valves and pull boxes must be maintained at all times without confined space constraints. These future building penetrations will be sealed and waterproofed by LIEC.

3.6 Building (or Strata) HVAC System Overview

The mechanical design of the Building (or Strata) must utilize energy from the DCP to satisfy all the space cooling demands; supplemental energy sources are not permitted. The Building (or Strata) system begins at the outlet of the ETS. Ownership and corresponding operations and maintenance of the building mechanical system remains the responsibility of the building owner.

3.7 Technical Requirements

For detailed technical requirements related to all components of the DCP, the Developer shall refer to the latest edition of "*City Centre District Energy Utility: Technical Requirements for Onsite Discrete Cooling Plants"* produced by LIEC.

4 DCP Compliance and Approval Process

The Developer and the Developer's engineer must work closely with LIEC and their representatives throughout the development permit, building permit, design, and construction processes to ensure compliance with the LIEC's performance and quality requirements. Early involvement of LIEC is highly recommended so a mutual understanding of project goals can be achieved. The information required throughout the compatibility review process is outlined below. Any deviation from these guidelines or the Technical Guidelines must be highlighted to LIEC for approval. Failure to provide the required information can result in delays during the permit application approval process.

4.1 Development Permit Stage

LIEC will review the general configuration of the Developer's proposed DCP and provide comments on general compliance with LIEC's requirements. LIEC will work closely with the Developer to ensure that the Development Permit process is not unduly delayed. The Developer is responsible for submitting preliminary design information to the satisfaction of LIEC to confirm that the Developer's design concept conforms to LIEC's requirements. This information shall include, but is not limited to:

1. Completed LIEC Connection Form (See Section 9);
2. Preliminary design drawings (schematics, plans, sections, elevations, details, equipment schedules, and others as required). The drawings should clearly indicate the proposed location of the ETS, DCP Piping, Energy Generation Plant and FDC, and the ownership demarcation boundary for the LIEC owned equipment;
3. Acknowledgement that a signed section 219 statutory right of way and covenant has been executed and registered against title;
4. Hourly (8760) energy modelling report and peak design demand (kW) for the DCP and all connected Buildings (or Strata). See section below discussing energy modelling requirements;
5. Preliminary design information regarding the Building (or Strata) side HVAC system including schematics, equipment information, etc.;
6. Data sheets and selection criteria for proposed major equipment within the DCP and confirmation that all equipment will be installed as per the manufacturer's guidelines;
7. High-level control philosophy describing the operation of DCP and the integration between the major equipment; and
8. Confirmation that the design is in line with the *CCDEU Technical Requirements for Onsite Discrete Cooling Plants*. Any deviations shall be highlighted to LIEC for approval.

4.1.1 Energy Modelling

An hourly (8760) energy model shall be completed for the entire development. Estimation of the Building (or Strata) peak cooling loads is the responsibility of the Developer's engineer.

Peak cooling energy use intensity is expected to be in accordance with the Energy Step Code per City of Richmond Bylaw 9769 and Bylaw 9771. Since the DCP equipment is sized to meet the peak demand of the Building (or Strata), over estimation of Building (or Strata) loads will result in over-sized equipment and higher capital costs. Therefore, it is critical that loads are estimated accurately to avoid over or under sizing of the equipment.

Energy modelling shall be conducted by a 'Qualified Modeller' in accordance with the National Energy Code of Canada for Buildings and BC Hydro's New Construction Energy Modelling Guidelines.[1] The energy modelling software shall be tested and in compliance with ASHRAE 140. The Developer shall use the following greenhouse gas emission intensities:

1. Electricity: 3.0 gCO_2e/MJ.

An energy modelling report shall be submitted to LIEC for review. The report shall include the entire development and include a breakdown showing specifics for each individual Customer. The report shall bear the seal of a Qualified Modeller or the Energy Modelling Supervisor. Refer to the EGBC/AIBC Joint Professional Practice Guidelines: Whole Building Energy Modelling Services.

The energy model must be submitted and approved by LIEC prior to issuance of the development permit. An updated energy model, incorporating any design changes which would impact the results of the energy model, must be submitted, and approved by LIEC prior to issuance of the building permit.

[1] Refer to New Construction Program's Energy Modelling Guideline from BC Hydro Power Smart, October 2018 https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/power-smart/builders-developers/energy-modeling-guidelines.pdf

4.2 Building Permit Stage

LIEC will review the detailed configuration of the Developer's final DCP design and provide comments on general compliance with LIEC's requirements. LIEC will work closely with the Developer to ensure that the Building Permit process is not unduly delayed. LIEC's engineer will review the DCP design to ensure the design intent of the CCDEU is met and that it is compliant with LIEC's requirements. This information shall include, but is not limited to:

1. All documents specified within Bylaw No. 9895. This includes:

    - An acknowledgement that the building is located on a Designated Property;
    - An executed Energy Services Agreement;
    - An executed Asset Transfer Agreement; and
    - All fees, including:
        - The building permit application fee; and
        - The invoice pertaining to onsite works for the district heating connection (refer to *Richmond City Centre District Energy Utility Service: A Design Guide for Connection to District Energy*)

2. Updated design drawings including but not limited to (schematics, plans, sections, elevations, details, equipment schedules, and others as required). Drawings shall clearly indicate access provisions and plans for operations and maintenance (LIEC) personnel, and DCP mechanical spaces shall be clearly dimensioned;

3. Process control narrative describing operation of the DCP;

4. Final hourly (8760) energy modelling report reflecting the finalized design. The report shall be signed and sealed by the Qualified Modeller or Energy Modelling Supervisor. This shall include at a minimum:

    - Peak energy demand for space cooling;
    - Combined peak cooling energy demand for any uses other than space cooling; and
    - Hour by hour consumption of energy for space cooling.

5. Schedule for installation of Energy Generation Plant including key milestones and proposed commencement date for delivery of energy by LIEC;

6. Class C (±25-40%) capital cost estimate; and

7. Operational cost estimate.

4.3 Construction Stage

LIEC will advise the Developer of any special design or construction standards that LIEC may have, and such standards will be incorporated into the specifications for the DCP and all connected Building (or Strata) mechanical systems. The Developer shall be responsible for the engineering, design, construction, installation, and commissioning of the DCP, as well as obtaining required regulatory permits including TSBC design registration, installation, and operating permits for applicable equipment. Similarly, the Developer shall be responsible for the engineering, design, construction, installation, commissioning, or operation of the Building (or Strata) mechanical systems. The following information is required:

1. Complete IFC drawings set and specifications for Mechanical, Electrical, Structural, and Architectural design for DCP reflecting the plans approved through the building permit application process. Mechanical rooms layout and the equipment general arrangement shall be indicated on the drawings;

2. Construction schedule to be provided in advance of the start of construction, highlighting each milestone and hold point for LIEC notification and review;

3. LIEC's representative shall be granted access to site for periodic inspections of the work during construction. The Developer shall provide a representative to guide LIEC's inspection and answer questions as they arise. In addition, the Developer shall notify LIEC of major milestones at least one (1) week in advance to facilitate scheduling an inspector. At minimum, the following milestones should be identified:

    - 75% piping/equipment installation (prior to piping insulation);
    - 100% piping/equipment installation (prior to commissioning);
    - Commissioning verification/demonstration; and
    - Training on equipment/plant operation.

4. Shop drawings for major mechanical, controls, and electrical equipment shall be submitted to LIEC representative for approval prior to returning approved shop drawings to the Developer's contractor. Shop drawings shall be signed and sealed by the Engineer of Record (EoR) and include any commentary made by the EoR or the EoR's supervisee; and

5. Following construction, the Developer shall submit an Owner's Manual to LIEC for records purposes. For Owner's Manual requirements, refer to supplementary document *City Centre District Energy Utility Technical Requirements for Onsite Discrete Cooling Plants*.

4.4 Commissioning Stage

Start-up and commissioning of the DCP and all connected Building (or Strata) mechanical systems is the sole responsibility of the Developer. The Developer shall notify LIEC of the date and time of commissioning so that LIEC can provide an on-site representative to witness commissioning.

A non-exhaustive list of commissioning responsibilities is listed below, but there may be additional requirements depending on the configuration of the development and DCP.

1. Obtain the services of a third party commissioning agent, acceptable to LIEC, to oversee and report on the commissioning process;
2. Provide schedule for commissioning including milestones for LIEC review;
3. Before starting, provide commissioning plan including all checklists to be used for commissioning for review by LIEC;
4. Prior to commissioning, provide written verification and corresponding documentation confirming that the system is ready for startup. This includes, but is not limited to the following requirements:
    - Submit all construction quality reports related to DCP infrastructure including, but not limited to, field review reports, material testing reports, hydrostatic testing reports, radiographic examination results, water quality reports, balancing reports, equipment testing and start-up reports, and equipment warranty information;
    - All safety controls installed and fully operational (dry run test);
    - Flushing, chemical cleaning (as required), charging, fluid operating (as required), are complete;
    - Start-up verification checks by manufacturers representatives completed; and
    - All deficiencies to be recorded, reviewed by the commissioning team and, subsequently corrected before proceeding to the next phase.
5. Commissioning shall include, but is not limited to the following:
    - Testing and signoff of all equipment by supplier’s representative;
    - Performance checks on all equipment;
    - Activation of all systems;
    - Testing, balancing and adjustment of all systems by a balancing firm, approved by LIEC;
    - All deficiencies are to be recorded, reviewed by the Development team and their Commissioning agent and, subsequently, corrected. The process at the point of the deficiency shall be repeated before proceeding forward;

6. Verification of commissioning by LIEC will commence only when the commissioning process has been totally completed. Submit test procedure completion test certificates at the time of requesting the commencement of the verification procedure. The verification process will include the demonstration of operation of all equipment and systems, under each mode of operation;

7. The system performance must be verified in accordance with the performance validation plan approved at the Building Permit Stage; and

8. Training should be arranged for LIEC staff or LIEC representative on operating the components of the DCP, and LIEC staff or LIEC representative should attend any equipment training session provided by equipment vendors and manufacturers.

4.4.1 ETS Commissioning

In addition to the requirements for the DCP, the ETS has some additional requirements for commissioning. Prior to commissioning of the ETS, the Building Owner (or Strata) shall flush and clean the Building's (or Strata's) internal hydronic systems. The ETS heat exchanger shall be bypassed during flushing and testing of the Building (or Strata) hydronic systems.

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 Building (or Strata) HVAC system can flow through the heat exchanger in the ETS. The Developer shall also provide commissioning, testing, and flushing reports to LIEC for approval before commissioning the ETS.

The Developer is responsible for commissioning all equipment and systems on the Building (or Strata) side of the system including the internal hydronic systems.

4.5 Occupancy Requirements (Close-Out)

A non-exhaustive list of close-out, or pre-occupancy, requirements is listed below, but there may be additional requirements depending on the configuration of the development and DCP.

1. Submit Owner's Manual containing, but not limited to, record drawings, construction specifications, approved shop drawings, field review reports, material testing reports, equipment test reports, warranties, commissioning reports, balancing reports, performance validation plan, and copies of the BC Building Code Letters of Assurance for everything related to the DCP (including the base building);

2. Address all outstanding deficiencies to the satisfaction of the Engineer of Record;

3. Address all outstanding items identified by and to the satisfaction of LIEC;

4. Provide signoff from the engineer that all required TSBC inspections and operational checks have been completed;

5. The Developer shall provide LIEC with substantial completion documentation related to the development indicating that all Contractors and Sub-Contractors have been paid and confirmation from the Victoria Land Titles Office that no Liens placed on the work;

6. Sign/execute the General Conveyance as per the Asset Transfer Agreement;

7. Prior LIEC's final acceptance of the system, the Developer's engineer shall submit a sealed letter confirming that the DCP and connected Building (or Strata) mechanical systems have been designed, constructed, and installed in full compliance with the drawings and specifications approved and agreed to in the Development Permit and subsequent Building Permit review stages;

8. Completed Asset Transfer Agreement Schedule A (General Conveyance) including a cost validation report by 3rd party for all assets being transferred to LIEC;

9. Completed Energy Services Agreement Schedule B (Assignment and Assumption Agreement) and Schedule C (Thermal Energy Delivery Parameters);

10. Provision of letters of credit pursuant to the bylaw and/or any covenant registered on the title; and

11. Transfer of utility accounts (BC Hydro, etc.), internet provider account and two (2) sets of access keys/FOB access to LIEC.

Note that reviews by LIEC are not intended to replace the in-house technical review by the Developer's engineer. As such, the Developer bears full responsibility for the engineering, design, construction, and commissioning of the DCP and building HVAC cooling system.

5 Billing and Cost of District Energy Service

5.1 Energy Metering

LIEC will maintain and operate Customer metering to measure total thermal energy supplied to each Building (or Strata), and for submitting quarterly bills to each Building Owner (or Strata) for DE service. The energy meter at each ETS collects data on water flow, cumulative energy, peak demand, and temperatures. Data from each ETS meter is transmitted to a central DEU server for utility billing purposes and to monitor and optimize the DEU. The meters are revenue-grade thermal energy meters that achieve high accuracy and performance and meet existing International and Canadian standards for thermal energy metering.

5.2 CCDEU Bill Structure

Customers are billed to rates determined by Richmond City Council on an annual basis and defined in the Bylaw 9895. The total cost of DE service to Customer Building (or Strata) is competitive with space cooling costs for a conventionally cooled building providing the same level of service. DE rates are expected to be more stable than gas and electricity costs over time.

Tariffs consist of three components:

1. Volumetric Charge, based on thermal energy use in the period;
2. Capacity Charge, based on the gross floor area of conditioned space within the Development (i.e. excluding parkade); and
3. Excess demand fees.

Volumetric Charges cover variable costs, which are primarily energy inputs (i.e., fuel 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 will vary throughout the year.

Capacity Charges cover fixed costs, which include operation and maintenance, equipment replacement, overhead, and the cost of interconnection with the future offsite DEU.

To minimize unnecessary additional capacity and cost, it is important that building Developers do not overestimate Building (or Strata) capacity requirements. Overestimation of peak demand results in higher fixed capacity charges for Customers in the form of an excess demand fee borne by the Developer. LIEC will work closely with building Developers to review realistic system demand requirements.

Similar to other energy utilities in BC, tariffs will be adjusted periodically based on changes in costs over time. The CCDEU service rate is reviewed annually by City of Richmond Council with the objective to keep the annual energy costs for Customers competitive with conventional energy costs, based on the same level of service.

5.3 Sub-Metering

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

6 Division of Responsibilities

This section outlines the responsibilities of the LIEC, the Developer, and the eventual Customer (or Strata) to ensure efficient integration of DE service and system compatibility.

6.1 Developer Responsibility

6.1.1 Building HVAC System

The Developer is responsible for designing and installing the building HVAC system. Ownership of the building HVAC system will remain with the Building (or Strata). The building HVAC system will be supplied with chilled water from the DCP. Specific requirements are outlined in the sections above. The Developer shall not materially change the design or substitute equipment without written approval from LIEC.

6.1.2 Building Energy Supply (DCP)

The Developer is responsible for engineering, designing, installing, and commissioning the DCP, including the cooling plant, the ETS and piping to the FDC. The FDC component will be designed, installed, and commissioned by LIEC in the future. The DCP will meet the thermal energy demands of the building. After commissioning, the ownership of the DCP will be turned over to LIEC. Specific requirements for each of these components are discussed in the sections above. The Developer shall not materially change the design or substitute equipment without written approval from LIEC. After ownership is turned over to LIEC, the Developer/Strata shall not adjust, modify, or tamper with any equipment.

6.1.3 Contract Boundary

The contract boundary between the LIEC owned equipment for the DCP and the building HVAC system at the Strata will be at the ETS. A set of valves on the building side of the heat exchangers will provide a clear demarcation point.

6.1.4 Compliance and Approval Process

The Developer is responsible for initiating the Compliance and Approval Process described in Section 4 and providing all documentation requested. LIEC will not be held responsible for any delays resulting from this process. The Developer shall not materially change the design or substitute any pertinent equipment during installation without LIEC's written approval.

Note that reviews by LIEC are not intended to replace the in-house technical review by the Developer's engineer. As such, the Developer bears full responsibility for the engineering and design of the DCP and connected Building (or Strata) HVAC systems.

The Developer will take all required steps to remedy any defects in the design, construction, and installation of the DCP and connected Building (or Strata) mechanical systems identified by the engineer of record within seven days of notification of the defects. The Developer shall obtain certification under seal from a professional engineer that the DCP and all connected Building (or Strata) mechanical systems have been designed constructed and installed in full compliance with the drawings and specifications approved and agreed to in the Building Permit review stage, prior to LIEC's final acceptance of the system. The Developer will cooperate with LIEC to allow LIEC to work in a timely manner compatible with the construction schedule of the Developer including the installation of municipal services.

6.1.5 Start-Up and Commissioning

Start-up and commissioning of the DCP and all connected Building (or Strata) mechanical systems is the sole responsibility of the Developer. The Developer shall notify LIEC of the date and time of commissioning so that LIEC can provide an on-site representative to witness commissioning.

The Developer is responsible for training LIEC staff or LIEC representative on operation of the DCP, including any specific training from manufacturers/vendors.

6.1.6 Warranty

For three (3) years following the final Building Permit inspection by the City permitting occupancy in respect to the last Building in the Development (the "Warranty Period"), the Developer will correct any defect arising from an error or deficiency in any aspect of the design, workmanship, labour or material in connection with the On Site DEU, save and except normal wear and tear, acts of God, lack of improper maintenance and damage caused by the City or the Service Provider, or those for whom the City or the Service Provider are at law responsible, or by those for whom the Developer is not vicariously liable.

The City or the Service Provider will promptly give the Developer notice in writing of observed defects and deficiencies that occur during the Warranty Period, provided that failure to give notice will not diminish or invalidate the obligation of the Developer to correct defects during the Warranty Period.

Should any repair or replacement work be required (the "Replacement Work") during the Warranty Period, to the extent the City and the Service Provider determine such repair or replacement to be major or significant, the City or the Service Provider may, by written notice to the Developer cause the Warranty Period for the Replacement Work to be extended, together with all consequential obligations of the Developer under this Agreement, related solely to the Replacement Work, by a period of two years from the date of such Replacement Work (the "Extended Warranty Period").

6.1.7 Statutory Right of Way

The Developer shall grant LIEC right of access on, over, and under the Development lands for the purpose of managing, operating, and maintaining the DCP and facilitating the future connection to the CCDEU by way of statutory right of way. In addition, LIEC requires security for payment of the fees and charges relating to the DES and provision of District Energy Services and will grant or cause to be granted to LIEC Statutory Rights of Way over each connected property. Each Statutory Right of Way shall be registered on title for the full lands before the Strata plans are filed against the applicable Strata Plan Lot or Lot in the Victoria Land Title Office and have priority over any financial encumbrance (except-as to the rent charge included in the Statutory Right of Way).

6.2 LIEC Responsibility

6.2.1 Building Energy Supply

Following DCP acceptance and ownership transfer, operation, and maintenance of the DCP is the sole responsibility of LIEC. This includes the DCP, FDC, each ETS, and all connecting DCP Piping. For ETS, LIEC is only responsible for components of the ETS up to the demarcation point. The demarcation point will be clearly marked on each ETS engineering drawing.

6.2.2 Compliance and Approval Process

Once the Developer initiates the compliance and approval process, as outlined in Section 4, LIEC will advise the Developer of any special design or construction standards that LIEC may have. These standards shall be incorporated by the Developer into the specifications for the DCP and all connected Building (or Strata) mechanical systems. LIEC will be involved throughout the design, construction, and commissioning process. LIEC will work closely with the Developer to ensure that the Development and Building Permit processes are not unduly delayed.

Note that reviews by LIEC are not intended to replace the in-house technical review by the Developer's engineer.

6.2.3 Close-Out Requirements

LIEC has the following responsibilities at Close-Out:

- LIEC will review the Developer's submissions and advise of any changes required, or any outstanding items required before the *Certificate of Acceptance* is issued.
- LIEC will issue a *Certificate of Acceptance* once the DCP has been completed to LIEC's satisfaction in accordance with, but not limited to, this document, and that all required documentation has been submitted.
- LIEC will take over ownership of the DCP following issuance of the *Certificate of Acceptance*, and all operation and maintenance items associated with ownership excluding '*Warranty Period*' work which is the Developer's responsibility.

6.3 Customer (Strata) Responsibility

6.3.1 Operation and Maintenance

Operation and maintenance of the Building (or Strata) mechanical system is the sole responsibility of the Customer. This includes all piping and other components necessary to connect the Building (or Strata) mechanical system to the associated ETS at the agreed demarcation point. The demarcation point will be clearly marked on each ETS engineering drawing.

6.3.2 Changes to the Building (or Strata) Mechanical System

After acceptance of the DCP and custody transfer to LIEC, any changes to the Building's (or Strata's) mechanical systems that may impact DCP performance shall be reported to and approved by LIEC 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 DCP and connected FDC, ETS, and DCP Piping is owned and maintained by LIEC. Under no circumstances can the Customer or any of its Contractors adjust, modify, or otherwise tamper with any DCP equipment. This includes adjusting or changing the position of any valves, gauges or instruments and altering the controls and control panel.

6.3.3 Billing and Service Charges

The Customer is responsible for paying all billing and service charges as detailed in the Energy Services Agreement.

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7 Reference Documents

1. *City Centre District Energy Utility: Technical Requirements for Onsite Discrete Cooling Plants*, Lulu Island Energy Company.
2. *City Centre District Energy Utility: Technical Requirements for Onsite Low-Carbon Energy Systems*, Lulu Island Energy Company.
3. *Richmond City Centre District Energy Utility Service: A Design Guide for Connection to District Energy,* Lulu Island Energy Company
4. *City Centre District Energy Utility Bylaw No. 9895*, City of Richmond.
5. *Building Regulation Bylaw No. 7230, Amendment Bylaw No. 9769 (BC Energy Step Code Implementation)*, City of Richmond.
6. *Richmond Official Community Plan Bylaw No. 9000, Amendment Bylaw no. 9771 (Energy Step Code)*, City of Richmond.
7. *New Construction Program's Energy Modelling Guideline,* BC Hydro Power Smart, October 2018.
8. *Corix District Energy Utility SCADA and Controls Design Standards and Guidelines*, Corix Utilities

8 CCDEU Contact Information

For more information on the CCDEU and development requirements, please contact:

Christopher David
Lulu Island Energy Company
Phone: 604-247-4902
Email: cdavid@luluislandenergy.ca

9 LIEC Connection Form

1. Development Information

Basic project information

Parameter	
Project Name	
Project Location	
Developer	
Architect	
Mechanical Engineer	

Provide a breakdown indicating the floor area included as part of each Strata, as each will be served by a separate ETS, and the total conditioned floor area that will be served by the DCP.

Space Type	Strata 1 (m^2)	Strata 2 (m^2)	Strata 3 (m^2)
Residential			
Commercial			
Retail			
Other			
Total			

2. Discrete Cooling Plant (DCP)

List the DCP operating parameters.

Mechanical Statistics	Space Cooling
Supply Temp. (°C)	
Return Temp. (°C)	
Peak Flow Rate (L/s)	
Peak Energy Supply (kW)	

List the energy generation equipment (ASHP, Chillers, Fluid Coolers etc.)

Energy Generation Equipment Type	# of Units	Cooling Capacity per Unit (kW)	Total Cooling Capacity (kW)
Total	N/A	N/A	

3. Energy Supplied by each ETS

Provide the conditions on the building side of each ETS. An ETS is required for each Strata.

Mechanical Statistics	ETS_1	ETS_2	ETS_3
Space Cooling Supply Temp. (°C)			
Space Cooling Return Temp. (°C)			
Space Cooling Flow (L/s)			
Peak Space Cooling Demand (kW)			

4. Annual Energy

Provide annual energy for each type of space.

	Space Cooling (MWh)		
	Residential	Commercial	Other
Jan			
Feb			
Mar			
Apr			
May			
Jun			
Jul			
Aug			
Sep			
Oct			
Nov			
Dec			
Total			

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