CITY OF DULUTH

REQUEST FOR PROPOSALS FOR

ENGINEERING SERVICES FOR DES HOT WATER CUSTOMER CONNECTIONS – PHASE 3

RFP NUMBER 19-20AA

ISSUED 9/30/19

PROPOSALS DUE 10/29/19 AT 2:00 PM

SUBMIT TO

CITY OF DULUTH
ATTN: PURCHASING DIVISION
CITY HALL, ROOM 120
411 WEST 1ST STREET
DULUTH, MN 55802

GENERAL INFORMATION

I-1. Project Overview. Duluth Energy Systems (DES) in Duluth, MN, is leading its conversion from a steam-based district energy distribution network to a hot water-based district energy network. The current once-through steam distribution network under Superior Street in downtown will be replaced with hot water supply and return piping. The future distribution system will provide hot water to DES customers in place of the steam service they receive today. DES is seeking a consultant to develop plans for the conversion of individual DES customer buildings' mechanical systems to receive the future hot water service. DES invites you to submit a proposal for mechanical engineering design and planning for the conversion of the customer buildings from the existing steam system to the future hot water system. Additional detail is provided in this RFP.

I-2. Rejection of Proposals. The City reserves the right, in its sole and complete discretion, to reject any and all proposals or cancel the request for proposals, at any time prior to the time a contract is fully executed, when it is in its best interests. The City is not liable for any costs the Bidder incurs in preparation and submission of its proposal, in participating in the RFP process or in anticipation of award of the contract.

I-3. Pre-proposal Conference. The City will hold a pre-proposal conference on Thursday, October 10, 2019 at 2:30 p.m. at City Hall, 411 West First Street, Duluth, MN in Conference Room 155 (formerly 106A). Site walk-throughs will take place the following week.

I-4. Questions & Answers. Any questions regarding this RFP must be submitted by e-mail to the Purchasing Office at purchasing@duluthmn.gov.

I-5. Addenda to the RFP. If the City deems it necessary to revise any part of this RFP before the proposal response date, the City will post an addendum to its website http://www.duluthmn.gov/purchasing/bids-request-for-proposals/ . Although an e-mail notification will be sent, it is the Bidder's responsibility to periodically check the website for any new information

I-6. Proposals. To be considered, hard copies of proposals must arrive at the City on or before the time and date specified in the RFP Calendar of Events. The City will not accept proposals via email or facsimile transmission. The City reserves the right to reject or to deduct evaluation points for late proposals.

Proposals must be signed by an authorized official. If the official signs the Proposal Cover Sheet, this requirement will be met. Proposals must remain valid for 60 days or until a contract is fully executed.

Please submit one (1) paper copy of the Technical Submittal and one (1) paper copy of the Cost Submittal. The Cost Submittal should be in a separate sealed envelope. In addition, Bidders shall submit one copy of the entire proposal (Technical and Cost submittals, along with all requested documents) on flash drive in Microsoft Office-compatible or pdf format.

All materials submitted in response to this RFP will become property of the City and will become public record after the evaluation process is completed and an award decision made.

I-7. Small Diverse Business Information. The City encourages participation by minority, women, and veteran-owned businesses as prime contractors, and encourages all prime contractors to make a significant commitment to use minority, women, veteran-owned and other disadvantaged business entities as subcontractors and suppliers**.** A list of certified Disadvantaged Business Enterprises is maintained by the Minnesota Unified Certification Program at http://mnucp.metc.state.mn.us/ .

I-8. Term of Contract. The term of the contract will begin once the contract is fully executed and is anticipated to end by May 31, 2020. The selected Bidder shall not start the performance of any work nor shall the City be liable to pay the selected Bidder for any service or work performed or expenses incurred before the contract is executed.

I-9. Mandatory Disclosures. By submitting a proposal, each Bidder understands, represents, and acknowledges that:

A. Their proposal has been developed by the Bidder independently and has been submitted without collusion with and without agreement, understanding, or planned common course of action with any other vendor or suppliers of materials, supplies, equipment, or services described in the Request for Proposals, designed to limit independent bidding or competition, and that the contents of the proposal have not been communicated by the Bidder or its employees or agents to any person not an employee or agent of the Bidder.

B. There is no conflict of interest. A conflict of interest exists if a Bidder has any interest that would actually conflict, or has the appearance of conflicting, in any manner or degree with the performance of work on the project. If there are potential conflicts, identify the municipalities, developers, and other public or private entities with whom your company is currently, or have been, employed and which may be affected.

C. It is not currently under suspension or debarment by the State of Minnesota, any other state or the federal government.

D. The company is either organized under Minnesota law or has a Certificate of Authority from the Minnesota Secretary of State to do business in Minnesota, in accordance with the requirements in M.S. 303.03.

I-10. Notification of Selection. Bidders whose proposals are not selected will be notified in writing.

DULUTH ENERGY SYSTEMS
MECHANICAL ENGINEERING DESIGN AND PLANNING
SCOPE OF WORK

Table of Contents

Request for Proposal 3
1. Project Overview 3
1.1. Preliminary Schedule 3
2. Project Description and Scope of Services 4
3. Specific Project Information 5
4. Evaluation Criteria and Contract Award 5

Request for Proposal

1. Project Overview

Duluth Energy Systems (DES) in Duluth, MN, is leading its conversion from a steam-based district energy distribution network to a hot water-based district energy network. The current once-through steam distribution network under Superior Street in downtown will be replaced with hot water supply and return piping. The future distribution system will provide hot water to DES customers in place of the steam service they receive today. DES is seeking a consultant to develop plans for the conversion of individual DES customer buildings' mechanical systems to receive the future hot water service. DES invites you to submit a proposal for mechanical engineering design and planning for the conversion of the customer buildings from the existing steam system to the future hot water system.

1.1. Preliminary Schedule

It is anticipated that the selected proposal will be accepted by**Tuesday, October 29th, 2019**. A Notice of Award is expected to be issued by **Wednesday, November 13th, 2019**. The company selected shall consider a signed and accepted Notice of Award as permission to begin work designing the aspects of the customer conversions described in this RFP. Building walkthroughs should begin immediately following signed contract arrangements. The company awarded the contract shall provide construction documents for all buildings (as described in Section 2) by **Friday, February 28th, 2020**.

For the process of preparing the proposal, DES project representatives will walk through some representative mechanical rooms to be converted. These walkthroughs will be scheduled after the pre-bid meeting. Companies are encouraged to send a representative to get a more complete sense of the required design work.

A prelimary schedule is as follows:

Milestone	Date
Pre-Bid Meeting	Oct. 10, 2019
Pre-Bid Site Walkthroughs	Oct. 14-18, 2019
Proposals Due	Oct. 29, 2019
Notice of Award	Nov. 13, 2019
Design Documents Complete	Feb. 28, 2020

Pre-bid meeting will be posted on the City of Duluth Purchasing website.

2. Project Description and Scope of Services

DES is requesting services of a contractor/consultant to perform design for the customer building mechanical conversions as described above. It is anticipated that each of the conversions will be unique, so a specific design for each building is required. The scope of services includes:

- Building load estimate and equipment sizing. Sizing shall include, but not limited to, heat exchangers, pumps, piping, terminal equipment (radiators, coils, unit heaters, etc.), and control valves. Provide equipment schedules.
- Preparation of the design elements of the customer building mechanical system conversions, including the locations, necessary piping, appurtenant items, controls, valves, etc. for the construction of the items listed in Section 3.
- Preparation of construction plans for the construction of the components designed, signed by a Professional Engineer, Licensed in the State of Minnesota.
- Preparation of specifications related to the conversions, signed by a Professional Engineer, Licensed in the State of Minnesota.
- Prepare and participate in biweekly meetings with DES or as requested by its Project Manager.

The conversion of the existing customer buildings from steam to hot water will require the completion of engineering documents to identify the steps required to allow the building to utilize the hot water district energy system. The selected consultant shall perform the mechanical design and generate documents required to convert each customer building from steam to hot water. This package will be supplied to contractors for bidding and construction.

Preliminary process and instrumentation diagrams for the hot water service entrance and energy transfer stations are shown in **Attachment A: Preliminary Hot Water Connection Diagrams**. A brief summary of each building's current heating system along with historic steam load is shown in **Attachment B: Building Summaries**. The preliminary energy transfer station schedule is shown in **Attachment C: ETS Schedule**. The Preliminary energy transfer station specification control document is shown in **Attachment D: ETS Specification Control Document**.

For each customer building identified in the ETS Schedule, the work shall include, but not be limited to:

- Provide peak load estimates and operating temperatures for the building heating loops. Size the heat exchangers and pumps to serve their relative heating loops.
- Generate the necessary design documents to concisely detail and specify the connection of the customer building to the district energy system (primary side). This shall include the location of the service entrance, the shutoff valves, the shunt assembly, appurtenances (drains, vents, etc), btu meter, and the location of the energy transfer station. All equipment shall include

necessary operating and maintenance clearances. The design shall include, where possible, a modular/pre-fabricated hot water energy transfer station. Identify any required demolition.

- Generate the necessary design documents to concisely detail and specify the conversion process for the building (secondary side). The design shall include any additional radiation, terminal units, heat transfer equipment, vents, drains, pumps, equipment relocation, or other work required to convert the building and serve the customer load. Identify any required demolition.

It is expected that the contractor/consultant will perform in person site walkthroughs in each of the customer building mechanical rooms to accurately design and detail the conversion work necessary in each of the buildings. Site walkthroughs should be coordinated through DES (218-723-3601) to obtain access to the buildings.

3. Specific Project Information

Description of the project approach you would typically take in organizing and completing a project of this type, description shall include:

- Identification of work to be completed by your firm as it relates to this Request for Proposal.
- Outline the steps that will be taken to perform the mechanical system conversion designs.
- Listing of the types of services or assistance you would require from DES.
- Project schedule.
- Completion of the DEED Jobs Report and Worksheet for State Funded Projects. Form will be provided by DES.

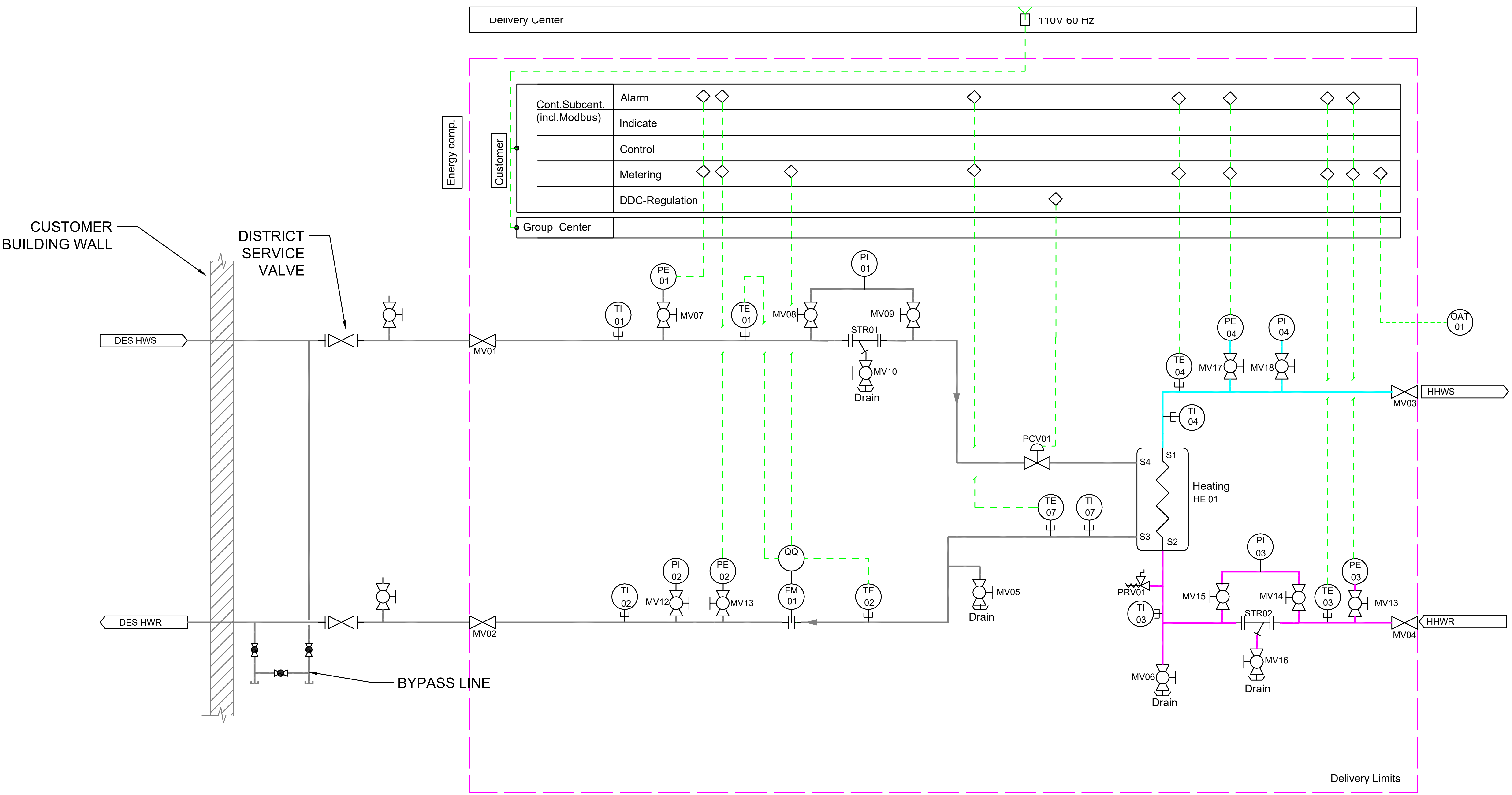
4. Evaluation Criteria and Contract Award

DES will evaluate and validate all qualifying proposals. The proposal evaluation process will permit DES to identify the proposal that best meets the needs of DES. Estimated project fees will be the primary criterion considered, but each proposal will be evaluated and scored as follows:

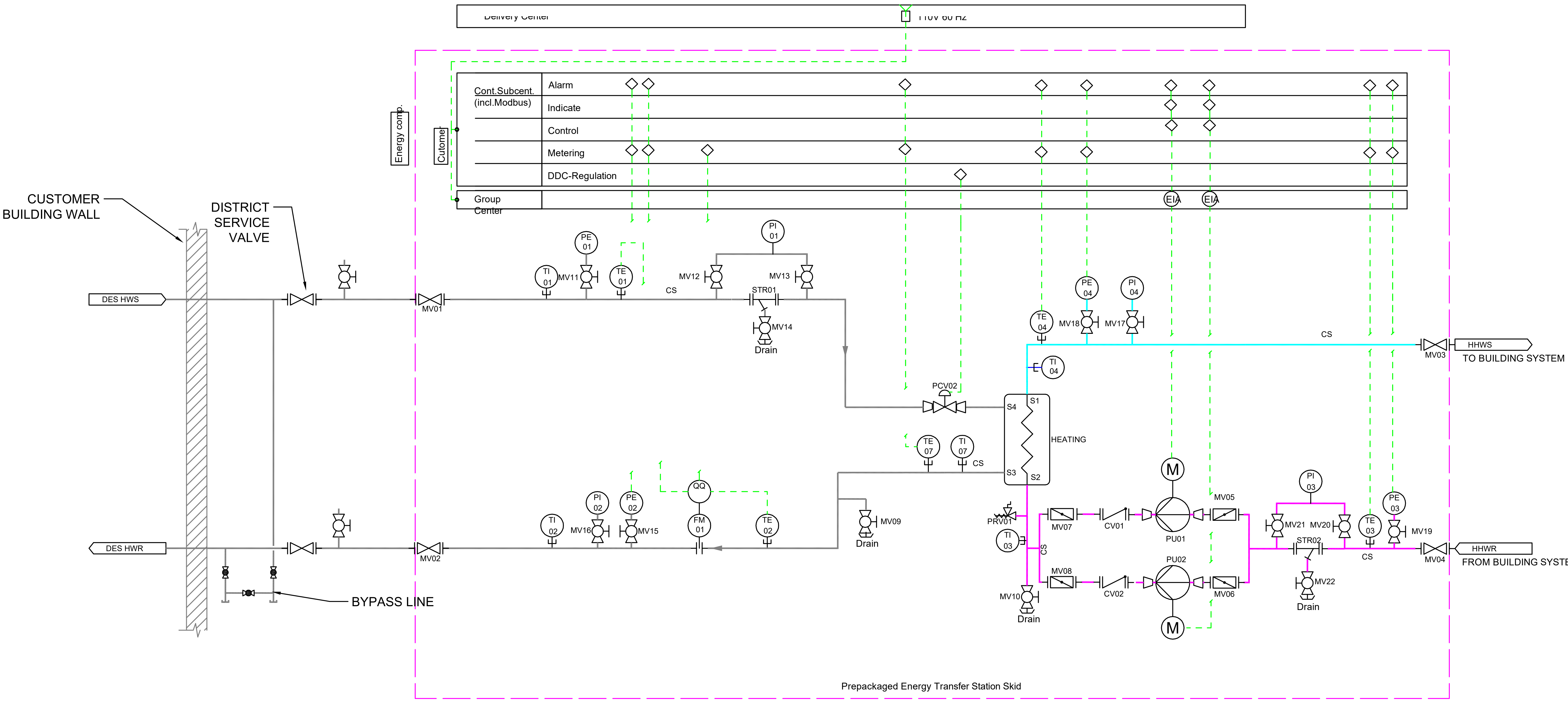
Selection Criteria	**Scoring (Pts)**
Estimated project fees.	45
Understanding of the requirements of this project.	20
Background experience of the firm and the project team as it directly relates to this project.	20
Qualifications and experience of key personnel assigned to this project.	10
Clarity, conciseness, and organization of the proposal.	5

The award of contract will be made utilizing the above criteria.

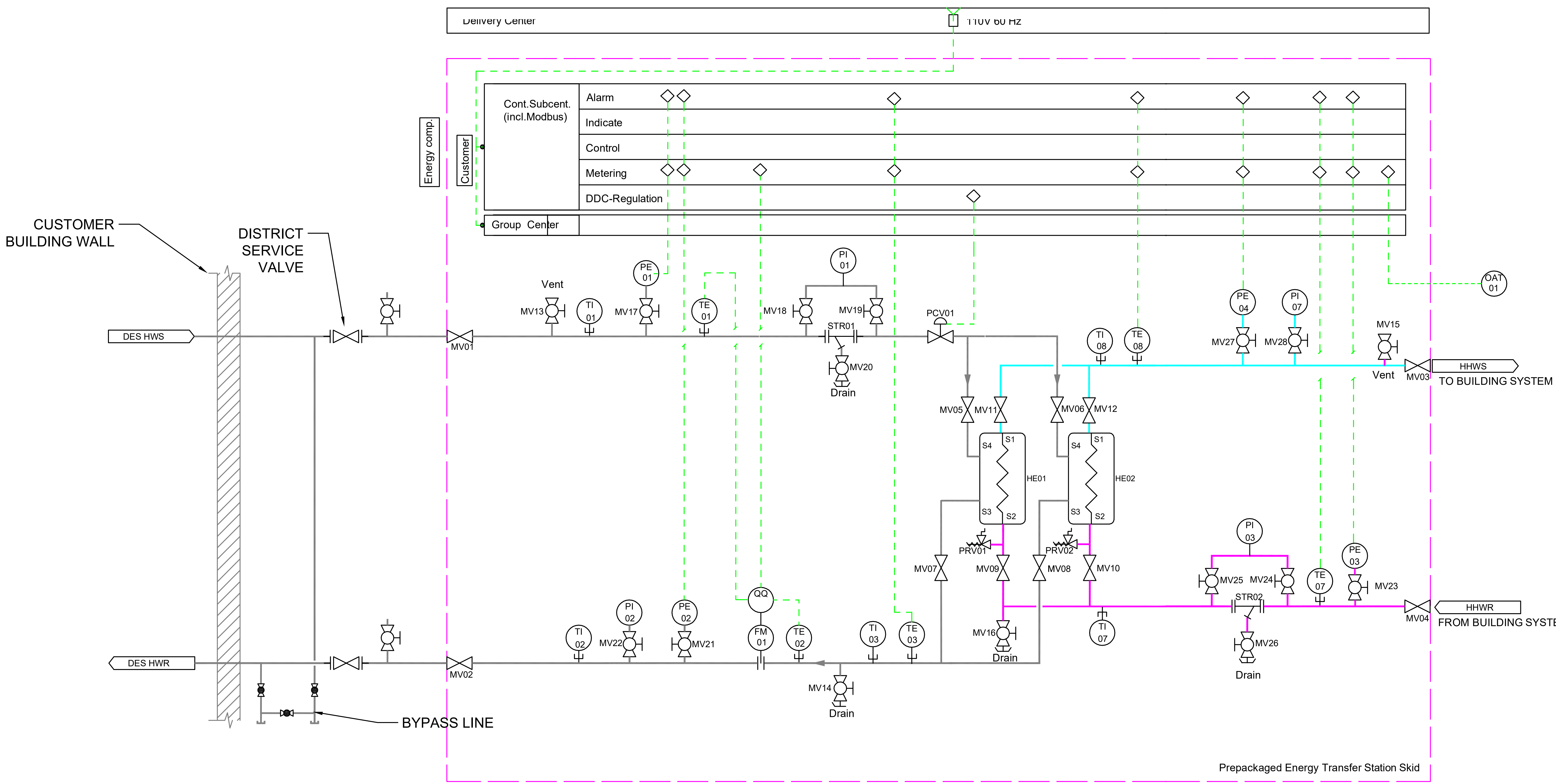
Space Heating without Secondary Pumps



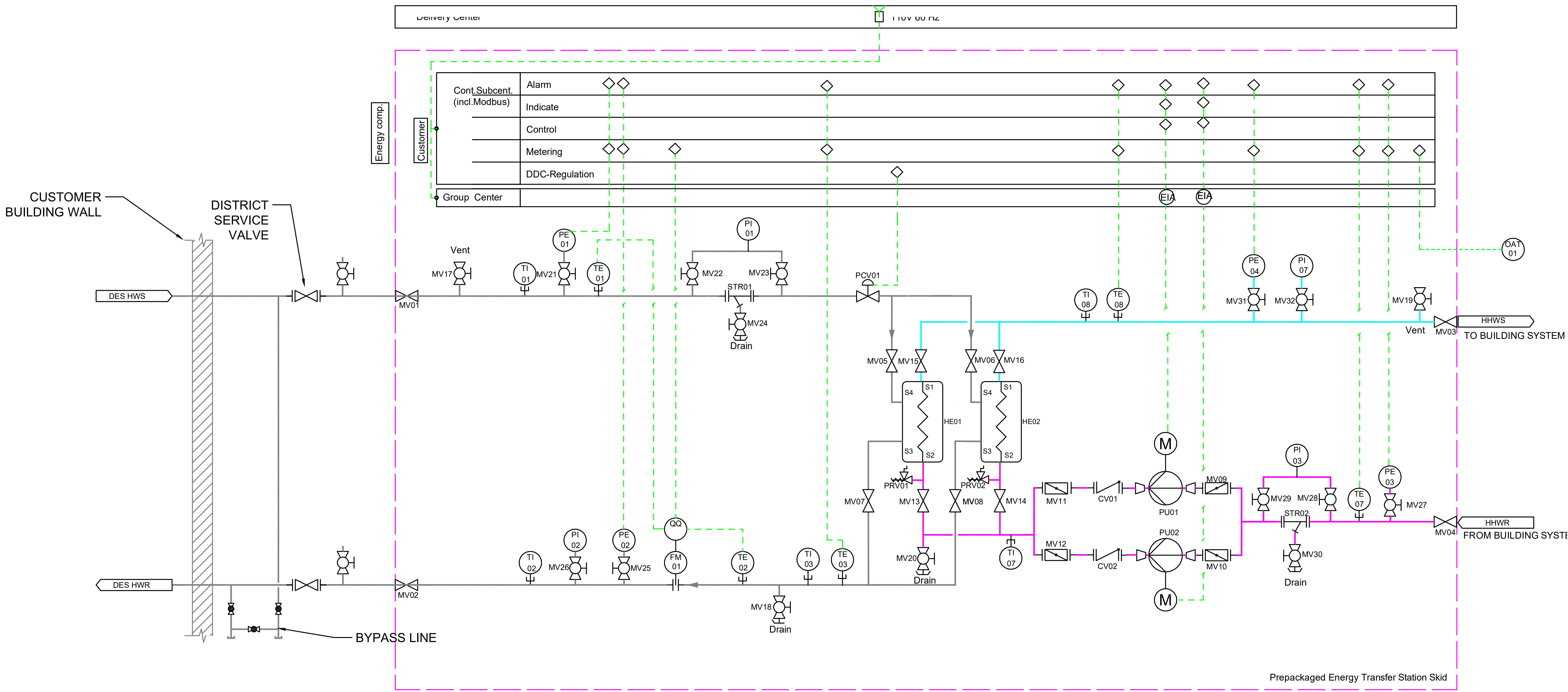
Space Heating with Secondary Pumps



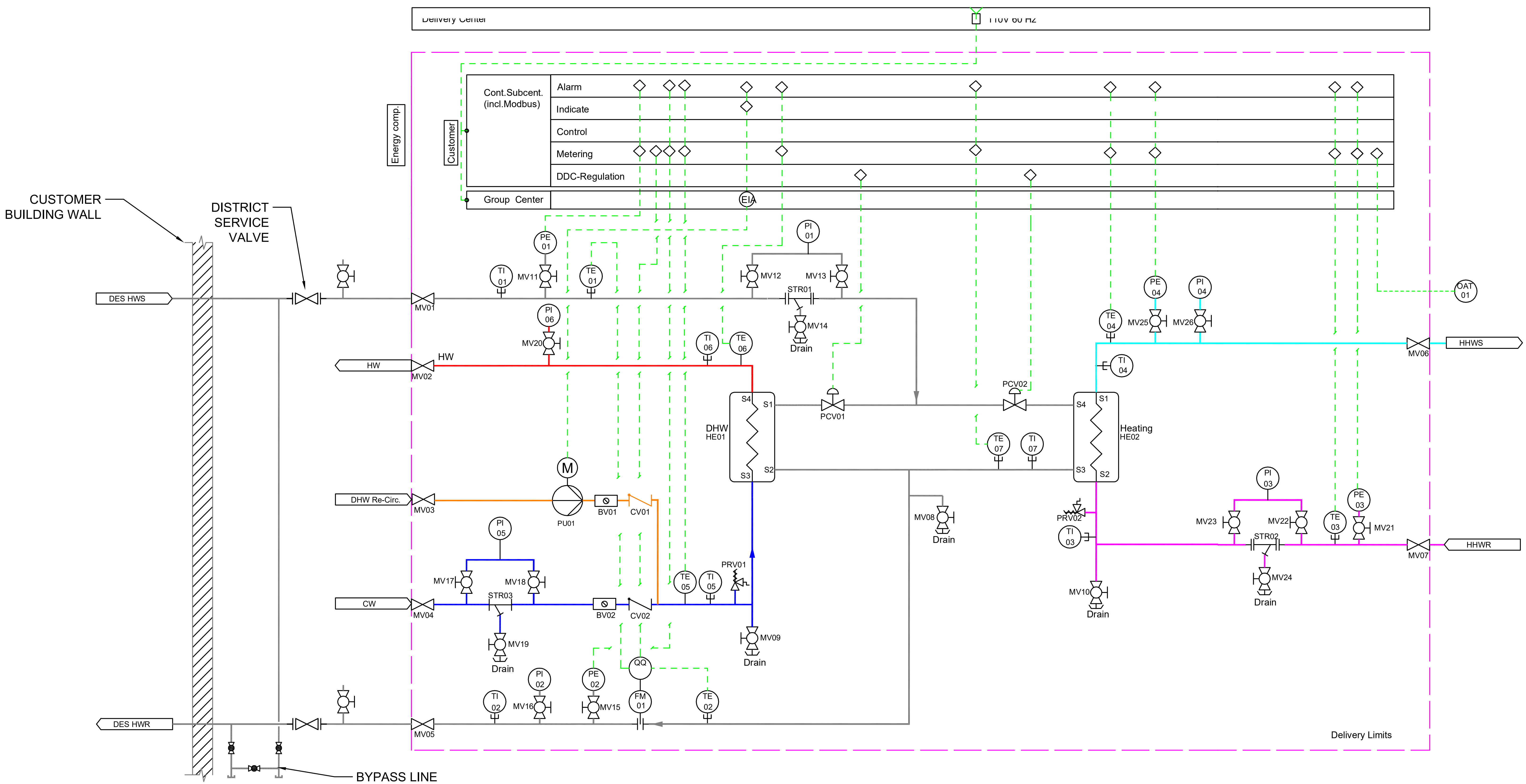
Space Heating without Secondary Pumps
Redundant Heat Exchangers



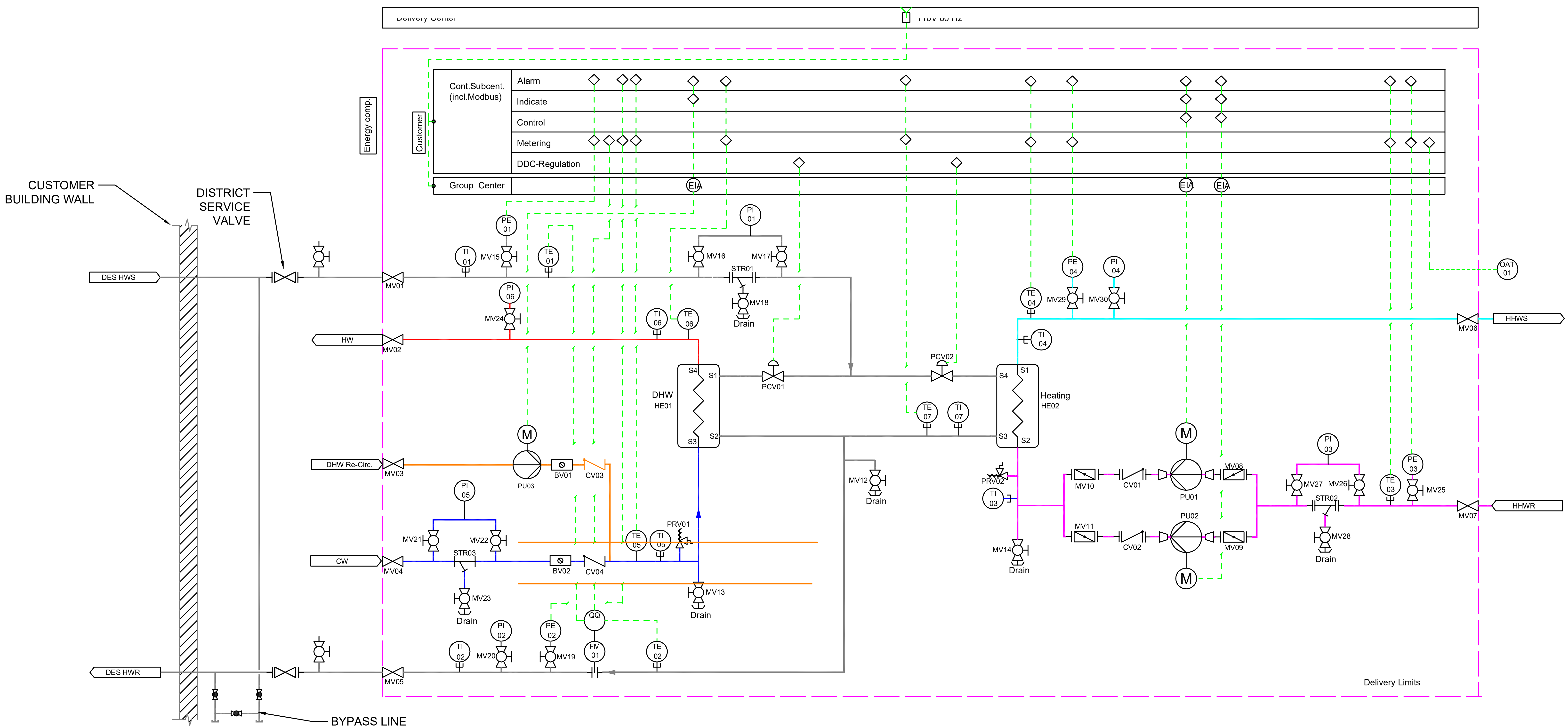
Space Heating with Secondary Pumps
Redundant Heat Exchangers



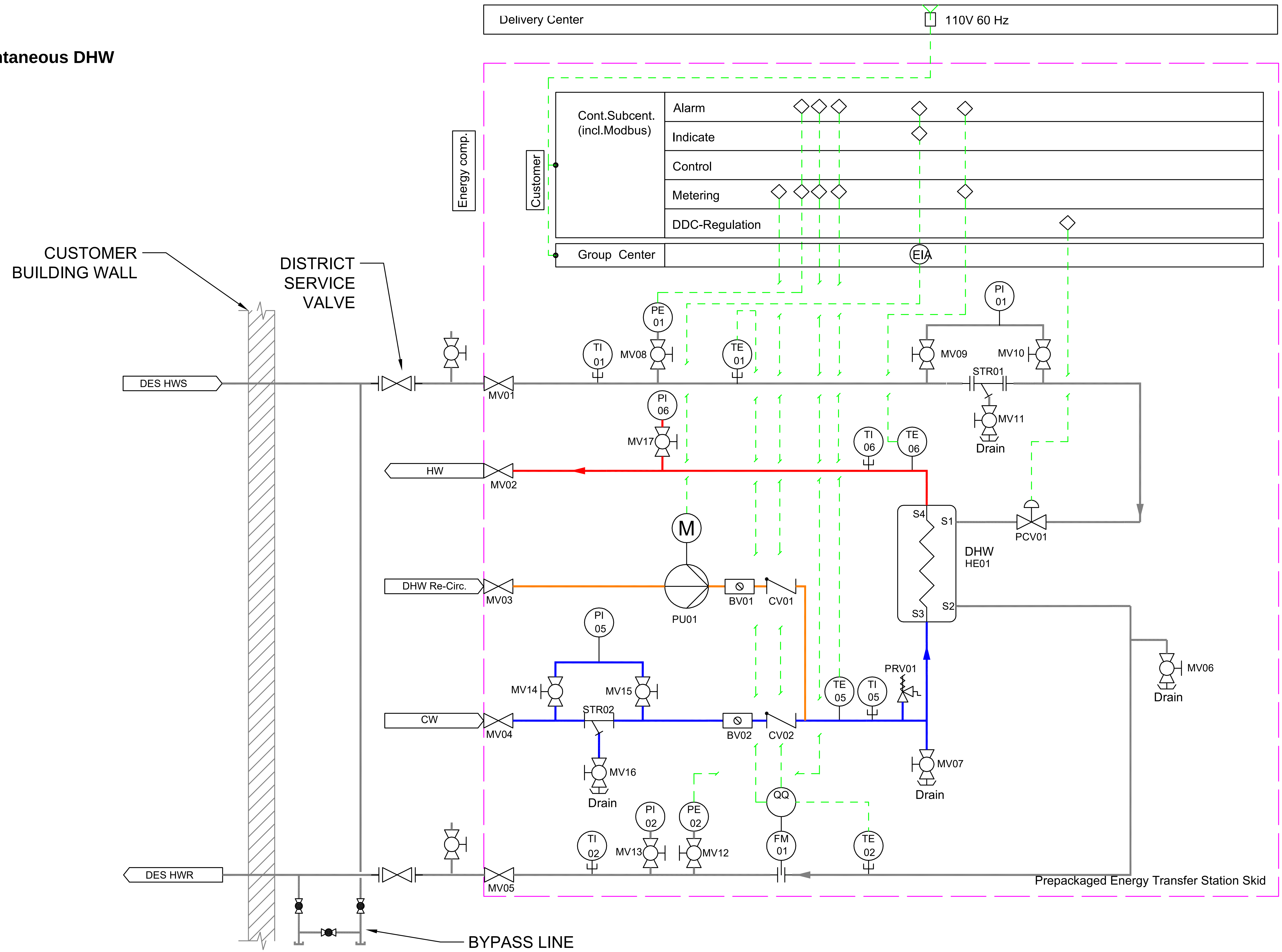
Space Heating without Secondary Pumps
Instantaneous DHW



Space Heating with Secondary Pumps
Instantaneous DHW



Instantaneous DHW



Northshore Bank of Commerce Notes:

Address: 131 W and 125 W Superior St

Customer Number - 2400 (125W) and 2490 (131W)

Current Status:

- Two separate buildings: 131W and 125W
- One mechanical room –
  - One domestic hot water system shared with both buildings
  - Steam DHW Hx
- 125W Building steam lateral comes from the 123W building
- 131W Building steam lateral comes from 2nd Ave W
- 125W Building:
  - There are four separate steam coils in AHU
    - Three on the top floor (cupola)
    - One on the second floor
  - There is one (1) unit heater at the Superior St entrance
  - There is a second unit heater in the stairwell going to the second floor
  - Second floor (Skywalk level) on Superior St has finned tube radiators in the two (2) offices looking out onto the street
- 131W Building:
  - There are four (4) separate steam coils in AHU located in the copala

- There is a pipe chase from the mechanical room to the copala
  - There is a UH on Superior St level at the bottom of the staircase coming from the Skywalk
  - Under the main entrance in the basement there is a finned tube radiator
  - Superior St level, front of building has finned tube radiation under the window

Basement

- Mechanical room in basement
  - Energy transfer station will be located here
  - Area and steam lateral both well insulated – area not seeing much radiant heat
- Sidewalk vaults will not be filled
- Finned Tube radiation in vault under main bank entrance (131W)
- Basement semi-finished space
  - Service lateral route will follow hallway in 125W building to mechanical room
  - Two holes will need to be bored through a blue stone wall to access the mechanical room

Superior St Level

- Finned tube radiation under front window of the 131W building
- Unit heater at bottom of each stairway coming from Skywalk in each building (total of two)

2nd Ave Entrance

- Unit heater between entrance doors??

Second Floor/Skywalk Level

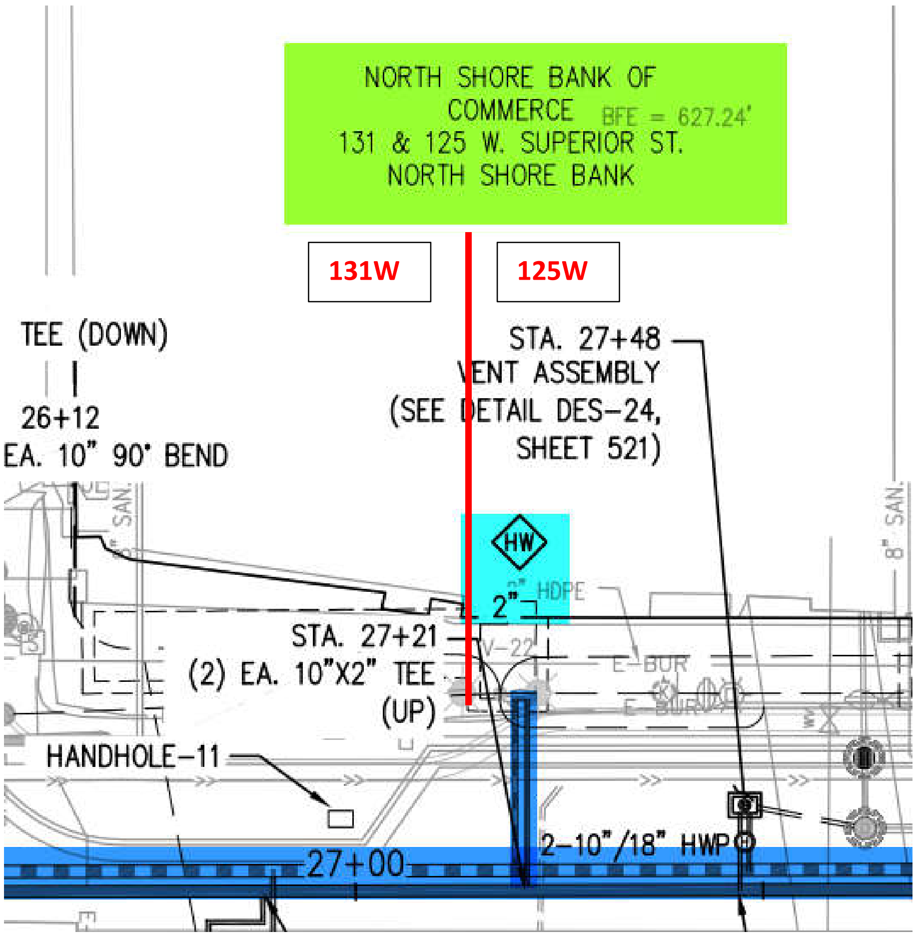
- Two offices in 125W have finned tube radiation under the windows facing Superior St

Other

- Domestic Hot Water will need to be converted from steam to HW (potential to replace with electric)

Proposed Hot Water Service Lateral Location and Size:

- Service Lateral will be separate supply/return lines – 2” Logstor integrated pipe
- This service lateral will come in from Superior St through the 125W building



Historical Steam Usage:

	NBC - total Historical Steam Usage											
	Dec	Nov	Oct	Sep	Aug	Jul	Jun	May	Apr	Mar	Feb	Jan
2019	0	0	0	0	72,000	102,000	95,000	162,000	168,000	86,000	253,000	263,000
2018	199,000	90,000	150,000	48,000	48,000	41,000	56,000	94,000	114,000	170,000	166,000	209,000
2017	145,000	141,000	122,000	51,000	73,000	50,000	65,000	117,000	151,000	176,000	187,000	216,000
2016	204,000	202,000	135,000	88,000	75,000	78,000	96,000	142,000	172,000	209,000	251,000	223,000
2015	206,000	152,000	136,000	80,000	70,000	70,000	116,000	147,000	165,000	197,000	270,000	247,000
2014	209,000	212,000	137,000	96,000	61,000	54,000	81,000	102,000	128,000	158,000	161,000	199,000
2013	173,000	135,000	107,000	56,000	45,000	41,000	65,000	116,000	179,000	137,000	152,000	116,000
2012	143,000	78,000	68,000	79,000	75,000	68,000	96,000	138,000	125,000	114,000	152,000	148,000
2011	128,000	115,000	73,000	58,000	22,000	14,000	76,000	90,000	117,000	142,000	152,000	158,000
2010	186,000	115,000	68,000	61,000	29,000	32,000	63,000	88,000	81,000	116,000	151,000	172,000
2009	172,000	155,000	100,000	110,000	76,000	63,000	72,000	76,000	90,000	132,000	152,000	221,000
Annual Avg.	**160,455**	**126,818**	**99,636**	**66,091**	**58,727**	**55,727**	**80,091**	**115,636**	**135,455**	**148,818**	**186,091**	**197,455**
Max Monthly Usage	**209,000**	**212,000**	**150,000**	**110,000**	**76,000**	**102,000**	**116,000**	**162,000**	**179,000**	**209,000**	**270,000**	**263,000**

Sawmill Unpainted Furniture Building Notes:

Address: 118 W Superior St

Customer Number - 2950

Current Status: All steam radiation building

- Steam service lateral enters building from Michigan St in sub-basement
- Building currently in flux. Owner has plans for the Superior St level but no plans for the other two levels
- Entrances do not have air locks
- No skywalk through this building

Sub-Basement

- Some of the steam lines are missing insulation and providing radiant heat to the basement
- Condensate coolers hanging from the ceiling providing heat to the basement and Michigan St level floor in that area
- Sub-basement has shelving racks and not used for much more than storage

Michigan St Level

- This level used to have a wood shop for fabricating furniture
- Fab area has three (3) ceiling hung unit heaters scattered randomly
- The other areas on this floor also have ceiling hung unit heaters, six (6) additional, scattered randomly around
- It appears that these unit heaters were added as needed
- It appears that each unit heater has its own thermostat

Superior St Level

- Radiation under main storefront window
- Radiation in office in rear of building

Second Floor

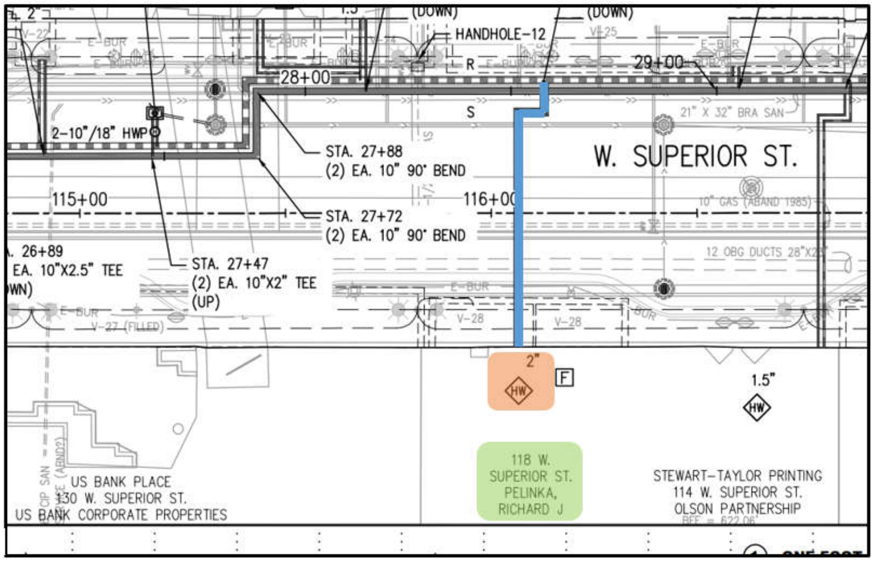
- Two (2) make up air units on the second floor
  - One unit has an old air compressor connected to it for a cooling loop. Owner didn't know if it was functional or not
- Radiators underneath windows on Superior St side
- Radiators in the bathrooms on the Michigan St side
- A few other radiators scattered on this floor as well. A couple of radiators disconnected and moved from their original position.

Other

- Electric domestic hot water – to remain

Proposed Hot Water Service Lateral Location and Size:

- Service Lateral will be separate supply/return lines – 2"
- According to drawing there are two separate sidewalk vaults (V-28). No determination as of now whether these will be filled during construction or not.



Historical Steam Usage:

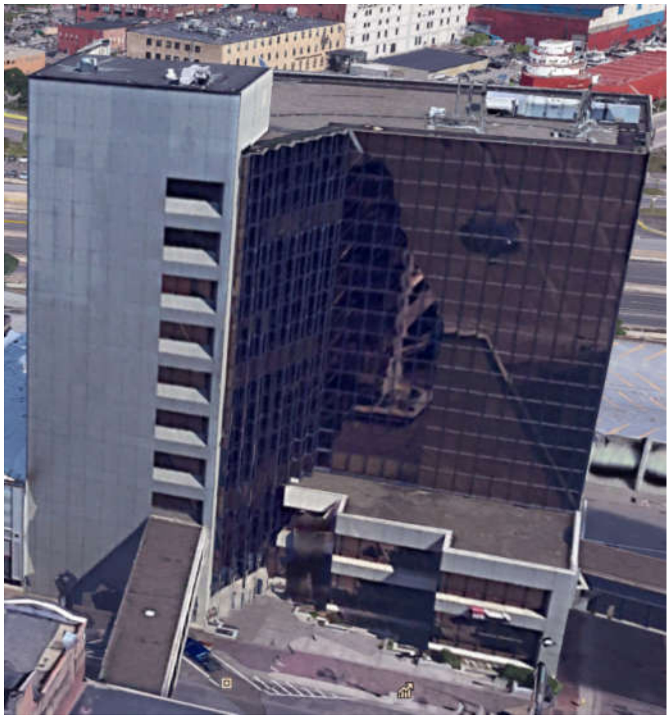
	Sawmill Unpainted Furniture Store Historical Steam Usage											
	Dec	**Nov**	**Oct**	**Sep**	**Aug**	**Jul**	**Jun**	**May**	**Apr**	**Mar**	**Feb**	**Jan**
2019					4,000	5,000	4,000	7,000	17,000	37,000	44,000	48,000
2018	43,000	32,000	5,000	4,000	4,000	4,000	4,000	5,000	23,000	39,000	41,000	73,000
2017	47,000	62,000	39,000	0	0	0	1,000	4,000	9,000	29,000	25,000	48,000
2016	43,000	8,000	0	0	0	0	0	0	1,000	11,000	23,000	30,000
2015	9,000	3,000	0	0	0	3,000	5,000	6,000	7,000	12,000	44,000	24,000
2014	0	0	0	0	0	0	0	2,000	17,000	28,000	45,000	66,000
2013	50,000	22,000	5,000	0	0	0	2,000	8,000	15,000	24,000	33,000	34,000
2012	19,000	2,000	0	0	0	0	0	0	0	9,000	31,000	22,000
2011	23,000	29,000	0	0	0	0	0	0	1,000	33,000	53,000	60,000
2010	67,000	15,000	0	2,000	3,000	3,000	4,000	3,000	8,000	16,000	47,000	58,000
2009	53,000	8,000	0	0	0	0	19,000	5,000	13,000	33,000	36,000	67,000
Annual Avg.	**43,125**	**22,250**	**0**	**0**	**0**	**0**	**0**	**3,636**	**12,222**	**24,636**	**38,364**	**48,182**
Max Monthly Usage	**67,000**	**62,000**	**39,000**	**4,000**	**4,000**	**5,000**	**19,000**	**8,000**	**23,000**	**39,000**	**53,000**	**73,000**

.

US Bank Notes:

Address: 130W Superior St

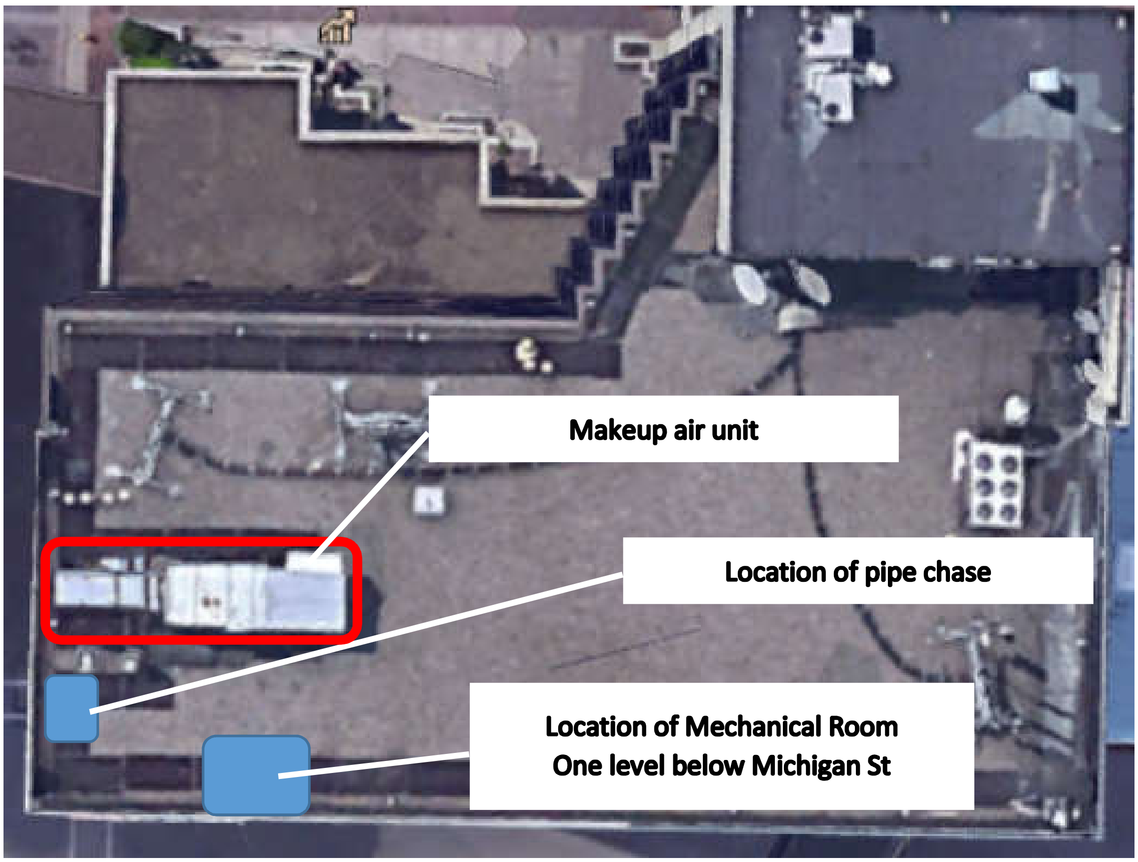
Customer Number - 2350



Current Status:

- Heat pump loop
  - Two (2) 3,500 gallon buffer tanks under the sidewalk vault on Michigan St
  - Four heat pump loop circulating pumps
    - One (1) primary for the lower half of the building and one (1) backup
    - One (1) primary for the upper half of the building and one (1) backup
  - One (1) steam to hot water heat exchanger with two steam control valves (1/3rd , 2/3rd)
  - Two (2) injection pumps to side stream a portion of the heat pump loop water through the heat exchanger and inject back into the main loop to control temperature
- Hydronic Radiation Loop
  - Radiation loop consists of:
    - One steam to hot water heat exchanger with two steam control valves (1/3rd, 2/3rd)
    - Three circulating pumps for different zones within the building
- Make up air unit (MAU)
  - MAU is currently a steam coil unit on the roof fed with low pressure steam from the mechanical room

- LP steam line follows a pipe chase behind an elevator located in the SW corner of the building
- Humidification
  - Steam humidifier located at the top of the MAU LP steam pipe chase
- Domestic hot water is currently electric and will remain so.
- Mechanical room is one level below Michigan St. See location of mechanical room in Figure below:

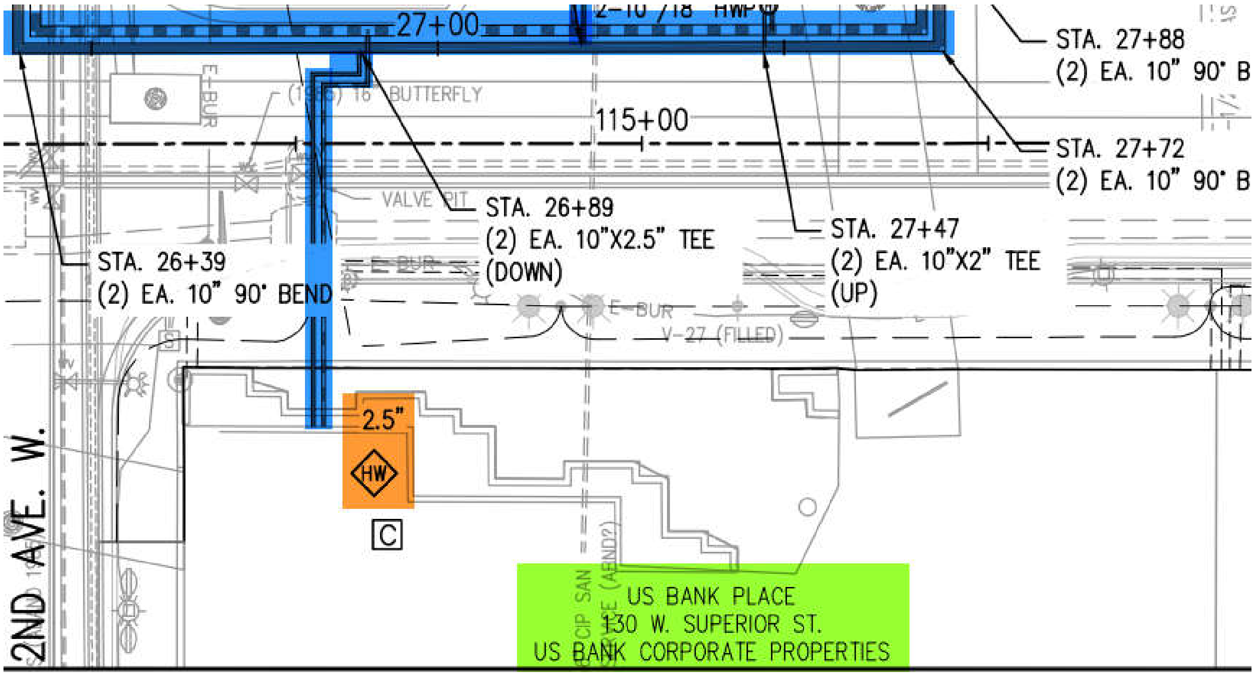


Building Conversion

The mechanical room does not have much room to install a pre-fabricated energy transfer station (ETS). This will increase the labor to demo the current Hx and pumps and stick build new Hx's and pumps in their place. US Bank is seeking capital to replace the MAU on the roof. If this capital is denied, new hot water coils will need to be spec'd and installed in the current unit. These coils, Hx, and circulating pumps will need to be sized for a glycol system.

Proposed Hot Water Service Lateral Location and Size:

- Service Lateral will be separate supply/return lines – 2.5" Logstor integrated pipe
- This service lateral will come in from Superior St
- A tentative route from the building penetration to the mechanical room has already been laid out by the building maintenance manager



Historical Steam Usage:

	US Bank (2350) Historical Steam Usage											
	Dec	**Nov**	**Oct**	**Sep**	**Aug**	**Jul**	**Jun**	**May**	**Apr**	**Mar**	**Feb**	**Jan**
2019					2,000	17,000	133,000	160,000	208,000	226,000	271,000	283,000
2018	201,000	216,000	60,000	1,000	1,000	2,000	52,000	136,000	204,000	194,000	233,000	346,000
2017	251,000	151,000	26,000	0	2,000	2,000	2,000	32,000	132,000	219,000	228,000	324,000
2016	290,000	108,000	9,000	8,000	8,000	8,000	12,000	93,000	137,000	176,000	312,000	349,000
2015	206,000	134,000	53,000	5,000	4,000	3,000	28,000	95,000	152,000	419,000	496,000	457,000
2014	406,000	214,000	77,000	0	0	0	18,000	112,000	160,000	253,000	329,000	408,000
2013	293,000	209,000	104,000	0	0	0	79,000	201,000	257,000	258,000	337,000	328,000
2012	295,000	211,000	147,000	0	0	0	0	137,000	277,000	276,000	284,000	300,000
2011	245,000	214,000	25,000	0	0	1,000	20,000	101,000	153,000	294,000	286,000	327,000
2010	352,000	137,000	0	0	0	0	0	72,000	110,000	142,000	278,000	325,000
2009	309,000	102,000	82,000	0	0	9,000	40,000	56,000	180,000	237,000	289,000	412,000
Annual Avg.	**284,800**	**169,600**	**58,300**	**1,400**	**1,545**	**3,818**	**34,909**	**108,636**	**179,091**	**244,909**	**303,909**	**350,818**
Max Monthly Usage	**406,000**	**216,000**	**147,000**	**8,000**	**8,000**	**17,000**	**133,000**	**201,000**	**277,000**	**419,000**	**496,000**	**457,000**

Wells Fargo Building Notes:

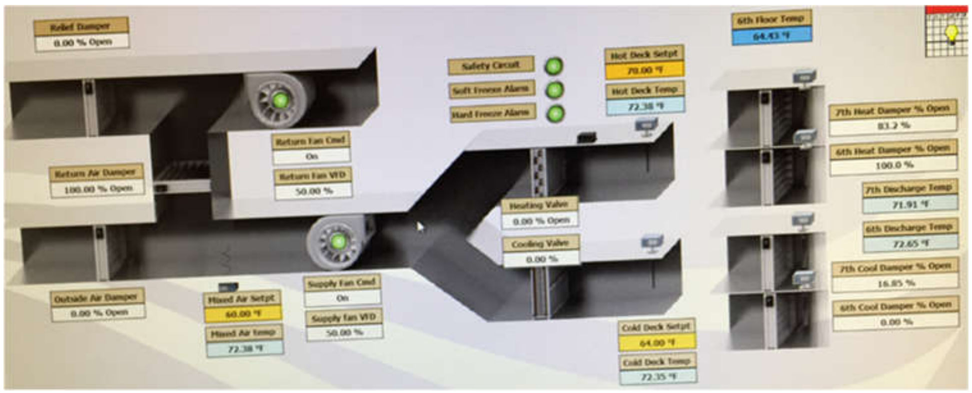
Address: 230 W. Superior St

Customer Number – 4310

Current System:

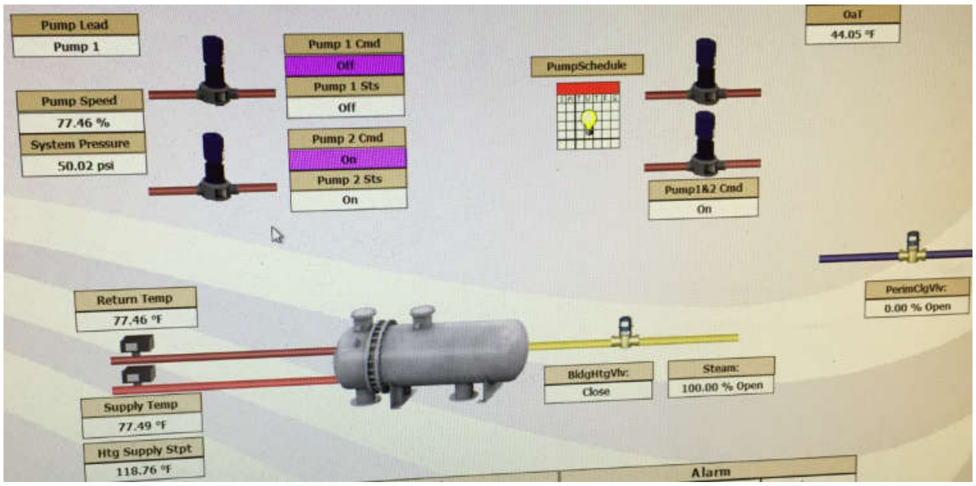
- Steam fed from Michigan
- Building has a chiller located in basement (SD) mechanical room
- Building has to be physically switch from heating to cooling or vice versa during the shoulder seasons
- Mechanical room sub-grade to Michigan St. (Two levels below Superior St.)
- Air Handling Units
    - Seven (7) Units – Located on Floors SD (basement), 1^{st}, 3^{rd}, 5^{th}, 7^{th}, 9^{th} (two on this floor)
        - Each unit is set up with a hot deck (steam coils) and a cold deck
        - Hot deck is typically two steam coils
        - Cold decks are isolated, drained, and filled with glycol during the winter
        - Four (4) downstream dampers (two on the hot deck and two on the cold deck) are controlled based on the discharge air temperature of the coils. One set of dampers (one hot, one cold) controls one floor. One AHU typically controls two floors. One hot duct damper is connect to one cold duct damper with connecting rods in an attempt to maintain the discharge air temperature set point for each floor.
        - The following AHU controls the temperatures on the following floors:
            - AHU #1 – Floor SD and AB

- AHU #2 - Floor #1 Vestibule and Teller Line
- AHU #3 - Floors 2nd and 3rd
- AHU #4 - Floors 4th and 5th
- AHU #5 - Floors 6th and 7th
- AHU #6 - Floor 8
- AHU #7 - Potential Future Unit
- AHU #8 - Serves perimeter of Floors 1 through 8
- AHU #9 - Floor 9



- Unit heaters
  - Northeast and Southwest stairway originally had a cabinet heater on every floor. Over the years this number has been reduced dramatically as they failed.
    - Northeast stairway had 11 cabinet heaters with a thermostat on the 5th floor controlling all of them
    - Southwest stairwell had 10 cabinet heaters with a thermostat on the 5th floor controlling all of them
  - Floor AB (AB=AutoBank, Michigan St level) there are two cabinet heaters, one in the janitors room and one in the adjoining garbage can room
  - Ninth floor penthouse mechanical room has two unit heaters suspended from the ceiling
  - Ninth floor atrium has eight cabinet unit heaters spread around the floor. This floor used to a restaurant but has long since been abandoned
  - The following floors have additional unit heaters:
    - Third Floor – 1
    - Fourth Floor – 2
    - Fifth Floor – 1
    - Sixth Floor - 2
    - Seventh Floor – 2
    - Eight Floor – 2
- Heating and Ventilating Units – two units
  - Floor AB in the MN Ballet back room
  - Floor SD (SD=Security Deposit, one level below Michigan St.) outside the main mechanical room. This unit hasn't worked in years according to personnel.

- Window units
    - Each window has a cabinet unit with a heating/cooling coil mounted inside along with a duct that is fed from AHU #8
    - Window units are all connected with a hydronic circulating loop that has a heat exchanger and circulating pumps in the 9th floor penthouse mechanical room
    - The circulating loop is valved for summer and heating seasons

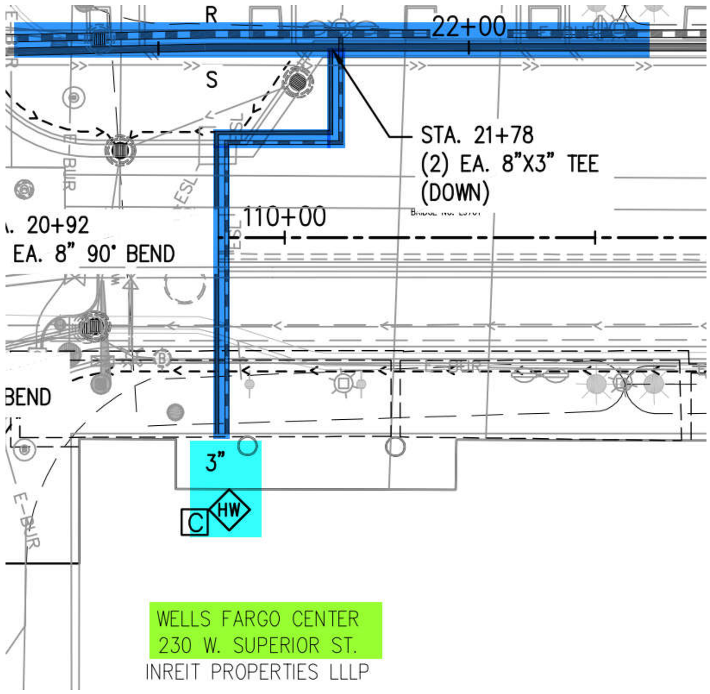


- Domestic Hot Water
    - System has steam heat exchanger along with a condensate recovery unit
    - Two buffer tanks
- Humidification
    - One unit located on Floor AB in the MN Ballet studio storage area

Proposed New System:

- AHU's
    - All steam coils will need to be replaced with hydronic coils
    - Heating hydronic loop will be valved to be common with chiller loop
    - Heating hydronic loop will need to be filled with glycol to protect the coils
    - Circulating pump(s) will need to be upsized due to the glycol reduction factor
- Unit Heaters
    - A reduction of stairwell cabinet heaters to maintain a temperature of roughly 50°F
    - Conversion of remaining unit heaters as required to maintain temp in area where they are located
- Window units
    - Hydronic loop heat exchanger will need to be relocated to so hot water supply/return lines don't have to be run to the 9th floor mechanical room
- DHW
    - Conversion of steam to hot water motive for this loop

Hot Water Service Lateral Information:



- 3" Logstor Integrated Pipe System entering building from Superior St.

Historical Steam Load:

	Wells Fargo (4310) Historical Steam Usage													
														1196
														1900
	Dec	**Nov**	**Oct**	**Sep**	**Aug**	**Jul**	**Jun**	**May**	**Apr**	**Mar**	**Feb**	**Jan**	**Annual Total**	**Peak Load**
2019					5,000	4,000	19,000	106,000	210,000	413,000	580,000	610,000	**# of Steam**	**MMBTU**
2018	419,000	318,000	82,000	8,000	15,000	15,000	15,000	15,000	160,000	354,000	471,000	668,000	2,540,000	1599
2017	415,000	327,000	28,000	18,000	20,000	19,000	20,000	51,000	156,000	389,000	405,000	612,000	2,460,000	1549
2016	577,000	201,000	89,000	10,000	12,000	17,000	1,000	71,000	258,000	418,000	666,000	673,000	2,993,000	1884
2015	416,000	226,000	20,000	17,000	13,000	16,000	15,000	59,000	160,000	358,000	680,000	1,043,000	3,023,000	1903
2014	549,000	573,000	212,000	4,000	4,000	14,000	27,000	212,000	595,000	847,000	1,043,000	1,264,000	5,344,000	3364
2013	1,141,000	762,000	317,000	14,000	14,000	18,000	36,000	316,000	708,000	584,000	842,000	991,000	5,743,000	3615
2012	850,000	723,000	121,000	39,000	103,000	96,000	149,000	243,000	627,000	535,000	982,000	1,159,000	5,627,000	3542
2011	740,000	613,000	167,000	39,000	47,000	41,000	68,000	190,000	504,000	924,000	1,073,000	1,072,000	5,478,000	3448
2010	1,106,000	669,000	75,000	63,000	60,000	50,000	65,000	156,000	224,000	466,000	827,000	998,000	4,759,000	2996
2009	1,008,000	631,000	524,000	80,000	91,000	72,000	116,000	196,000	588,000	782,000	926,000	1,386,000	6,400,000	4029
Annual Avg.	**722,100**	**504,300**	**163,500**	**29,200**	**11,857**	**14,714**	**19,000**	**146,818**	**380,909**	**551,818**	**772,273**	**952,364**	**4,436,700**	
Max Monthly Usage	**1,141,000**	**762,000**	**524,000**	**80,000**	**103,000**	**96,000**	**149,000**	**316,000**	**708,000**	**924,000**	**1,073,000**	**1,386,000**	**6,400,000**	

117 W Maurices Building Notes:

Address: 117 W. Superior St

Customer Number – 2370

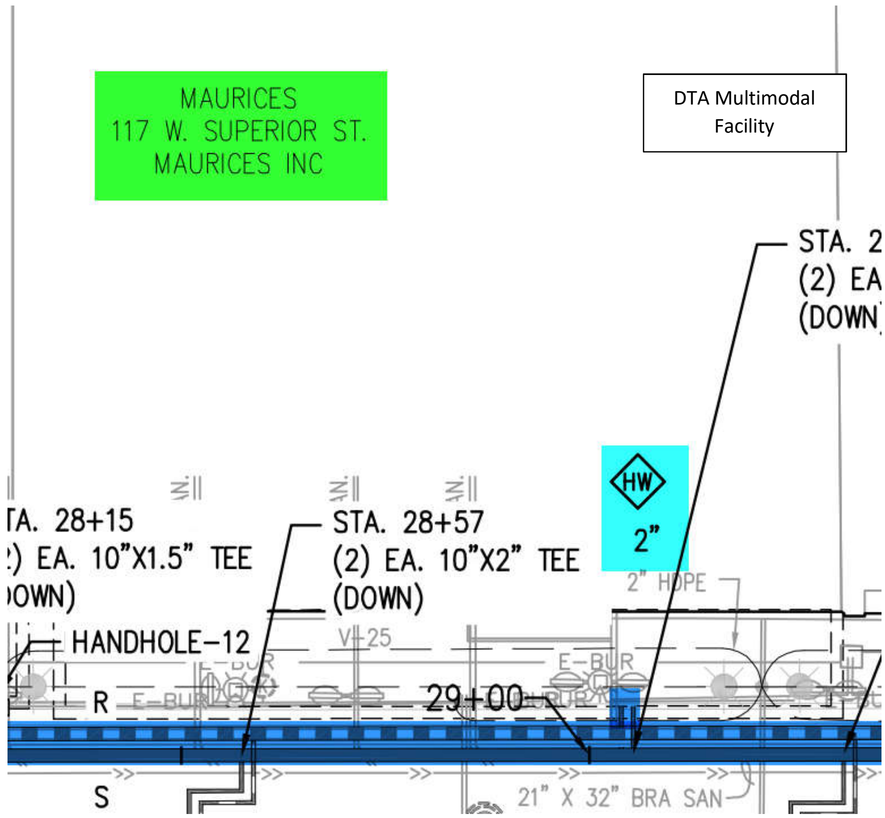
Current System:

- Steam fed from Superior St
- Mechanical room in sidewalk vault
- Steam to hot water heat exchanger
- Radiation loops throughout building

Proposed New System:

- Building heating system will not change, only motive
- New Energy Transfer Station
  - ETS will replace current steam to hot water heat exchanger
  - ETS will replace current circulating pumps
  - Energy Transfer Station will be located outside the current mechanical room to the west and tight against the outer wall.
- No updates to the building heating system required

Hot Water Service Lateral Information:



- Service lateral will be 2" Logstor integrate pipe

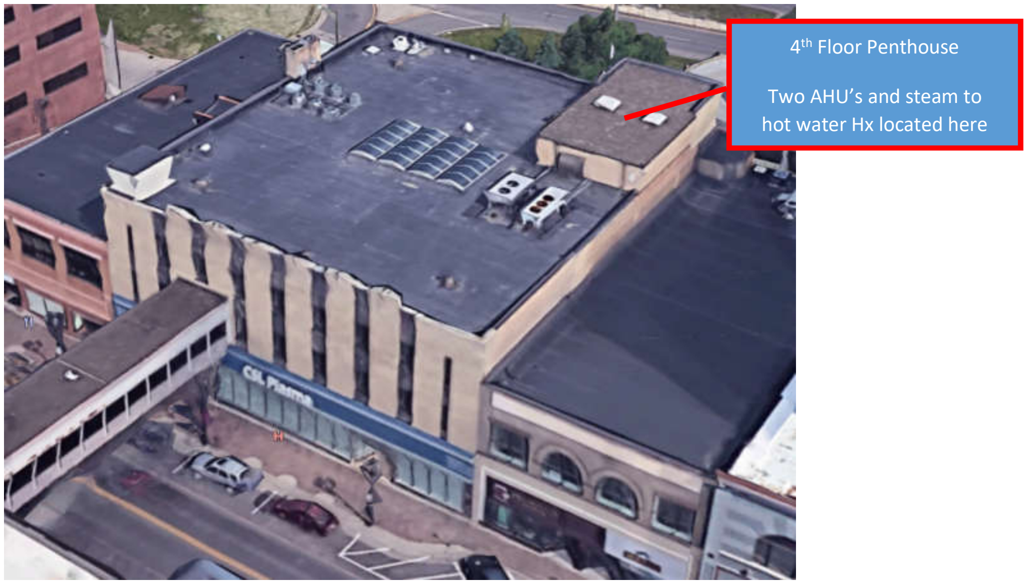
Historical Steam Load:

	Maurices 117W (2370) Historical Steam Usage													1196 1900
	Dec	**Nov**	**Oct**	**Sep**	**Aug**	**Jul**	**Jun**	**May**	**Apr**	**Mar**	**Feb**	**Jan**	**Annual Total**	**Peak Load**
2019					0	0	0	0	0	87,000	122,000	126,000		
2018	113,000	90,000	0	0	0	0	0	0	38,000	118,000	143,000	181,000	683,000	430
2017	134,000	95,000	0	0	0	0	0	0	15,000	119,000	123,000	151,000	637,000	401
2016	139,000	34,000	0	0	0	0	0	0	48,000	108,000	185,000	209,000	723,000	455
2015	149,000	71,000	0	0	0	0	0	22,000	37,000	111,000	216,000	200,000	806,000	507
2014	160,000	157,000	0	0	0	0	0	0	57,000	144,000	169,000	226,000	913,000	575
2013	203,000	115,000	49,000	0	0	0	0	29,000	113,000	145,000	193,000	171,000	1,018,000	641
2012	143,000	96,000	11,000	0	0	0	0	15,000	75,000	81,000	142,000	163,000	726,000	457
2011	126,000	61,000	0	0	0	0	0	9,000	76,000	137,000	147,000	177,000	733,000	461
2010	188,000	68,000	0	0	0	0	0	2,000	64,000	81,000	144,000	165,000	712,000	448
2009	165,000	63,000	33,000	0	0	0	0	0	11,000	74,000	149,000	201,000	696,000	438
Annual Avg.	**152,000**	**85,000**	**9,300**	**0**	**0**	**0**	**0**	**7,000**	**48,545**	**109,545**	**157,545**	**179,091**	**764,700**	
Max Monthly Usage	**203,000**	**157,000**	**49,000**	**0**	**0**	**0**	**0**	**29,000**	**113,000**	**145,000**	**216,000**	**226,000**	**1,018,000**	

Bella Grace Notes:

Address: 104 W Superior St

Customer Number - 4310



Current Status:

- This building is split into two separate entities.
  - Bella Grace / AHL Heath Care Group – Sub-Basement/Michigan St Level/Second Floor/Third Floor
  - CSL Plasma – Superior St Level
- CSL Plasma has converted their portion of the building over to gas
- Bella Grace portion of the building is currently set up as follows:
  - **Sub-Basement** is where the steam main enters the building and is connected to the reducing station. There is no insulation on any of the steam pipes at this level. Nothing in this area except steam piping, sprinkler main, and water service. Once steam service is disconnected this area will have no heat.
  - **Michigan St Level** – current plan is to turn this into indoor parking. There is a steam coil AHU on this floor right above the steam reducing station. This unit will need to be upgraded to provide some heat to this level. Owner plans to keep sprinkler system operational on this level.
  - **Second Floor -** hydronic baseboard fin tube radiation under the windows on both Michigan St and Superior St sides of the building. There is also a unit heater above the ceiling in the skywalk connected to the same circuit. These units are fed from the 4th floor penthouse mechanical room.
  - **Third Floor -** Same baseboard fin tube radiation configuration as the second floor.

- **Four Floor Penthouse -** There is a steam to hot water heat exchanger located in this room. There are also two hydronic-coil AHU located in this room as well, one for the second floor and one for the third floor. Each of the two circuits (AHU and baseboard radiation) have their own circulating pumps. It appears that these two systems run with water and not glycol. Uncertain how the control scheme is set up in this room to control the louvers for outside air and the intake louvers on the AHU. There are also two separate inline duct fans that appear to be infusing outside air into both the second and third floors. Not sure of the operation of these units during the winter (manual shut off or temperature controlled). Not important to the scope of this project.

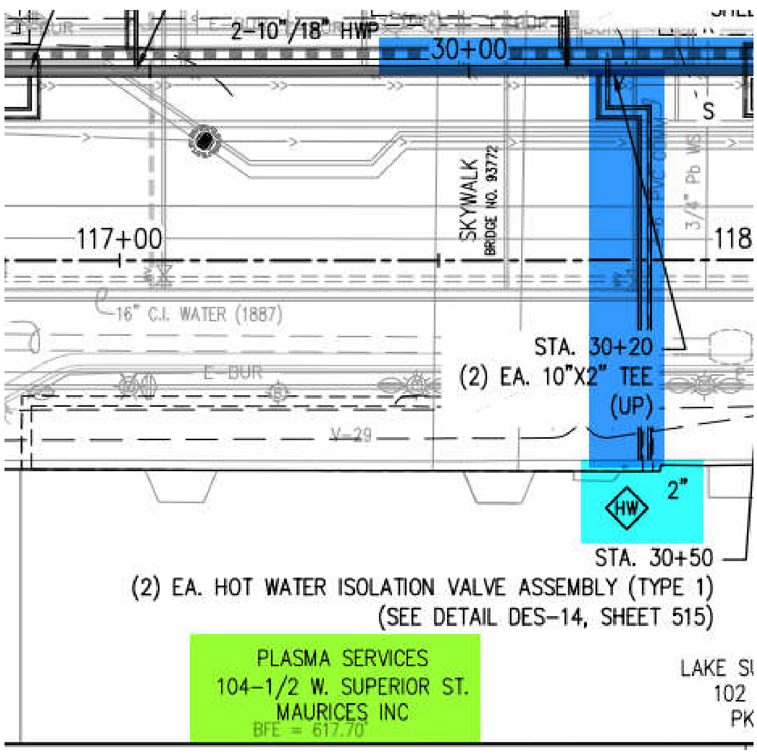
Building Conversion

This conversion should be relatively straight forward. The Energy Transfer Station (ETS) could be placed in the sub-basement where the current steam reducing station is located.

- A new hydronic coil will need to be installed in the Michigan St level AHU and connected to the ETS
- A new unit heater or some form of heat will need to be installed in the sub-basement to replace what heat will be lost from the radiation for the uninsulated steam lines when the steam system is shut down
- A supply and return lines will need to be run to the fourth floor penthouse and tied into the current two hydronic loops
- New pumps will be supplied by DES for these circuits, sizing will need to be included in the plans.
- Heat exchanger sizing will need to be adjusted to include the potential load the AHU on Michigan St and new unit heater in the sub-basement will add. Hx sizing will need to be included in the plans

Proposed Hot Water Service Lateral Location and Size:

- Service Lateral will be separate supply/return lines – 2” Logstor integrated pipe
- This service lateral will come in from Superior St
- Building owner is installing an elevator in the general location of the proposed service lateral. Confirmation of this location will need to be verified with the building owner and elevator contractor.
- Building owner was not sure whether he would fill in the sidewalk vault or not



Historical Steam Usage:

	Bella Grace (2150) Historical Steam Usage													1196
														1900
	Dec	**Nov**	**Oct**	**Sep**	**Aug**	**Jul**	**Jun**	**May**	**Apr**	**Mar**	**Feb**	**Jan**	**Annual Total**	**Peak Load**
2019					0	75,000	0	88,000	78,000	142,000	150,000	175,000		
2018	162,000	4,000	5,000	0	0	0	0	0	77,000	137,000	135,000	175,000	695,000	437
2017	144,000	126,000	17,000	0	0	0	0	0	17,000	132,000	132,000	153,000	721,000	454
2016	145,000	100,000	4,000	0	0	0	0	1,000	129,000	158,000	188,000	194,000	919,000	578
2015	164,000	140,000	67,000	0	0	0	0	55,000	101,000	143,000	234,000	207,000	1,111,000	699
2014	177,000	181,000	79,000	0	0	0	6,000	62,000	143,000	185,000	198,000	230,000	1,261,000	794
2013	207,000	163,000	50,000	0	0	0	0	98,000	168,000	165,000	204,000	189,000	1,244,000	783
2012	182,000	149,000	72,000	0	2,000	1,000	1,000	74,000	128,000	115,000	196,000	178,000	1,098,000	691
2011	199,000	112,000	21,000	0	0	0	0	38,000	125,000	157,000	161,000	159,000	972,000	612
2010	178,000	102,000	0	0	0	0	0	68,000	101,000	107,000	131,000	147,000	834,000	525
2009	145,000	86,000	54,000	0	0	0	0	24,000	107,000	119,000	140,000	181,000	856,000	539
Annual Avg.	**170,300**	**116,300**	**36,900**	**0**	**182**	**100**	**636**	**46,182**	**106,727**	**141,818**	**169,909**	**180,727**	**971,100**	
Max Monthly Usage	**207,000**	**181,000**	**79,000**	**0**	**2,000**	**75,000**	**6,000**	**98,000**	**168,000**	**185,000**	**234,000**	**230,000**	**1,261,000**	

DTA Superior St Building Notes:

Address: 212-214 W. Superior St

Customer Number – 1241

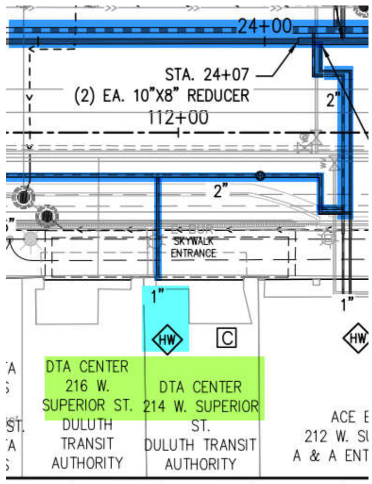
Current System:

- Steam fed from Michigan St
- Building is an all steam radiation building
- Three populated floors (Michigan St, Superior St, Skywalk Level)
- Air handling unit (steam coil) located on Michigan St
- When building was fully occupied it was separated into seven different billing zones
- Currently there are no tenants in the building
- Skywalk system located on second floor
- Domestic Hot Water Systems are all electric

Proposed New System:

- The Energy Transfer Station to be located in the sub-basement (below Michigan St)
- Sidewalk vault exists under Superior St – ETS located one level below this
- AHU on Michigan St will need to be converted from Steam to HW
- All the steam radiators and unit heaters will need to be replaced and plumbed to the ETS
    - Radiators spread throughout the building.
    - A thorough walk through will be required
- Domestic hot water
    - Will remain electric

Hot Water Service Lateral Information:



- 1” Logstor Integrated Twin Pipe System entering building from Superior St.

Historical Steam Load:

	DTA Superior St (1241) Historical Steam Usage													1196 1900
	Dec	Nov	Oct	Sep	Aug	Jul	Jun	May	Apr	Mar	Feb	Jan	Annual Total	Peak Load
2019					5,000	5,000	3,000	24,000	38,000	44,000	45,000	23,000		
2018	31,000	20,000	23,000	11,000	4,000	0	4,000	5,000	33,000	39,000	64,000	88,000	322,000	203
2017	46,000	26,000	6,000	4,000	0	0	1,000	8,000	28,000	36,000	47,000	48,000	250,000	157
2016	35,000	9,000	3,000	3,000	5,000	14,000	13,000	17,000	23,000	19,000	16,000	8,000	165,000	104
2015	2,000	2,000	1,000	0	2,000	0	2,000	14,000	18,000	20,000	33,000	46,000	140,000	88
2014	19,000	14,000	0	0	0	0	0	4,000	5,000	5,000	4,000	5,000	56,000	35
2013	8,000	1,000	0	0	0	0	0	3,000	4,000	5,000	12,000	7,000	40,000	25
2012	6,000	4,000	2,000	0	0	0	0	10,000	9,000	6,000	10,000	8,000	55,000	35
2011	4,000	1,000	0	0	0	0	0	0	4,000	7,000	9,000	10,000	35,000	22
2010	13,000	9,000	0	0	0	0	0	1,000	2,000	2,000	9,000	14,000	50,000	31
2009	15,000	7,000	5,000	0	0	0	0	4,000	14,000	21,000	24,000	37,000	127,000	80
Annual Avg.	**17,900**	**9,300**	**4,000**	**1,800**	**1,455**	**1,400**	**2,091**	**8,182**	**16,182**	**18,545**	**24,818**	**26,727**	**124,000**	
Max Monthly Usage	**46,000**	**26,000**	**23,000**	**11,000**	**5,000**	**14,000**	**13,000**	**24,000**	**38,000**	**44,000**	**64,000**	**88,000**	**322,000**	

USA Foxx & Furs Building Notes:

Address: 29 W Superior St

Customer Number - 810

Current Status:

- All steam radiation building
- Steam service lateral enters building from the Global Village building, Superior St. side
- Superior St entrance does not have an air lock
- Skywalk through this building
- There is a pipe chase next to an old elevator shaft on the west side of the showroom running from the basement to the second floor.

Basement

- Some of the steam lines are missing insulation and providing radiant heat to the basement
- No other source of heat in the basement
- Work space for the guys that sew furs together
- Very congested space
- Not a full basement
- Half of the building (back half) only has a crawl space

Superior St Level

- Radiation under main storefront window

- Two other radiators (one cast iron, one finned tube) in sewing room on this floor
- Back half of this floor is their cold storage area

Second Floor/Skywalk Level

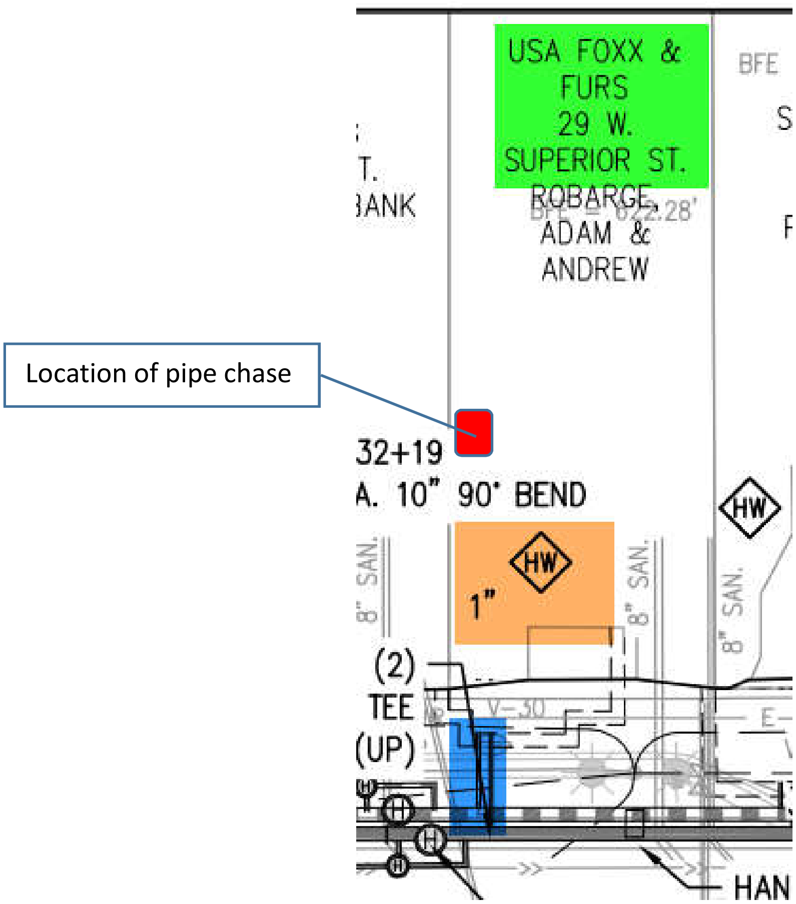
- The skinning room is on this level
- Ceiling mounted unit heater
- Finned tube radiator along west wall, but typically hidden behind inventory

Other

- Electric domestic hot water – to remain

Proposed Hot Water Service Lateral Location and Size:

- Service Lateral will be 1" Logstor integrated pipe
- According to drawing there is a sidewalk vaults (V-30). No determination as of now whether this will be filled during construction or not. It could be behind a wall already



Historical Steam Usage:

	Dec	Nov	Oct	Sep	Aug	Jul	Jun	May	Apr	Mar	Feb	Jan
USA Foxx and Furs Store Historical Steam Usage												
2019					10,000	0	0	3,000	9,000	21,000	31,000	19,000
2018	21,000	19,000	7,000	0	0	0	0	0	9,000	16,000	34,000	42,000
2017	27,000	15,000	2,000	0	0	0	0	0	1,000	14,000	14,000	19,000
2016	15,000	5,000	0	0	0	0	0	0	6,000	11,000	20,000	27,000
2015	25,000	4,000	0	0	0	0	0	0	3,000	12,000	42,000	26,000
2014	31,000	27,000	0	0	0	0	0	1,000	8,000	29,000	32,000	43,000
2013	38,000	12,000	3,000	0	0	0	0	2,000	13,000	19,000	27,000	24,000
2012	17,000	2,000	0	0	0	0	0	0	0	3,000	13,000	18,000
2011	7,000	2,000	0	0	0	0	0	0	4,000	18,000	24,000	30,000
2010	31,000	7,000	0	0	0	0	0	0	0	5,000	26,000	28,000
2009	28,000	2,000	2,000	0	0	0	0	0	2,000	16,000	69,000	35,000
Annual Avg.	**24,000**	**9,500**	**1,400**	**0**	**0**	**0**	**0**	**545**	**5,000**	**14,909**	**30,182**	**28,273**
Max Monthly Usage	**38,000**	**27,000**	**7,000**	**0**	**10,000**	**0**	**0**	**3,000**	**13,000**	**29,000**	**69,000**	**43,000**

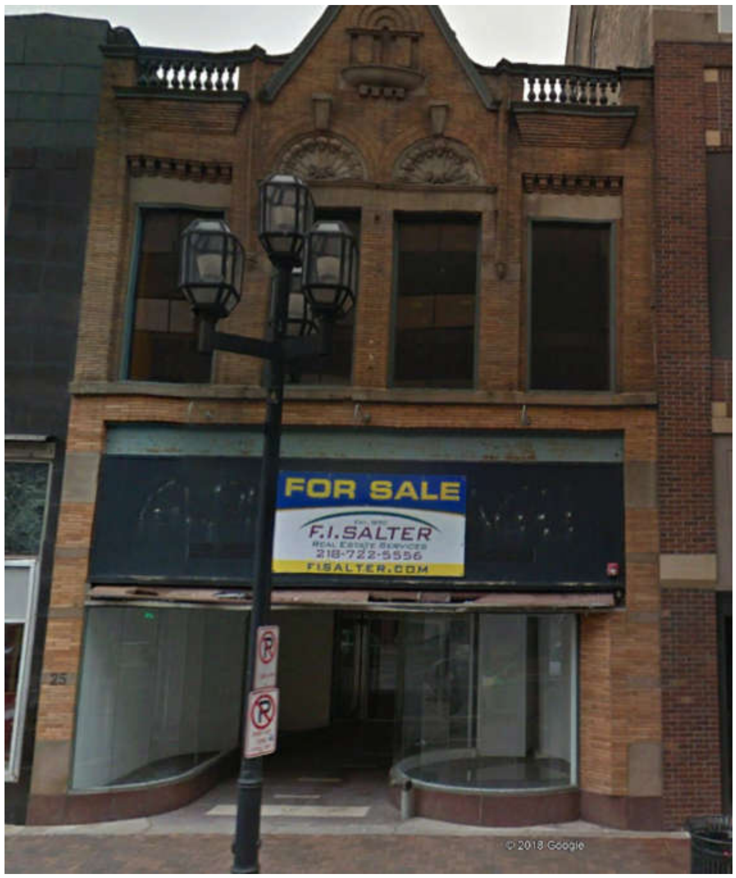
DULUTH ENERGY SYSTEMS

9/6/19

Global Village Building Notes:

Address: 25 W. Superior St

Customer Number - 850



Current Status:

- Steam radiation building
- Two Steam unit heaters
    - One over front entrance door
    - One on second floor near rear of building suspended from ceiling
- One steam radiator on second floor in rear storage room
- No dedicated heater in skywalk. Open air gate on second floor allows building heat to escape into the skywalk
- Building is currently empty

- Steam service enters from Superior St. Steam piping and condensate lines not well insulated and providing heat to the basement area. Supplemental heat required in this area? Is this heat radiating up to the Superior St level and does this need to be captured on this floor too?
- Basement is wide open providing an easy route for the supply/return lines to be routed to the rear of the building
- Domestic hot water system is electric. Will remain electric.

Basement:

- Steam lines and condensate lines are not well insulated and are radiating heat into the basement. This heat source will need to be figured in when calculating building load.
- Nothing in basement of any significance to prevent pipe runs from being installed in this area
- Sidewalk vault exists in front of this building. Assume vault to be filled.

Superior St Level:

- Unit heater with electric fan directly over front entrance
- Front entrance does not have an air lock, but entrance door is setback from the front of the building significantly

Second Floor:

- Suspended unit heater with electric fan in NW corner
- Pipe chase from basement to this heater already exists
- Demolition will be required to install hot water supply/return lines

Skywalk:

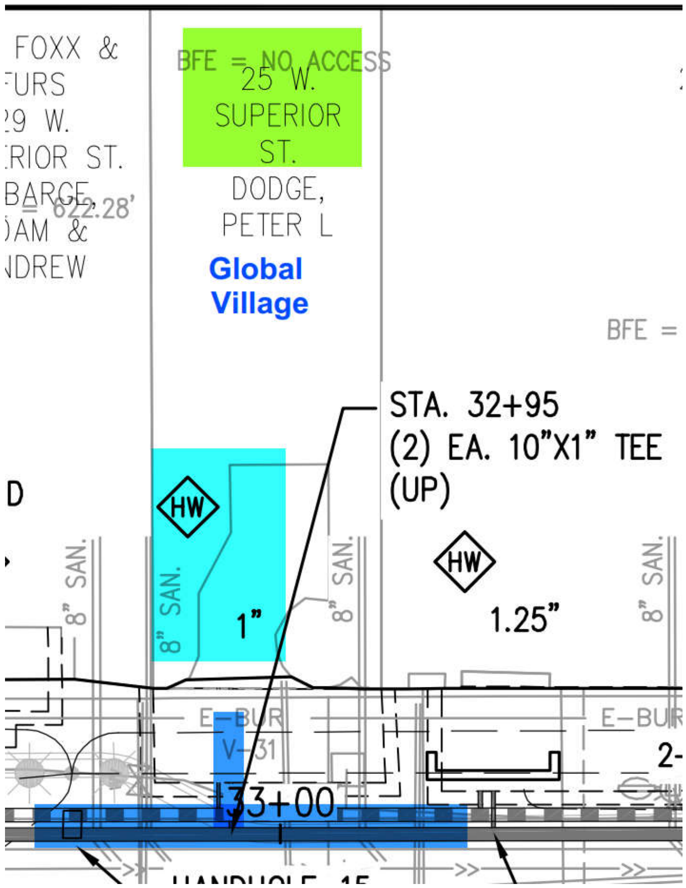
- Building heats their portion of the skywalk by allowing building heat to migrate through an open air lockable gate. Not sure how long this will remain this way, new tenant (when space is rented) may want this entrance more secure than it is currently

Heat control was not obviously evident. With only two unit heaters and on two separate floor there isn't much for options. Each floor should have a thermostat controlling each unit heater.

System will require recirculating pumps. Design should specify pump specs required to provide UH with proper flow.

Proposed Hot Water Service Lateral Location and Size:

- Service lateral will be a 1" Logstor twin pipe



Historical Steam Usage (# of steam):

	Global Village (1270) Historical Steam Usage (# of steam)													1196 1900
	Dec	**Nov**	**Oct**	**Sep**	**Aug**	**Jul**	**Jun**	**May**	**Apr**	**Mar**	**Feb**	**Jan**	**Annual Total**	**Peak Load**
2019					1,000	0	6,000	27,000	27,000	31,000	29,000	32,000		MMBTU
2018	10,000	0	0	0	0	0	1,000	0	0	24,000	6,000	6,000	47,000	30
2017	17,000	12,000	0	0	0	0	0	0	0	21,000	38,000	31,000	119,000	75
2016	38,000	0	0	0	0	0	0	2,000	14,000	34,000	45,000	44,000	177,000	111
2015	33,000	28,000	7,000	0	0	0	0	0	20,000	29,000	41,000	38,000	196,000	123
2014	32,000	29,000	0	0	0	0	0	0	12,000	46,000	48,000	50,000	217,000	137
2013	43,000	30,000	7,000	0	0	0	0	0	8,000	30,000	59,000	37,000	77,000	48
2012	77,000	16,000	5,000	0	0	0	0	0	0	27,000	57,000	38,000	220,000	138
2011	42,000	28,000	0	0	0	0	0	0	16,000	43,000	45,000	4,000	178,000	112
2010	26,000	22,000	0	1,000	0	1,000	2,000	2,000	1,000	10,000	10,000	0	75,000	47
2009	57,000	0	0	0	0	0	0	0	0	23,000	74,000	85,000	239,000	150
Annual Avg.	**37,500**	**16,500**	**1,900**	**100**	**91**	**100**	**818**	**2,818**	**8,909**	**28,909**	**41,091**	**33,182**	**154,500**	
Max Monthly Usage	**77,000**	**30,000**	**7,000**	**1,000**	**1,000**	**1,000**	**6,000**	**27,000**	**27,000**	**46,000**	**74,000**	**85,000**	**239,000**	

Harbour View Apartments/Center Building Notes:

Address: 306 W. Michigan St

Customer Number – 1250/1251

Current System:

- Steam fed from Michigan
- Mechanical room in sidewalk vault
- Building is split into two separate accounts
  - One for the apartments
  - One for the business center
- Two (2) separate steam to hot water heat exchangers
  - One for the apartment heat pump loop
  - One for the business center heat pump loop
  - One heat pump loop has ethylene glycol (20%) and the other has environmentally friendly glycol (30%?)
- Steam line un-insulated in mechanical room
- Steam unit heaters
  - Basement – bottom of stairwell (modine unit)
  - Generator room – modine unit
  - Three unit heaters in Skywalk
- Steam radiation
  - Finned tube radiator in storage room on second floor

Proposed New System:

- Two separate heat pump loops
  - One for business center
  - One for apartments
  - Target temp for both is 72°
  - Each loop has its own injection system
  - Glycol systems
- Replacement of unit heaters - six (6) units
  - Bottom of stairwell by elevator shaft
  - Bottom of stairwell outside of mechanical room
  - Generator Room
  - Three (3) unit heaters in the skywalk
- Replacement of steam finned tube radiator in storage room on second floor with in kind or unit heater
- Addition of two (2) unit heaters for mechanical room to replace radiant heat from uninsulated steam lines.

Hot Water Service Lateral Information:

- 4" Logstor Service lateral coming from the Alworth Building

Historical Steam Load:

	Harbour Apartments (1250) Historical Steam Usage (# of steam)													1196 1900
	Dec	**Nov**	**Oct**	**Sep**	**Aug**	**Jul**	**Jun**	**May**	**Apr**	**Mar**	**Feb**	**Jan**	**Annual Total**	**Peak Load**
2019					0	0	0	44,000	119,000	211,000	284,000	309,000		MMBTU
2018	216,000	203,000	126,000	0	0	0	0	2,000	142,000	191,000	279,000	359,000	1,518,000	956
2017	259,000	192,000	43,000	0	0	0	0	96,000	155,000	206,000	205,000	277,000	1,433,000	902
2016	242,000	105,000	91,000	0	0	0	0	46,000	126,000	158,000	233,000	257,000	1,258,000	792
2015	172,000	120,000	56,000	0	0	0	0	88,000	139,000	179,000	326,000	294,000	1,374,000	865
2014	236,000	232,000	91,000	38,000	0	0	79,000	125,000	169,000	261,000	302,000	363,000	1,896,000	1193
2013	301,000	166,000	63,000	0	10,000	12,000	31,000	98,000	149,000	215,000	306,000	282,000	77,000	48
2012	244,000	140,000	78,000	0	0	0	0	47,000	124,000	146,000	241,000	244,000	1,264,000	796
2011	191,000	131,000	28,000	8,000	0	0	27,000	41,000	102,000	199,000	237,000	270,000	1,234,000	777
2010	272,000	108,000	6,000	1,000	0	1,000	2,000	50,000	85,000	94,000	182,000	217,000	1,018,000	641
2009	217,000	67,000	59,000	0	0	0	2,000	56,000	125,000	175,000	220,000	291,000	1,212,000	763
Annual Avg.	**235,000**	**146,400**	**64,100**	**4,700**	**909**	**1,300**	**12,818**	**63,000**	**130,455**	**185,000**	**255,909**	**287,545**	**1,228,400**	
Max Monthly Usage	**301,000**	**232,000**	**126,000**	**38,000**	**10,000**	**12,000**	**79,000**	**125,000**	**169,000**	**261,000**	**326,000**	**363,000**	**1,896,000**	

- Steam for Heat Pump Loop for apartments only

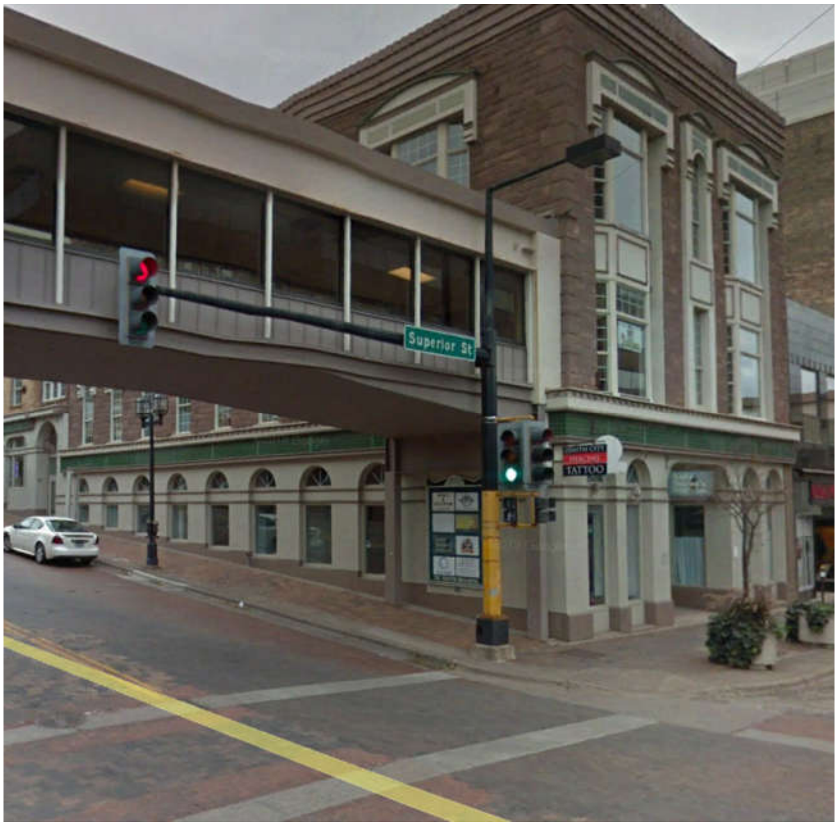
	Harbour Center (1251) Historical Steam Usage (# of steam)													1196 1900
	Dec	**Nov**	**Oct**	**Sep**	**Aug**	**Jul**	**Jun**	**May**	**Apr**	**Mar**	**Feb**	**Jan**	**Annual Total**	**Peak Load**
2019					0	0	1,000	18,000	50,000	95,000	143,000	156,000		MMBTU
2018	110,000	96,000	51,000	0	0	0	0	2,000	80,000	120,000	182,000	238,000	879,000	553
2017	160,000	114,000	17,000	0	0	0	0	31,000	70,000	111,000	113,000	159,000	775,000	488
2016	142,000	49,000	28,000	0	0	0	1,000	22,000	77,000	100,000	142,000	162,000	723,000	455
2015	104,000	64,000	23,000	0	0	0	0	26,000	54,000	85,000	200,000	176,000	732,000	461
2014	125,000	107,000	26,000	2,000	0	0	0	18,000	69,000	142,000	183,000	236,000	908,000	572
2013	199,000	74,000	18,000	0	0	0	13,000	60,000	95,000	115,000	169,000	149,000	77,000	48
2012	131,000	72,000	19,000	0	0	0	0	1,000	53,000	65,000	118,000	129,000	588,000	370
2011	108,000	8,000	0	0	0	0	1,000	1,000	9,000	27,000	73,000	122,000	349,000	220
2010	101,000	7,000	1,000	0	0	0	0	27,000	42,000	62,000	114,000	134,000	488,000	307
2009	139,000	48,000	29,000	0	0	0	1,000	18,000	55,000	98,000	123,000	191,000	702,000	442
Annual Avg.	**131,900**	**63,900**	**21,200**	**200**	**0**	**0**	**1,545**	**20,364**	**59,455**	**92,727**	**141,818**	**168,364**	**622,100**	
Max Monthly Usage	**199,000**	**114,000**	**51,000**	**2,000**	**0**	**0**	**13,000**	**60,000**	**95,000**	**142,000**	**200,000**	**238,000**	**908,000**	

- Steam for heat pump loop, unit heaters, and finned tube radiators

Hunter Building Notes:

Address: 31 W Superior St

Customer Number - 860



Current Status:

- Heat pump loop
    - Pumps and heat exchanger in mechanical room in basement
    - Summer/winter valving for cooling tower on third floor next to the MAU
    - Injection loop
- Steam unit heaters at both entrances (Superior St and 2nd Ave W.)
    - Both entrances have an air lock
- Steam coil MAU on the third floor
-

Basement

- Mechanical room in basement
    - Heat pump controls, circulating pumps, injection pump, and heat exchanger all located here

- Basement is an open space
  - Service lateral piping to the mechanical room with be straight forward

Superior St Level

- Unit heater at front entrance between doors

2nd Ave Entrance

- Unit heater between entrance doors

Second Floor/Skywalk Level

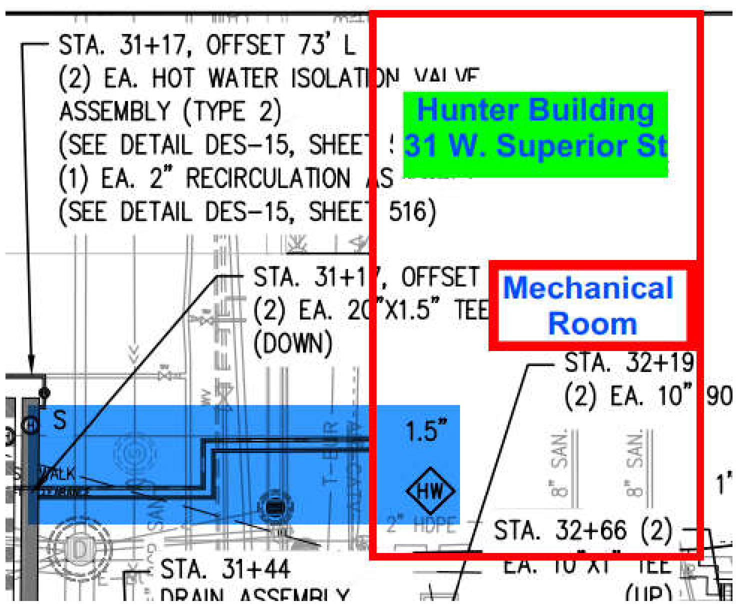
- ??

Other

- Electric domestic hot water – to remain

Proposed Hot Water Service Lateral Location and Size:

- Service Lateral will be separate supply/return lines – 1.5” Logstor integrated pipe
- This service lateral will come in from 2nd Ave W, not Superior St



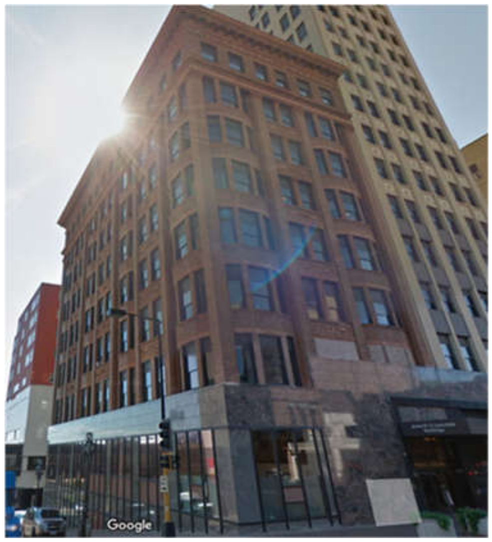
Historical Steam Usage:

	Hunter Building Historical Steam Usage											
	Dec	**Nov**	**Oct**	**Sep**	**Aug**	**Jul**	**Jun**	**May**	**Apr**	**Mar**	**Feb**	**Jan**
2019					0	0	0	31,000	33,000	59,000	73,000	74,000
2018	62,000	56,000	8,000	0	0	0	0	6,000	33,000	36,000	57,000	106,000
2017	108,000	45,000	6,000	0	0	0	3,000	43,000	46,000	55,000	56,000	69,000
2016	62,000	21,000	0	0	1,000	1,000	5,000	18,000	55,000	66,000	80,000	91,000
2015	64,000	36,000	3,000	3,000	1,000	3,000	4,000	8,000	47,000	51,000	104,000	128,000
2014	72,000	55,000	26,000	2,000	0	3,000	4,000	20,000	25,000	125,000	128,000	109,000
2013	104,000	63,000	17,000	0	0	3,000	2,000	10,000	54,000	51,000	79,000	83,000
2012	71,000	43,000	29,000	0	0	1,000	2,000	0	12,000	47,000	78,000	85,000
2011	69,000	47,000	0	0	0	0	9,000	42,000	51,000	85,000	97,000	111,000
2010	119,000	47,000	0	0	0	0	0	27,000	43,000	56,000	104,000	114,000
2009	108,000	36,000	19,000	0	24,000	37,000	37,000	39,000	61,000	74,000	95,000	118,000
Annual Avg.	**83,900**	**44,900**	**10,800**	**500**	**0**	**4,364**	**6,000**	**22,182**	**41,818**	**64,091**	**86,455**	**98,909**
Max Monthly Usage	**119,000**	**63,000**	**29,000**	**3,000**	**24,000**	**37,000**	**37,000**	**43,000**	**61,000**	**125,000**	**128,000**	**128,000**

Alworth/Lonsdale Building Notes:

Address: 302 W. Superior St

Customer Number – 1300



Current System:

- Steam fed from Michigan St
- Lonsdale/Alworth/312 Building considered all one heating system
- Steam Radiation Building
- Heat Pump Loop
    - Steam fed heat exchanger controls an injection loop to maintain a constant temperature in the heat pump loop
    - This loop tempers the building since there isn't a lot of control on the steam radiation portion of the heating system
    - Flow through the heat exchanger is controlled by throttling a butterfly valve in between the two pipe taps off the main loop

Proposed New System:

- Heat pump loop heat exchanger will be converted from steam to hot water
- Location of the Energy Transfer Station will be in the basement of the Lonsdale Building

Hot Water Service Lateral Information:

- Service lateral will be 4.0" Logstor supply and return lines coming in from 3rd Ave W
- 4" pipe route needs to be design to the two pipes running to the Harbor Center under Michigan St. These two pipes daylight in the basement of the Alworth Building
- Depending on load required for heat pump loop size of service lateral feeding the Hx will need to be determined also

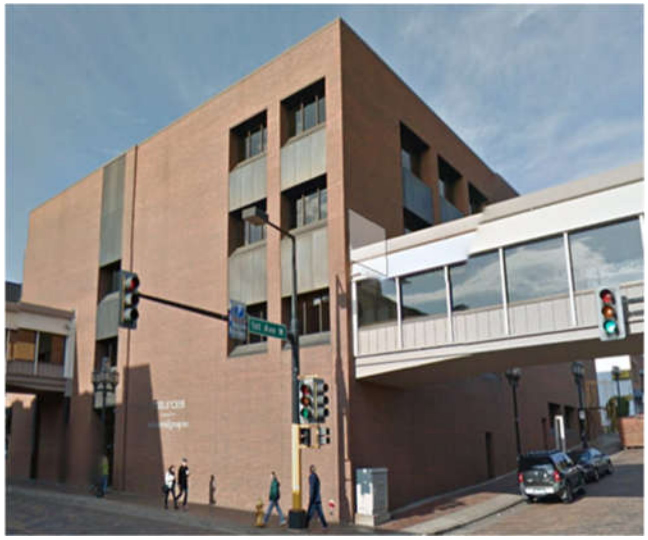
Historical Steam Load:

ETS already designed for this system.

Old Maurice Building Notes:

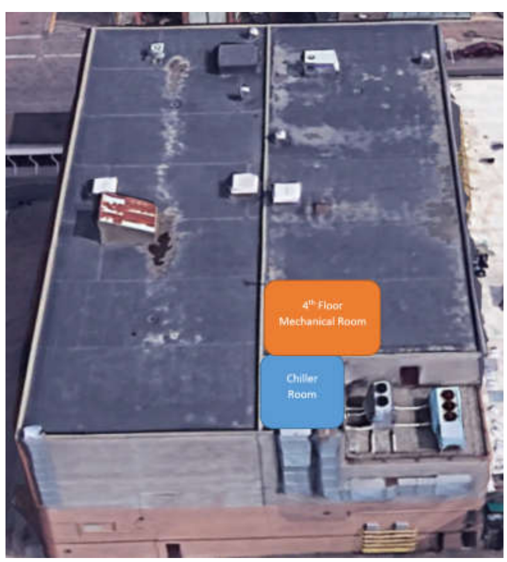
Address: 101-105 W. Superior St

Customer Number – 2380



Current System:

- Steam fed from Superior St
    - Pressure reducing station located in basement in sidewalk vault
- Building is a compilation of three buildings (101W, 103W, and 105W) – floor plan is a mess with multiple levels within each different building all connected together with common space
- There is one (1) double steam coil air handling unit (AHU) on the third floor of the 103W building
- There are three(3) steam coil makeup air units (MAU) within the building
    - All three (3) MAU's are in the fourth floor mechanical room
    - All three (3) MAU's have a hot deck – cold deck arrangement
        - Chiller located on the fourth floor along with the cooling tower

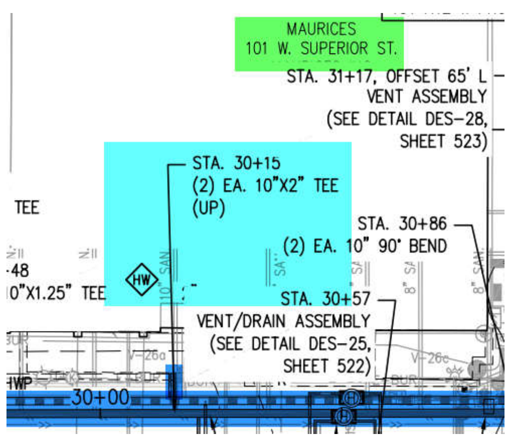


- Radiation
  - Steam radiators located throughout the 101W building
  - Steam to HW heat exchanger located in fourth floor mechanical room
  - HW radiators spread sporadically throughout all three buildings
- Domestic Hot Water Systems are all electric

Proposed New System:

- Some thought will need to be given to the placement of the Energy Transfer Station(s)
  - There will be a lot of piping required in this building in order to capture all of the different heating units
- Third Floor AHU
  - Steam coil will need to be replaced with a hydronic coil
  - This AHU to be tied to the MAU circuit on the 4th Floor
  - System heat exchanger will need to be sized accordingly
  - Circulating pumps will need to be sized to capture the pressure drop across all of the coils and also that glycol will be required in the system
- Fourth Floor MAU's
  - All steam coils to be replaced with hydronic coils
  - System will require glycol due to the outside air passing through the coils
  - Chiller system may need to be upsized to overcome glycol efficiency reduction
- Radiation
  - Steam radiators (cabinet, finned tube, unit heaters) will need to be plumbed and replaced(if required) with new hydronic units as required
- Domestic hot water
  - Will remain electric

Hot Water Service Lateral Information:



- 2" Logstor Integrated Pipe System entering building from Superior St.

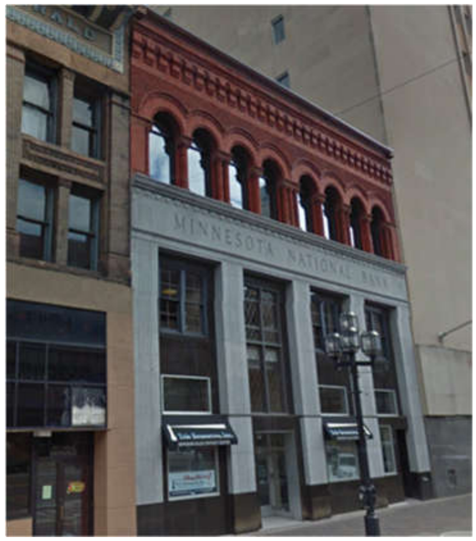
Historical Steam Load:

	Maurices 105W (2380) Historical Steam Usage													
														1196
														1900
	Dec	**Nov**	**Oct**	**Sep**	**Aug**	**Jul**	**Jun**	**May**	**Apr**	**Mar**	**Feb**	**Jan**	**Annual Total**	**Peak Load**
2019					0	0	0	30,000	84,000	157,000	191,000	204,000		
2018	161,000	156,000	62,000	0	0	0	0	0	78,000	139,000	177,000	238,000	1,011,000	636
2017	164,000	164,000	0	0	0	1,000	1,000	0	13,000	152,000	152,000	201,000	848,000	534
2016	169,000	94,000	18,000	0	0	0	0	2,000	83,000	184,000	249,000	258,000	1,057,000	665
2015	223,000	151,000	59,000	0	0	0	0	31,000	119,000	142,000	267,000	256,000	1,248,000	786
2014	202,000	179,000	2,000	2,000	0	0	0	38,000	93,000	189,000	222,000	288,000	1,215,000	765
2013	269,000	136,000	51,000	0	0	0	0	37,000	145,000	153,000	244,000	221,000	1,256,000	791
2012	179,000	138,000	104,000	0	1,000	0	0	72,000	119,000	120,000	184,000	193,000	1,110,000	699
2011	173,000	174,000	85,000	12,000	0	0	0	80,000	146,000	199,000	228,000	235,000	1,332,000	838
2010	271,000	162,000	32,000	0	0	0	0	68,000	116,000	156,000	207,000	275,000	1,287,000	810
2009	258,000	122,000	108,000	0	0	0	0	55,000	231,000	229,000	182,000	295,000	1,480,000	932
Annual Avg.	**206,900**	**147,600**	**52,100**	**1,400**	**91**	**100**	**91**	**37,545**	**111,545**	**165,455**	**209,364**	**242,182**	**1,184,400**	
Max Monthly Usage	**271,000**	**179,000**	**108,000**	**12,000**	**1,000**	**1,000**	**1,000**	**80,000**	**231,000**	**229,000**	**267,000**	**295,000**	**1,480,000**	

MN National Bank Notes:

Address: 222 W Superior St

Customer Number - 1270



Current Status:

- Steam enters building from Michigan St – subgrade to Michigan St. (sub-basement)
- Building heating system is comprised of two air handling unit in the sub-basement
- AHU already have hydronic coils
- Suspended unit heater (Modine unit) installed by heat exchanger to cool condensate and provide heat to the sub-basement area
- Steam lines and heat exchanger are very well insulated – not much radiant heat provided by the system

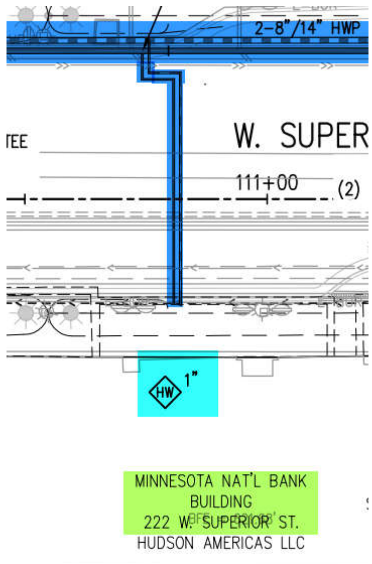
Building Conversion

The challenge is to figure out the best placement for the Energy Transfer Station

- Placing the ETS where the current heating system is now
    - Pro - easy to connect to the current system
    - Pro - electrical available
    - Con - long run of district piping
- Placing the ETS where the service lateral will enter the sub-basement
    - Pro - short run of district piping
    - Con - no electrical service in this area
    - Neutral - connection to the current system
- DHW is currently electric and will remain electric

Proposed Hot Water Service Lateral Location and Size:

- Service Lateral will be separate supply/return lines – 1" Logstor integrated pipe
- This service lateral will come in from Superior St
- There is a sidewalk vault under Superior St
- Service Lateral needs to be piped to the sub-basement



Historical Steam Usage:

	MN National Bank (1270) Historical Steam Usage													
														1196
														1900
	Dec	**Nov**	**Oct**	**Sep**	**Aug**	**Jul**	**Jun**	**May**	**Apr**	**Mar**	**Feb**	**Jan**	**Annual Total**	**Peak Load**
2019					0	0	0	4,000	8,000	24,000	42,000	48,000		
2018	27,000	23,000	0	0	0	0	0	1,000	11,000	20,000	38,000	57,000	177,000	111
2017	33,000	25,000	0	0	0	0	0	3,000	8,000	28,000	34,000	50,000	181,000	114
2016	40,000	0	0	0	2,000	1,000	1,000	2,000	15,000	25,000	31,000	24,000	141,000	89
2015	12,000	2,000	3,000	2,000	1,000	2,000	1,000	4,000	4,000	5,000	15,000	16,000	67,000	42
2014	6,000	0	0	0	0	0	0	1,000	2,000	18,000	24,000	32,000	83,000	52
2013	24,000	2,000	2,000	0	0	0	2,000	8,000	7,000	6,000	21,000	26,000	98,000	62
2012	27,000	6,000	1,000	0	1,000	0	2,000	5,000	8,000	4,000	39,000	38,000	131,000	82
2011	13,000	2,000	0	0	0	0	0	0	2,000	22,000	35,000	43,000	117,000	74
2010	35,000	1,000	0	0	0	0	0	1,000	2,000	8,000	38,000	45,000	130,000	82
2009	38,000	0	0	0	0	0	0	3,000	14,000	25,000	29,000	40,000	149,000	94
Annual Avg.	**25,500**	**6,100**	**600**	**200**	**364**	**300**	**545**	**2,909**	**7,364**	**16,818**	**31,455**	**38,091**	**127,400**	
Max Monthly Usage	**40,000**	**25,000**	**3,000**	**2,000**	**2,000**	**2,000**	**2,000**	**8,000**	**15,000**	**28,000**	**42,000**	**57,000**	**181,000**	

MN Surplus Building Notes:

Address: 218 W. Superior St

Customer Number - 1261

Current Status: Currently an all steam radiation building with:

- Steam Service Lateral enters building from Michigan St.

Michigan St Level:

- Unit heater hanging from the ceiling near Michigan St. entrance

- Unit heater hanging from the ceiling near the bottom of the staircase
- Energy Transfer station will be located on this level on the Superior St side
    - Storage area with a false floor will need additional support under the ETS

Superior St Level:

- Unit heater in front of building on east wall pointing toward main store entrance
- One steam radiator against west wall near front entrance
- Two steam radiators in back storage room
    - Radiators located under windows that have been boarded up
    - Potential at some point in time that these windows would be re-established

Second Floor (Front half is used by the Beargrease Marathon Staff):

- Steam radiator in the bathroom (near the rear of the building)
- Steam radiator at the top of the steps (rear of building) under boarded up windows
    - Potential to re-establish these windows some day
- Beargrease office has an electric heater over the doorway leading to the skywalk – replace with hot water unit
- Steam radiator against the east wall in the Beargrease office

Skywalk:

- Steam radiators in the skywalk?

Owners were receptive to running the hot water supply and return lines under the ceiling panels as long as they were insulated and looked good. They discussed at some point in time they might re-establish the windows on the Michigan side of the building so steam radiators should be replaced with enough baseboard radiation capability if they ever are.

Both entrances do not have air locks.

Unit heaters are big, noisy, and don't fit the décor of the store. If we can replace with something else that will fit the space better we should explore those options. Both unit heaters are attempting provide a warm air wash over each of the entrances.

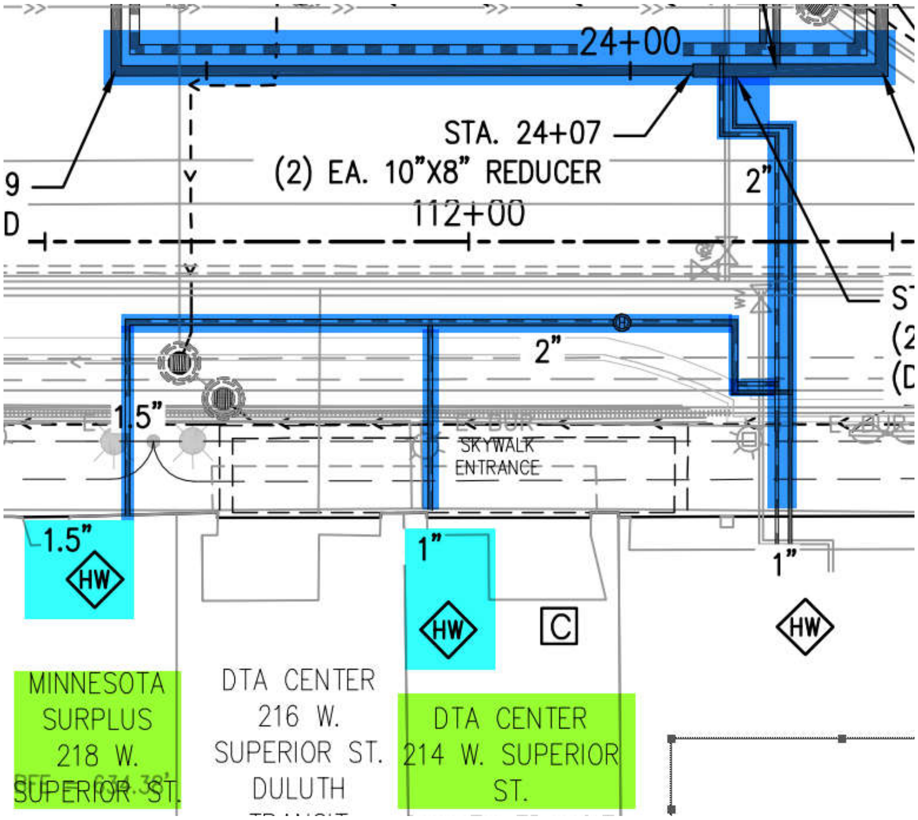
There was no talk with the owners regarding controlling the heat throughout the building. Currently there isn't much control. Radiators by the entrances should either have some continuous flow or the entire building might have to get converted to glycol.

All radiators, unit heaters can be run off the same circuit at the same temperature. Should only require one (1) heat exchanger for this entire load.

Very small DHW load so DHW will remain electric.

Proposed Hot Water Service Lateral Location and Size:

- Service lateral will be a 1.5” Logstor twin pipe
- No sidewalk vault if front of building



Historical Steam Usage (# of steam):

	Minnesota Surplus (1260) Historical Steam Usage													1196 1900
	Dec	Nov	Oct	Sep	Aug	Jul	Jun	May	Apr	Mar	Feb	Jan	Annual Total	Peak Load
2019					0	0	0	0	2,000	10,000	23,000	30,000		
2018	13,000	12,000	0	0	0	0	0	0	9,000	13,000	30,000	41,000	118,000	74
2017	26,000	11,000	5,000	0	0	0	0	0	0	16,000	18,000	27,000	103,000	65
2016	34,000	6,000	0	0	0	0	0	6,000	10,000	14,000	25,000	28,000	123,000	77
2015	20,000	0	0	0	0	0	0	0	0	10,000	42,000	38,000	110,000	69
2014	21,000	24,000	0	0	0	0	0	0	7,000	18,000	24,000	30,000	124,000	78
2013	26,000	7,000	0	0	0	0	0	2,000	10,000	14,000	28,000	31,000	118,000	74
2012	21,000	12,000	1,000	0	0	0	0	0	4,000	7,000	18,000	28,000	91,000	57
2011	25,000	25,000	2,000	0	0	0	0	1,000	4,000	14,000	17,000	25,000	113,000	71
2010	27,000	13,000	0	0	2,000	7,000	7,000	8,000	8,000	12,000	27,000	25,000	136,000	86
2009	28,000	6,000	3,000	0	0	0	0	3,000	11,000	16,000	20,000	33,000	120,000	76
Annual Avg.	**24,100**	**11,600**	**1,100**	**0**	**182**	**700**	**636**	**1,818**	**5,909**	**13,091**	**24,727**	**30,545**	**115,600**	
Max Monthly Usage	**34,000**	**25,000**	**5,000**	**0**	**2,000**	**7,000**	**7,000**	**8,000**	**11,000**	**18,000**	**42,000**	**41,000**	**136,000**	

ETS Schedule

Project Name: **Duluth Hot Water - Energy Transfer Stations**

Phase	Bldg #	Building Name	HX Capacity [MBH]	Service Type	District-Side Flow [gpm]	Bldg-Side Flow [gpm]	District-Side EWT [ºF]	District-Side LWT [ºF]	Bldg-Side EWT [ºF]	Bldg-Side LWT [ºF]	New Pump Req'd? (Y/N)	Prelim-inary Pump Flow [gpm]	Prelim-inary Pump Head [ft]	Glycol? [Y/N]	Campus-Side Range of Potential DP at Peak [psid]	Voltage available in Mech room
3	4310	Wellsfargo		HHW			215					0				
3	4310	Wellsfargo		DHW			160					0				
3	1270	MN Natl Bank		HHW			215					0				
3	1260	MN Surplus		HHW			215					0				
3	1241	DTA Center - Superior St		HHW			215					0				
3	1360	Skywalk		HHW			215					0				
3	1230	Old Ace Hardware		HHW			215					0				
3	1250	Harbour Apt's		HHW			215					0				
3	1251	Harbour Center		HHW			215					0				
3	1280	Duluth Plumbing Supply		HHW			215					0				
3	2400 & 2490	Northshore Bank - 125W & 131W		HHW			215					0				
3	2400 & 2490	Northshore Bank - 125W & 131W		DHW			160					0				
3	2380	Maurices 105 W sup		HHW			215					0				
3	2150	Bella Grace		HHW			215					0				
3	2350	US Bank		HHW			215					0				
3	2350	US Bank		HHW			215					0				
3	2350	US Bank		HHW			215					0				
3	2950	Sawmill Furniture		HHW			215					0				
3	2370	Maurices 117W		HHW			215					0				
3	860	Hunter Building		HHW			215					0				
3	810	Foxx Furs		HHW			215					0				
3	850	Global Village		HHW			215					0				

PACKAGED DISTRICT HEATING SUBSTATIONS SPECIFICATION CONTROL DOCUMENT

September 12, 2019

DISCLAIMER

The design information and equipment selections presented herein are preliminary. This Specification Control Document is not approved until signed and approved by Owner. The Supplier shall be responsible for the detailed design, specification, and final selection of all equipment, systems, and components subject to qualification and approval by Owner and/or their designated engineering representative.

TABLE OF CONTENTS

1 GENERAL REQUIREMENTS 3
1.1 SUMMARY 3
1.2 DEFINITIONS 3
1.3 REFERENCE STANDARDS 4
1.4 QUALITY ASSURANCE 4
1.5 SUBMITTALS 5
1.6 DELIVERY, STORAGE AND HANDLING 5
1.7 COMMISSIONING 6
1.8 ON-SITE O&M TRAINING 6
1.9 WARRANTY 6
2 DESIGN AND CONFIGURATION REQUIREMENTS 7
2.1 GENERAL 7
2.2 SUBSTATION CONFIGURATION 7
2.3 TEMPERATURE AND PRESSURE REQUIREMENTS 8
2.4 INSTALLATION AND IDENTIFICATION OF PIPES AND EQUIPMENT 10
2.5 HEAT EXCHANGERS - GENERAL 10
2.6 HEAT EXCHANGERS FOR SPACE HEATING 13
2.7 DOUBLE WALL PLATE AND FRAME HEAT EXCHANGER (FOR DHW) 13
2.8 CONTROL VALVES AND ACTUATORS 14
2.9 PUMPS AND VARIABLE FREQUENCY DRIVES 15
2.10 ENERGY METER 16
2.11 TEMPERATURE AND PRESSURE TRANSMITTERS AND GAUGES 17
2.12 OTHER VALVES 18
2.13 STRAINERS 19
2.14 BALANCING VALVES 19
2.15 PIPING SYSTEM 19
2.16 THERMAL INSULATION HEAT EXCHANGERS 19
2.17 CONTROL SYSTEM - COMMUNICATION 20
2.18 CONTROL SYSTEM – FUNCTIONS 20
2.19 CONTROL SYSTEM - ALARMS 21
2.20 ELECTRICAL 22
2.21 SUBSTATION SKID FRAME 22
3 PERFORMANCE TESTING 23
3.1 PURPOSE 23
3.2 GENERAL 23
3.3 PERFORMANCE TEST – FOR EACH SUBSTATION CONFIGURATION 23
3.4 ACCEPTANCE TEST – FOR EVERY SUBSTATION 24

1 GENERAL REQUIREMENTS

1.1 SUMMARY

This Specification Control Document (SCD) provides for the design and procurement of packaged district heating substations that are designed to transfer thermal energy from the Medium Temperature Hot Water (MTHW) district heating system to customer buildings.

1.2 DEFINITIONS

Design Pressure — The design pressure is the maximum allowable working pressure as defined in ASME B31.1 Power Piping Code.

Heat Exchanger (HX) — A device that permits heat to be extracted from one system for use in another without mixing fluids.

Interconnecting Pipe — Piping that runs from the isolation valves within the building wall to the substation.

Medium Temperature Hot Water (LTHW) – A description used with district heating systems that distribute water at a supply temperature between 190°F and 250°F.

Operating Pressure — The operating pressure is the pressure at which the system normally operates.

Owner — The entity that will own and operate the packaged substations.

Owner's Representative — Hired by the Owner to provide continuity of design as well as oversee and review the work by the Supplier and/or the Owner's contractor.

Service Line — Piping that runs from the main lines of an underground district heating distribution system to the customer interior wall terminating (normally) at the isolation valves where the service lines penetrate the building wall.

Substation –- An integrated energy transfer station that is packaged on a skid and designed to be installed at the interface between a district heating distribution system and customer buildings.

Supplier — The vendor supplying packaged district heating substations described herein.

1.3 REFERENCE STANDARDS

1.3.1 This section is applicable only to district heating substations procured as packaged units.

1.3.2 The latest published edition of a reference shall be applicable unless identified by a specific edition date.

1.3.3 All reference amendments adopted prior to the effective date of a contract with a Supplier shall be applicable.

1.3.4 The design and construction of the district heating substation shall be in accordance with applicable laws and regulations.

1.3.5 All materials, construction, and workmanship shall comply with the latest editions of the applicable codes and standards from the following:

- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- American Society of Mechanical Engineers (ASME)
- American Society of Testing and Materials (ASTM)
- American National Standards Institute (ANSI)
- American Water Works Association (AWWA)
- Instrument Society of America (ISA)
- Underwriters Laboratories (UL)
- National Electrical Manufacturer's Association (NEMA)
- National Fire Protection Association (NFPA)
- American Standards Association (ASA)

1.3.6 The supplier may submit a request to the Engineer for acceptance of an alternate standard. In the request, the supplier must provide sufficient documentation demonstrating that the requested standard meets or exceeds ANSI/ASME/ASTM standards and has been approved by the local mechanical inspector.

1.4 QUALITY ASSURANCE

1.4.1 Equipment and piping components shall be made in the United States, Canada or Europe to ANSI/ASME/EN standards.

1.4.2 Welding shall be in accordance with ANSI/ASME B31.1 and the following quality assurance requirements:

A. Welders employed by the Supplier shall have passed a qualification test in accordance with ANSI/ASME B31.1 and Section IX, ASME Boiler and pressure vessel code.
B. All welds shall be examined by a Certified Welding Inspector and in accordance with inspection and examination requirements of ANSI/ASME B31.1.

1.4.3 The Supplier shall undertake performance tests and acceptance tests of packaged district heating substations in accordance with Section 3 of this specification.

1.5 SUBMITTALS

1.5.1 The Supplier shall provide the following information for qualification and approval. Part numbers are required for all substation components. All units must be US customary units but metric may be included for reference:

A. Substation Schematic Drawings
B. Component Submittals
C. Assembly/Installation Drawings (including interfaces, dimensions, and weights)
D. Process and Instrumentation Diagrams
E. Control Equipment Description
   - Functional description
   - Sequence of operation
F. Programs for Performance Testing, Commissioning and On-site O&M Training (including proposed personnel)
G. Operation and Maintenance Manual
H. Qualification Test Procedure Report
I. Weld Procedure Specifications (WPS), Procedure Qualification Records (PQR), and Welder Performance Qualifications (WPQ)
J. Acceptance Test Procedure
K. Substation Datasheet Template
L. Requested Deviations

1.5.2 For each packaged substation furnished by the Supplier the following information shall be provided:

A. Factory Acceptance Test Report
B. Substation Datasheet – including description of the nameplate, all major components (including part numbers and serial numbers), and revision levels of controlling drawings and documents
C. Declaration of Conformity - with a certificate that the unit has been inspected during manufacture in accordance with requirements of applicable pressure vessels directives and confirming that the district heating substation is suitable for use with design pressures and temperatures as per this specification.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Supplier shall be required to provide 2-D CAD files of models with proposal. The engineer of record shall verify the equipment can fit into given location of where the energy transfer stations are to be installed. If equipment does not fit, then installation contractor is responsible for providing feedback to Supplier for redesign efforts. Engineer of record shall have responsibility to confirm that packaged substation skids are designed to fit within available space and that there is adequate egress for delivery to installation location. The Supplier is to design the substation to be broken down into sections if required.

1.6.2 Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.

1.6.3 Supplier shall be responsible for shipping of all materials, and delivery of substations to site in accordance with Owner's delivery schedule.

1.7 COMMISSIONING

1.7.1 The Supplier shall provide support during substation commissioning for all phases of substation deployment and mutually sign off on all completed commissioning activities and checklists together with the commissioning agent.

1.7.2 Customer shall provide suppler a minimum of 3 weeks advanced notice for start-up if start up is required.

1.7.3 Commissioning and start-up support services shall include support by a representative from the entity responsible for control system integration for the packaged substation skids. Support services representative shall have a minimum of 1 year experience with low temperature hot water district energy substation control systems.

1.8 ON-SITE O&M TRAINING

1.8.1 Supplier shall provide one (1) day on-site operational and maintenance training sessions to Building Owner's operating staff as part of this contract.

1.9 WARRANTY

1.9.1 A manufacturer's warranty shall be provided for a period of not less than twenty four (24) months from the date of substation start-up or thirty six (36) months after delivery. Under which the Supplier agrees to repair or replace systems, products, or components that fail, or do not perform in accordance with Owner's requirements, due to defects in materials or workmanship at no cost provided that defects occurred under normal and proper use.

1.9.2 The manufacturer's warranty shall cover all elements and components of the substation, including controls and control system.

2 DESIGN AND CONFIGURATION REQUIREMENTS

2.1 GENERAL

2.1.1 Design, sizing and configuration requirements for each packaged substation are specified in this section and defined in Appendix A. The Supplier must request a deviation for approval for any design/configuration requirement that cannot be met.

2.1.2 Each packaged substation shall be equipped with the following at a minimum:

- Heat exchanger(s) for space heating
- Heat exchanger(s) for domestic hot water (if applicable)
- Control valve(s) for heating
- Control valves for domestic hot water (if applicable)
- Pumps and VFDs (if selected for supply with the integrated package)
- Revenue grade energy meter
- Control system with local panel and HMI and network interface
- Temperature and pressure sensors and gauges
- Thermal insulation (removable) for heat exchangers (PHE exempt)
- Isolation, filling, check, safety, drain and vent valves
- Strainers for primary/heating and domestic hot water

2.1.3 Flow on both sides of the district heating substation is designed to vary.

A. The substation must be capable of delivering the range of supply temperatures for heating water and domestic hot water on the building side.

B. The substation must also be capable of achieving the low return water temperature expected on the district side of the heat exchangers, provided the building heating hot water systems perform as intended.

2.1.4 No district side water flow should pass through the substation unit when there is no load. For this purpose, an unloaded unit is one which is not being called on to supply space heating, domestic hot water or domestic hot water circulation.

2.2 SUBSTATION CONFIGURATION

2.2.1 Achieving hot water return temperatures at or below 160°F from customer buildings is critical to successful district heating system performance. This results in lower district return water temperature which reduces the flow rate necessary to serve the heating loads and preserves available capacity.

2.2.2 For hydraulically remote (hydraulically critical) customer buildings in the district heating system a minimum differential pressure of 20 psid (110 kPa) will be allocated. This includes 4 psid (28 kPa) for the interconnecting piping and 16 psid (83 kPa) for the packaged substation on the district side. For those hydraulically remote substations with both space heating and DHW HX the Supplier shall work to configure the space heating and DHW HX in series, but may consider a parallel HX configuration if required due to differential pressure limitations.

2.2.3 The piping and control valve configuration for series connection of heating HX and DHW HX illustrated in the substation schematics found in Appendix A is a suggested configuration. Alternative vendor configurations may be acceptable, pending Owner approval, but they must meet the following functional requirements:

A. When district supply water supplementing is required to maintain building side domestic hot water temperature requirements, configuration and control must be designed for minimal use of district supply water peaking, versus designed for full space heating HX return flow through the DHW HX in conjunction with district supply water peaking.

B. Configuration and control must allow for instantaneous DHW load to be served by district supply water when space heating HX is not in use in buildings without DHW or IHW storage tanks

2.2.4 Substation schematics identifying general requirements and Supplier scope of work are included in Appendix A.

2.3 TEMPERATURE AND PRESSURE REQUIREMENTS

2.3.1 The following table shall be considered the design temperatures and pressure for the district heating system and connected buildings:

Design Pressures and Temperatures		
	District	Building
Design Pressure	150 psig	150 psig*
Design Temperature	215 °F	180 °F*

*Design temperature and pressure on building side must be verified for each individual building.

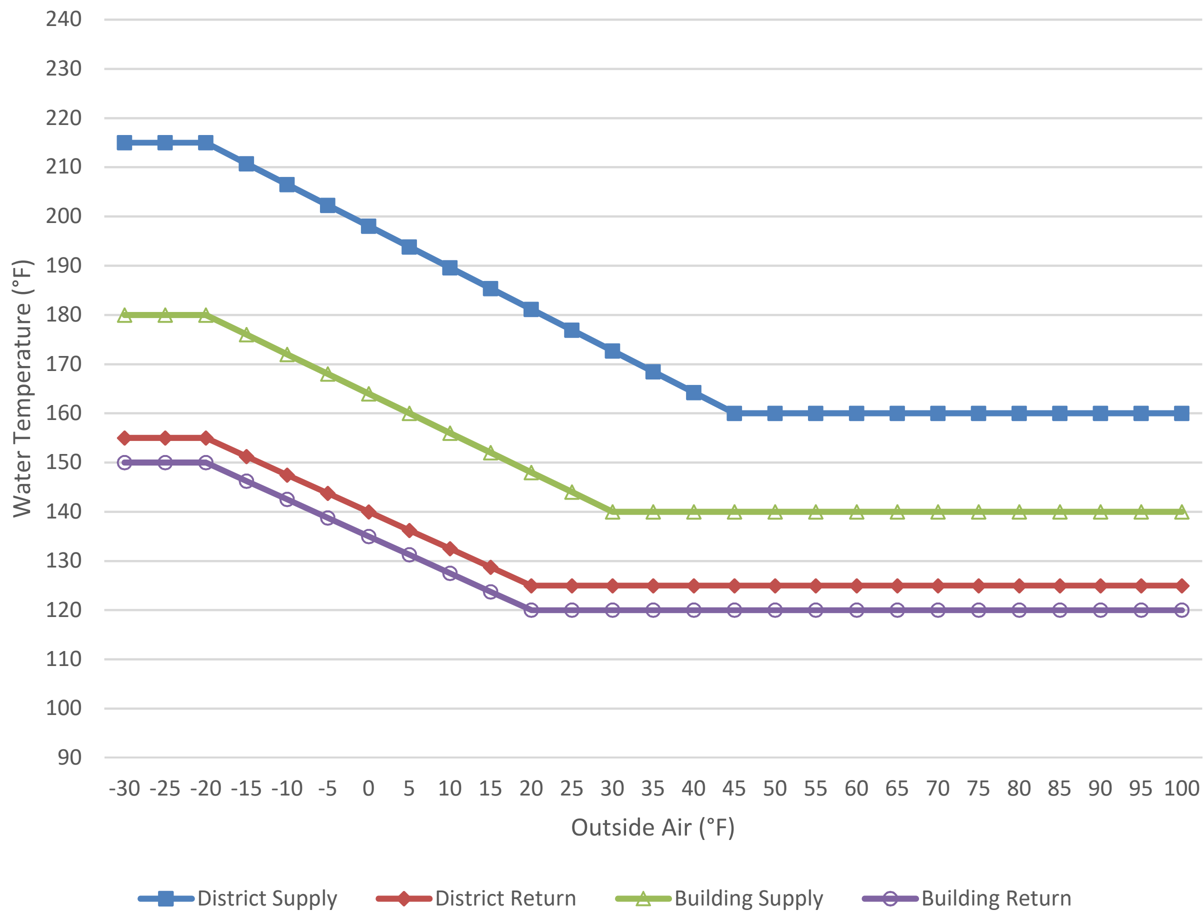
All components and equipment shall be either PN16 rated (232 psi at 200°F) or ANSI Class 150 rated (260 psi at 200°F) or higher.

Substation hydronic piping and equipment shall be hydrostatic pressure tested to a pressure of 1½ times the design pressure for a period of minimum 30 minutes with no drop in pressure.

2.3.2 District heating substations must meet the design and operating conditions and strategies of the district heating distribution system:

A. Allowable differential pressure in building(s) for each substation are to be provided by Owner’s Representative to Supplier.

B. Supply temperature varies from 160-220°F over the year with the outside air temperature between. The outside air temperature reset schedule is as follows:



2.3.3 Heat exchangers shall be selected based on the capacity, temperature and pressure information provided by the Owner.

Maximum allowable pressure drop (ΔP) across the heat exchangers is 5 psi.

Space Heating Heat Exchanger Selection Criteria					
District Side Conditions			Building Side Conditions		
Supply Temp	Return Temp	Max. ΔP	Return Temp	Supply Temp	Max. ΔP
215°F	155°F	5 psi	150°F	180°F	5 psi

Domestic Hot Water Heat Exchanger Selection Criteria					
District Side Conditions			Building Side Conditions		
Supply Temp	Return Temp	Max. ΔP	Inlet Temp	Supply Temp	Max. ΔP
215-160°F	120-95°F	5 psi	50°F	130-140°F	5 psi (14 kPa)

2.4 INSTALLATION AND IDENTIFICATION OF PIPES AND EQUIPMENT

2.4.1 Substation shall be configured such that equipment and components can conveniently and safely be serviced and/or replaced.

2.4.2 Equipment intended for operation, supervision, indication or inspection shall be clearly visible, easy to read and reach.

2.4.3 Components that may need to be operated during usage shall be positioned such that contact with hot surfaces is avoided.

2.4.4 Electronic equipment shall not be subjected to higher temperatures than that for which it is intended.

2.4.5 The design of connections and sealing surfaces shall be appropriate to the type of material used in the connected pipes, and to the substation's design data.

2.4.6 Welded connections are preferred but whenever flanges and/or threaded connections must be used for equipment, connection type should be to ANSI/ASME standards unless a deviation is approved by the Owner's Representative.

2.4.7 Provide nameplate on each piece of equipment, mechanically fastened complete with raised or recessed letters.

2.4.8 Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.

2.5 HEAT EXCHANGERS – GENERAL

ACCEPTABLE MANUFACTURERS:

1. Alfa Laval
2. Sondex
3. Swep

FRAME COMPONENTS

2.5.1 The Plate Heat Exchanger manufacturer shall not subcontract or purchase for resale the plates. They shall press their own plates.

2.5.2 The Plate Heat Exchanger Manufacturer shall have an established and on-going QA/QC program including manuals available for inspection at plant.

2.5.3 The Plate and Frame heat exchanger manufacturer shall have extensive background and experience in the design and fabrication of plate and frame heat exchangers. The manufacturer shall have fabricated plate heat exchangers for a minimum of twenty (20) years.

2.5.4 Heat exchangers for space heating shall be sized for design load capacity defined in designer's specification and equipment schedule. Heat exchangers for space heating shall be brazed plate type. If brazed plate type heat exchangers are not available for the capacity defined in designer's specification then AHRI-certified gasketed plate and frame type heat exchangers shall be acceptable. When gasketed plate and frame type heat exchangers must be used they shall be selected with frames that allow for future expansion of at least 20% additional plates.

2.5.5 Plate heat exchangers shall be certified according to ARI Standard 400 and listed on the ARI.org site **http://www.ahridirectory.org/ahridirectory/pages/llhe/defaultSearch.aspx**. If heat exchanger is not ARI certified, then the manufacturer shall provide an independent third party field performance test using the mapped ratings, limits and tolerances of ARI Standard 400 to verify performance to specification. Any and all cost associated with correcting a non-performing heat exchanger to meet the performance requirements shall be the responsibility of the supplier. Any cost associated with the field performance test shall be included in the price of the heat exchanger.

2.5.6 Plate heat exchangers shall be designed, constructed, and tested in accordance with Section VIII, Division I of the ASME Pressure Vessel Code.

2.5.7 Preference will be given to single pass designs with all connections on the fixed cover.

2.5.8 The fixed and movable covers shall be of sufficient thickness for the design pressure and code requirements <u>and shall have no welded reinforcements or stiffeners.</u>

2.5.9 The movable cover shall be provided with a steel or nylon roller bearing for units greater than 50" in height (from bottom of feet). This allows the movable cover to be moved without additional rigging or handling equipment.

2.5.10 The carrying and guide bars shall be designed to allow for expansion of at least 20%.

2.5.11 The carrying and guide bars guiding system shall be precision manufactured of stainless steel to prohibit corrosion and facilitate movement of the plates. A stainless steel sleeve for the carrying bar is acceptable on connections 4” and above. Painted or surfaces are not permitted.

2.5.12 The entire frame shall be bolted together to allow unit to be field assembled to permit rigging into place. Welding of the frame components is not permitted.

2.5.13 Plate and carrying bar design shall permit the removal or access to any plate in the plate pack without the need to remove any other plates.

2.5.14 Provide lifting lugs designed to allow lifting of the entire unit’s flooded weight.

2.5.15 All steel surfaces shall be thoroughly cleaned and prepared for painting per SSPC-SP1063T, painting over mill scale is not acceptable. All steel components shall be primed using a high grade epoxy primer and finish painted using a high solids urethane or polyurethane coating.

<u>CONNECTIONS</u>

2.5.16 Connections equal to or less than 2" shall be stainless steel NPT type.

2.5.17 To avoid leakage on port area, studded port design should be provided on heat exchangers with connections greater than 2". Flanged nozzle connections are not acceptable.

<u>COMPRESSION BOLTS</u>

2.5.18 Compression bolts shall not require special tools and shall be equipped with lock washers at the movable cover to facilitate opening and closing of the unit from the fixed cover.

2.5.19 Compression bolts shall be equipped with captive nuts at the fixed cover and threaded nuts at the movable cover. Welding of the nut to the closure bolt is prohibited.

2.5.20 Bolts shall be provided with rolled threads to reduce galling and a minimum of 1.5 times width hex nuts to adequately distribute the load, plus ball bearing box washers at all critical closing bolts on all units greater than 50" in height.

2.5.21 Bolts shall be liberally coated with LUBRIPLATE FML-2 for lubrication and rust prevention, and covered with a plastic protective sleeving for protection from the environment and to prevent bodily injury. Alternatively, zinc plating of rods is acceptable.

2.5.22 The bolting system shall be designed so that only (4) compression bolts are required opening and closing of the unit.

PLATES

2.5.23 The plate and frame heat exchanger shall consist of pressed type ALLOY 316 to provide the required heat transfer area to meet the operating conditions specified.

2.5.24 Individual plates shall be pressed from a homogeneous single metal sheet in one step. No multi-stage pressing of one sheet is allowed.

2.5.25 Each heat transfer plate to be with herringbone corrugations to optimize heat transfer with nominal pressure loses. Corrugations to be designed to provide support to adjacent plates at evenly distributed support points to allow pressurization of each circuit to a full differential of 1.3 times the design pressure for one hour without buckling or deformation of the heat transfer plates.

2.5.26 All plates and gaskets shall be permanently marked to identify quality and material.

2.5.27 Each heat transfer plate shall have a built-in self-aligning system to accurately locate the plates in the frame assembly and prevent lateral plate movement and maintain maximum gasket contact under pressure.

2.5.28 Plates shall be reinforced on the upper and lower mounting slots to avoid bending hangers on the plates.

2.5.29 The plate and frame heat exchanger shall be designed to perform the capacities and pressure drops as shown on the schedule. Plates to be alloy 316 with 2B finish and tapered gasket grooves.

2.5.30 The plate pack shall be covered with an aluminum shroud in accordance with OSHA.

GASKETS

2.5.31 Gaskets shall have relieving grooves to prevent intermixing of fluids and cause leak to flow to outside of unit.

2.5.32 One piece molded GLUED EPDM gaskets are required and shall fit around both the heat transfer area and the port holes.

2.5.33 EPDM or NBR and shall be rated for at least 10 year working life under design temperature and pressure conditions.

2.5.34 Preference shall be given to non-glued gasketing systems.

2.5.35 If an adhesive is necessary, it shall be compatible with the gasket material and the fluids. The adhesive shall be a 2 component epoxy glue and heat cured.

2.5.36 The Supplier shall decide on the optimum number of heat exchangers required to fulfill space heating and domestic hot water load requirements to minimize cost and footprint of each substation without compromising the ability to perform scheduled maintenance and cleaning.

2.5.37 Heat exchangers shall be supplied with removable insulation kits and supports (stands, brackets etc.), see thermal insulation requirements.

2.6 HEAT EXCHANGERS FOR SPACE HEATING

2.6.1 BRAZED PLATE HEAT EXCHANGERS (FOR SPACE HEATING)

A. Heat exchanger(s) shall consist of thin corrugated Type 316L stainless steel plates stacked on top of each other and brazed together. Brazing material shall be copper. Every second plate shall be inverted so that a number of contact points are created between the plates. The plate patterns are to create two separate channels designed for counter flow. Plate thickness shall be of a minimum of 1/64”.

B. The plate pack shall be covered by Type 316 stainless steel cover plates. Nozzle connections shall be threaded, flanged or studded port.

2.6.2 GASKETED PLATE AND FRAME HEAT EXCHANGERS (FOR SPACE HEATING)

A. Frame shall be epoxy painted carbon steel and the carrying and guide bar surface in contact with the plates and roller shall be made of, or cladded with a, corrosion resistant material such as stainless steel.

B. Nozzle connections shall be threaded, flanged or studded port.

C. The plates shall be corrugated Type 316 stainless steel. The plates should have no supporting strips and should be pressed in one step. The part of the plate in contact with the carrying and guiding bars shall be reinforced to prevent bending and twisting during the handling of the plates. The plates shall be fully supported and fully steered by the carrying bar and guided by the guide bar to prevent misalignment in both vertical and horizontal directions. Plate design shall permit the removal of any plate in the pack without the need to remove all of the other plates ahead of it.

D. Gaskets shall be clip-on or snap-on (glue-free) EPDM or NBR and shall be rated for at least 10 year working life under design temperature and pressure conditions. The gaskets shall be in one piece, as well as one piece molded, in a groove around the heat transfer area and around the portholes of the plates. The gasket groove shall allow for thermal expansion of the gaskets. The gaskets shall have a continuous support along both its inner and outer edges and to prevent over-compression of the gaskets.

2.7 DOUBLE WALL PLATE AND FRAME HEAT EXCHANGER (FOR DHW)

2.7.1 Frame shall be epoxy painted carbon steel and the carrying and guide bar surface in contact with the plates and roller shall be made of, or cladded with a, corrosion resistant material such as stainless steel.

2.7.2 Nozzle connections shall be threaded, flanged or studded port.

2.7.3 The double wall plate elements shall be comprised of two plates pressed together simultaneously and laser welded at the port. Failure of one plate or weld shall result in an external detection without inter-leakage. The plates shall be corrugated Type 316L stainless steel. Metal to metal contact shall exist between adjacent plates. The plates should have no supporting strips and should be pressed in one step. The part of the plate in contact with the carrying and guiding bars shall be reinforced to prevent bending and twisting during the handling of the plates. The plates shall be fully supported and fully steered by the carrying bar and guided by the guide bar to prevent misalignment in both vertical and horizontal directions. Plate design shall permit the removal of any plate in the pack without the need to remove all of the other plates ahead of it. Plate thickness shall be a minimum of 1/64".

2.7.4 Gaskets shall be clip-on or snap-on (glue-free) EPDM or NBR and shall be rated for at least 10 year working life under design temperature and pressure conditions. The gaskets shall be in one piece, as well as one piece molded, in a groove around the heat transfer area and around the portholes of the plates. The gasket groove shall allow for thermal expansion of the gaskets. The gaskets shall have a continuous support along both its inner and outer edges and to prevent over-compression of the gaskets.

2.8 CONTROL VALVES AND ACTUATORS

2.8.1 Control valves shall be high performance industrial grade and must be rated and selected to accommodate the design temperatures and pressures noted herein.

2.8.2 All modulating control valves shall be selected to ensure proper sizing in the hydraulic gradient, to allow for expansion and growth and changes in the district heating system's load profile, to provide temperature stability in the presence of real time pressure fluctuations, and to deliver the lowest possible return water temperature included local control system.
Flow rates on MTHWS to control valve in excess of 125 GPM shall use 1/3, 2/3 control valve configuration. Control valve rangeability shall be a minimum of 100:1 and control valve actuator resolution shall be no greater than 1% to ensure 100:1 turndown in the location in the hydraulic gradient where the substation is installed.

If the Supplier seeks to use conventional (pressure-dependent) control valves then the supplier shall provide a control valve sizing and selection method statement for approval by the Owner's Representative. Control valves shall be sized by engineers experienced in control valve sizing and based on differential pressure figures provided by Owner's Representative and associated with the expected differential pressure in the hydraulic gradient in the location where it is applied. Two control valves i.e. 1/3–2/3 split range shall be considered for large turn down. Control valve sizing calculations for each substation shall be submitted to the Owner's Representative for approval.

2.8.3 Control valve position must have a nameplate that indicates position that is visible at all times.

2.8.4 Actuators must be capable of producing the torque necessary to shutoff the valve at the rated shutoff pressure of pumps in the district heating system or 90 psid, whichever is greater.

2.8.5 District side control valves serving instantaneous DHW HX shall be provided with short positioning time actuators, such as magnetic actuators, to ensure adequate building-side DHW supply temperature response. The Supplier shall consider and mitigate potential surge effects from application of fast acting valves in this application.

2.8.6 Actuator running time from open to closed position of all valves (control and isolation) shall be adjusted to valve design, size and piping system structure so that harmful pressure waves (water hammer) does not occur.

2.8.7 Valves and actuators for space HX applications shall be configured as Normally Closed (signal to open) / Fail Closed so that there is full shutoff with a loss of actuator power and reposition automatically without intervention.

2.8.8 Valves and actuators for DHW HX applications shall be fail safe and configured as Normally Closed (signal to open) / Fail Closed so that there is full shutoff with a loss of actuator power and reposition automatically without intervention.

2.8.9 Control valve actuator shall have manual override capability at local or substation control system level.

2.9 PUMPS AND VARIABLE FREQUENCY DRIVES

2.9.1 GENERAL

A. Pumps shall be designed with at least the same pressure and temperature class as the system where it is installed.
B. Pumps equipped with integral VFD shall have a high pressure protection in the supply line and low pressure protection in the suction line.
C. Pump connection type shall be flanged.
D. Each pump shall be designed for 100% capacity.
E. Each pump shall have a power disconnect at the pump whether or not there is a panel in the room. Disconnect shall be placed to allow the service technician to disconnect the power to the pumps while working on the pumps.
F. Each pump shall have manual override at local or substation control system level.
G. Each pump shall have sufficiently low noise levels so that no noise is transferred into the occupied space of the building.

2.9.2 DOMESTIC HOT WATER PUMPS

A. The packaged substation shall be equipped with a domestic hot water charging pump when semi-instantaneous system is used. The purpose of the charging pump is to fill the storage tank with desired water temperature.
B. The packaged substation shall be equipped with a domestic hot water circulation system with an in-line pump. The purpose of the circulation of warm water is to keep the system active and the temperature on such a level that both comfort and health requirements are satisfied for the customer. It shall be sized for 30% of peak demand flow and have enough head pressure to circulate through substation,

storage tank and building network.

C. The wet part of the pump shall be made of water-resistant materials with high oxygen content and suitable for actual water hardness.

2.9.3 SPACE HEATING DISTRIBUTION PUMPS

A. Each pump supplied shall have an integral VFD each.

B. Unless otherwise indicated, distribution pumps shall be configured in pairs with each pump/VFD having 100% capacity and automatic switchover should a single pump fail in service.

2.10 ENERGY METER

2.10.1 Energy meters will allow the Owner to accurately track and/or invoice each customer for thermal energy. The meter is also useful for the surveillance of operations in district heating networks and for monitoring of temperatures and flows needed for system troubleshooting and optimization.

2.10.2 The energy meter shall consist of an inline ultrasonic or magnetic type flow meter, a matched pair of temperature sensors, temperature sensor thermowells and energy calculator/integrator. Energy meter installation shall comply with manufacturer's technical requirements and advice with respect to necessary lengths of straight pipes and positions of temperature sensors.

2.10.3 Acceptable Energy Meters

A. Onicon System-40 inline ultrasonic BTU meter for service sizes 2.5" and less.

B. Onicon System-20 with inline electromagnetic flow meter for service sizes greater than 2.5".

2.10.4 Energy Meter shall conform to Environmental Class C, in accordance with EN 1434.

2.10.5 FLOW METER

A. The flow meter shall be of inline ultrasonic or magnetic type and tested in accordance with EN 1434-4 and EN 1434-5.

B. Dimensions shall be in accordance with EN 1434-2 for compatibility and ease of replacement.

C. Flow meter shall be in compliance with Accuracy Class 2 in accordance with EN 1434.

D. Manufacturer's recommendations for installation shall be followed.

2.10.6 TEMPERATURE SENSORS

A. The temperature sensor pairs shall be tested in accordance with EN 1434-4 and EN 1434-5 and the types and dimensions shall be in accordance with EN 1434-2 for compatibility and ease of replacement.

B. Since the temperature information will be used for performance checking, the maximum permissible error in the temperature shall be within limits of EN 1434.

C. Resistance Temperature Detectors (RTDs) shall be paired PT100 or PT500 type sensors with maximum thermal response time to accommodate the fastest expected time rate of change for the application.

D. Temperature sensors shall be installed in thermowells.

2.10.7 ENERGY CALCULATOR

A. The calculator shall be tested in accordance with EN 1434-4 and EN 1434-5, factory calibrated and supplied with verification certificate.

B. The time interval between calculations and measurements of temperatures and flows shall accommodate the fastest expected time rate of change for the application.

C. The local display shall have at least the following information easily accessible:
- accumulated energy (MMBtu or kBtu)
- accumulated water volume (gallons)
- supply and return temperature (°F)

D. Minimum remote communication output (e.g. Modbus or Bacnet) module for the following data:
- accumulated energy (MMBtu or kBtu)
- accumulated water volume (gallons)
- supply and return temperatures (°F)
- instantaneous heat load (MBH or kBtu/hr)
- instantaneous flow (gpm)
- peak value of heat load with timestamp (MBH or kBtu/hr)
- peak flow rate with timestamp (gpm)

All the above information (inclusive of set points, error codes, addresses, etc.) shall also be available on the local display after some additional display button operations.

The calculator shall include a pulse and two analog outputs for remote meter reading.

E. The calculator shall be able to store, in an extended memory, at least:
- peak values of heat load and flow with timestamp
- mean value of flow under a number of periods of about 15 minutes
- error codes with time stamp

F. Local display in metric units shall be acceptable only if energy calculator data is available at controller touch panel interface in US customary units.

2.11 <u>TEMPERATURE AND PRESSURE TRANSMITTERS AND GAUGES</u>

2.11.1 The following temperature and pressure transmitters shall be included in the substation (over and above transmitters required for Energy Metering).If these transmitters do not include a local display, temperature and pressure gauges shall also be installed for local display. Measured value shall be presented in US customary units (i.e. °F and psi)

A. To be provided for control/alarm:

- One TT to measure DHW HX entering cold temperature
- One TT to measure DHW HX leaving warm temperature
- One TT to measure space heat HX building supply temperature
- One TT to measure space heat HX building return temperature
- One TT to measure space heat HX district supply temperature
- One TT to measure space heat HX district return temperature

B. To be provided for monitoring/alarm:

- One PT to measure district side supply pressure
- One PT to measure district side return pressure
- One PT to measure space heat building side supply pressure
- One PT to measure space heat building side return pressure

2.11.2 Temperature and pressure transmitters/gauges installed on the district side shall be of industrial grade, as well as building side transmitters used for control purposes.

2.11.3 Temperature and pressure transmitters/gauges and/or installed on the building side may be of commercial grade, except for transmitters used for control purposes.

2.12 OTHER VALVES

2.12.1 ISOLATION VALVES

A. Isolation valves shall be ball valves with Schedule 40 butt weld ends to match pipe, steel body, stainless steel ball and stem, Teflon seat, and reduced bore.
B. Provide a lever actuator for valves up to and including NPS 5" and a gear operated actuator with hand wheel for valves NPS 6" and above.
C. Valves located above 8 feet from floor level shall be equipped with a chain wheel installation.

2.12.2 DRAIN AND VENT VALVES

A. Manual drain and vent valves shall be installed at the high and low points on the district side, DHW and building heating side. These valves should be fitted with a removable plug. The size should not be less than ½" (DN 15). The connection type can be welded or threaded.

2.12.3 Manual drain and vent valves around each heat exchanger shall be ¾" to allow for future connection for chemical injection and periodic flushing of the heat exchanger while the isolation valves are closed.

2.12.4 PRESSURE RELIEF VALVES

A. A pressure relief valve shall be located between the isolation valves on the cold side for each heat exchanger in order to prevent overpressure during shut downs.
B. The valve shall be sized for thermal expansion at design load conditions and the set pressure should be consistent with the pressure class of the heat exchanger. The Supplier shall submit calculations and sizing information to the Owner's Representative for approval.

C. Pressure relief valves shall be ASME rated direct spring loaded type, lever operated, non-adjustable factory set discharge pressure (max design pressure).
D. Each valve shall be drained separately to floor drain.
E. Relief valve capacity shall exceed input rating of protected equipment.

2.12.5 CHECK VALVES

A. Check valves shall be non-slam type and should include an inspection hole in order to check for possible leakages.
B. Maximum pressure drop for check valves shall be 1.3 psi (9 kPa).

2.13 STRAINERS

2.13.1 Strainers are required at both the hot and cold side inlets of all heat exchangers to protect heat exchangers, control valves, and other components for from suspended particles and debris.

2.13.2 Strainers shall be Y-pattern body, screwed brass or iron for NPS 2" and smaller, flanged steel or iron for NPS 2 ½" and over. Screen area shall be a minimum of three times the area of the inlet pipe.

2.13.3 Stainless steel perforated screen with a mesh size according to requirements for HX and/or control valve, whichever requirement is finer.

2.13.4 Screens shall be accessed by way of flanged cover and equipped with blow off valve suitable to ensure a thorough flushing of the filter.

2.13.5 The strainer shall be positioned in such manner that flushing will not harm other equipment.

2.14 BALANCING VALVES

2.14.1 Balancing valves are required on the cold side inlet of DHW heat exchanger and shall meet lead-free requirement NSF-61, Annex G.
2.14.2 Balancing valve may be solder connection or screwed for NPS 2" and smaller, screwed bronze 2.5" and larger.

2.15 PIPING SYSTEM

2.15.1 All piping shall be in accordance with ASTM A53 Grade B.

- Up to and including NPS 2": Sch. 40, ERW or seamless, plain ends.
- NPS 2 ½" and over: standard weight, ERW or seamless, beveled ends.

2.15.2 Pipe joints shall be butt-welded joints to ANSI/ASME B31.1 latest edition. No other welded joints will be allowed. Backing rings will not be allowed.

2.16 THERMAL INSULATION HEAT EXCHANGERS

2.16.1 Brazed heat exchangers shall be supplied with removable insulation kits and supports (stands, brackets etc.). Plate Frame heat exchangers are exempt.

2.16.2 The insulation shall consist of freon free insulation (polyurethane foam) and jacketed in aluminum or PVC to match adjacent pipes.

2.16.3 Minimum insulation sized to provide personnel safety (anti- scald) to below 105°F (40°C) and/or condensation due to cold domestic water.

2.17 CONTROL SYSTEM - COMMUNICATION

2.17.1 Network

The packaged substation control system shall be able to communicate (bidirectional data transfer) with Building Automation Systems through protocols BACnet, Modbus TCP, Modbus RTU or LON. Each substation control system shall be supplied with communication equipment for one of these protocols, in accordance with Owner requirements, but shall have the ability to be readily upgraded to include additional protocols in future.

2.17.2 Local User Interface

Local user interface shall be via touch panel of industrial quality. Panel screens shall include, but not limited to:

- Actual and set point values.
- Domestic Hot Water Process actual and set point values.
- Control Loop Parameters
- Alarms with reset capability

2.17.3 Local Connection Interface

The control cabinet shall at a minimum be equipped with a local USB-PC and SD connection facility.

2.18 CONTROL SYSTEM – FUNCTIONS

The substation control system shall include all conventional control functions for District Heating applications and include, but not limited to, functions described in this section.

2.18.1 SPACE HEATING SUPPLY TEMPERATURE CONTROL

- The control system shall have the capability to set the space heating supply water temperature from a reset schedule base on the measured outside air temperature.
- If an outside air temperature (OAT) sensor exists within the building the substation control system shall use this sensor.
- A control loop shall be implemented in the automation system to close the space heat control valve on the district side if the building side distribution pumps are turned off.

2.18.2 DHW SUPPLY TEMPERATURE CONTROL

- The control system shall ensure a stable DHW supply temperature during the whole year.
- The control system shall be able to prioritize flow to DHW HX over the space heating should that be necessary in system operation at a peak condition or during a maintenance procedure.

2.18.3 DOMESTIC HOT WATER PUMP CONTROL

The delivery of domestic hot water within a reasonable time of turning on the tap is a basic comfort requirement.

- DHW circulation pump control shall at all times ensure prescribed water temperature is maintained in the water storage tank (if present) and/or supplied at the furthest tapping point in the building within required time limit. This pump control shall be executed by means of temperature measurement.
- DHW circulation pump control shall at all times ensure that no excess water is circulated for the requirements above.
- Recommended domestic hot water system requirements (adjustable):
  - DHW temperature of 122°F reaches the tap within approximately 10 seconds (this can be ensured through a variable pump capacity, thermostatic valves and balancing valves).
  - DHW HX supply temperature shall be at least 130°F for systems without storage tank.
  - DHW HX supply temperature shall be at least 140°F for systems that includes a storage tank.

2.18.4 DISTRIBUTION PUMP CONTROL

- The VFD for distribution pumps shall be controlled with a differential pressure transmitter located on the secondary supply and return connections of substations.
- The control system shall have the capability to operate with a minimum signal select and two differential pressure transmitters.

2.19 <u>CONTROL SYSTEM - ALARMS</u>

2.19.1 The control system shall allow for alarms and alarm management for all monitored equipment and critical functions.

2.19.2 It shall be possible for the operator to redefine alarm set points as well as time limits compared to default settings.

2.19.3 Control system alarms shall include but not limited to:

- All control system monitored water temperatures and pressures.
- Set point(s) for control have not been obtained for a defined amount of time.
- Control valve(s) fails to move.
- Pumps are stopped
- Control system has been manually bypassed.
- Communication errors

2.20 ELECTRICAL

2.20.1 Provide all required devices for proper system operation, including special electrical switches, transformers, relays, pushbutton stations, etc.

2.20.2 All electrical and control components shall have minimum NEMA-12 or IP54 rating or be protected in a cabinet with NEMA-12 or IP54 enclosure rating and exposed electrical connections covered. Components inside cabinet shall be labeled for ease of identification. Cabinet shall be an integrated component within the substation skid.

2.20.3 All electrical and control equipment shall be designed to operate in the following temperature and humidity ranges without interruption or impairment of continuous service:

- Temperature: 0-104°F (0-40°C)
- Humidity: 0-95%, non-condensing

2.20.4 Provide wiring and conduit required to connect devices furnished as a part of the packaged substation. Install wiring to comply with the National Electrical Code.

2.21 SUBSTATION SKID FRAME

2.21.1 All elements of the packaged substation shall be firmly secured to the substation skid frame.

2.21.2 Substation skid frame shall be constructed of steel and shall be all-welded construction, except where substation must be broken down into sections for egress purposes.

2.21.3 Substation skid shall be painted with corrosion resistant paint.

2.21.4 Substation skid frame shall be fitted with adjustable feet for leveling of skid during installation.

3 PERFORMANCE TESTING

3.1 PURPOSE

3.1.1 The purpose of performance testing is to test and approve/certify each configuration type/model of district heating substation package to be provided by the Supplier.

3.2 GENERAL

3.2.1 The Supplier shall undertake Performance Test per this section on one substation for each configuration type/model of substation and Acceptance Test on all substations.

3.2.2 The Supplier must give to Owner's Representative and/or Independent Certifier not less than ten (10) Business Days' notice of the date or dates on which it intends to carry out performance testing as per this section.

3.3 PERFORMANCE TEST – FOR EACH SUBSTATION CONFIGURATION

3.3.1 GENERAL

The Supplier shall provide a method statement for the following tests to be performed in the test rig in a written Qualification Test Procedure:

A. Inspection of conformity of the substation's primary circuit with the requirements in this document.
B. Static performance tests of the space heating and domestic hot water parts of the unit.
C. Dynamic performance tests of the space heating and domestic hot water parts of the unit.
D. Substation pressure drop test.
E. Operating test of the control system.

3.3.2 INSPECTION OF CONFORMITY

Verify equipment, installation and construction conforms to requirements of this specification.

3.3.3 OPERATING TEST OF THE CONTROL SYSTEM

The Supplier shall develop and submit for approval control system hardware and software acceptance test program. This document shall detail the test procedures to be performed on each control system panel furnished by the Supplier.

3.3.4 PRESENTATION OF RESULTS

The test reports shall be presented in a way that makes it is possible to compare test results between similar substation units. Test reports and product marking shall clearly indicate the system data applicable to the approved unit. It shall be possible to compare both static and dynamic test data.

Record notes, details of any actions taken, and observations during the tests under 'Other Information' in the test report.

Summarize the results of each test as follows: Complies / Does Not Comply with the requirements of the test program.

3.4 ACCEPTANCE TEST – FOR EVERY SUBSTATION

3.4.1 The Supplier shall submit a detailed acceptance test procedure designed to demonstrate compliance for every substation with contract requirements. This procedure shall include factory pretesting of controller software for each substation. This procedure shall be submitted to the Owner or the Owner's Representative for approval prior to the start of the testing.

PROPOSAL COVER SHEET
CITY OF DULUTH
RFP# 19-20AA

Bidder Information:	
Bidder Name	
Mailing Address	
Contact Person	
Contact Person’s Phone Number	
Contact Person’s E-Mail Address	
Federal ID Number	
Authorized Signature	
Title	