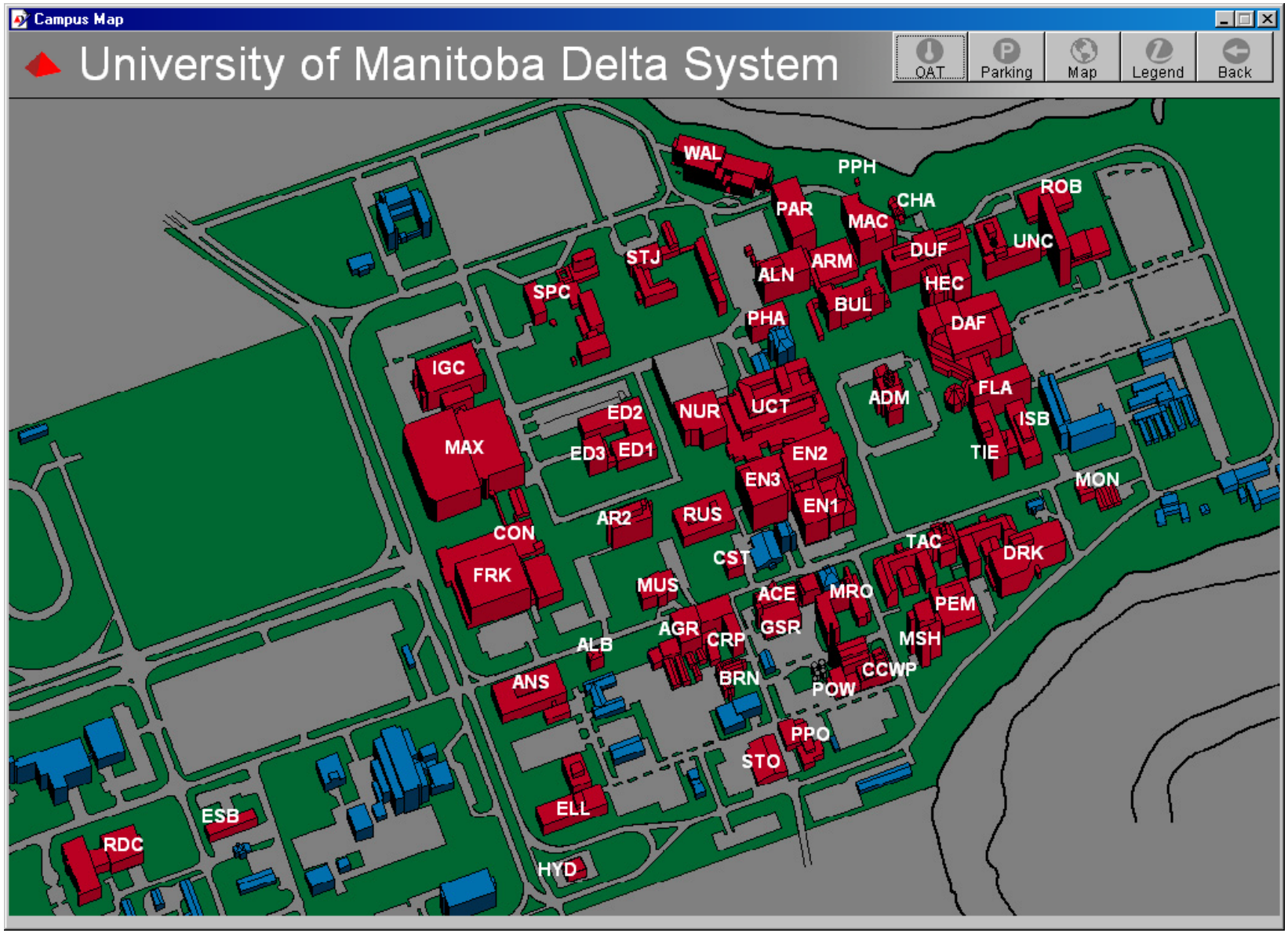
Updated: June 10, 2022 mf
Created: March 11, 2008

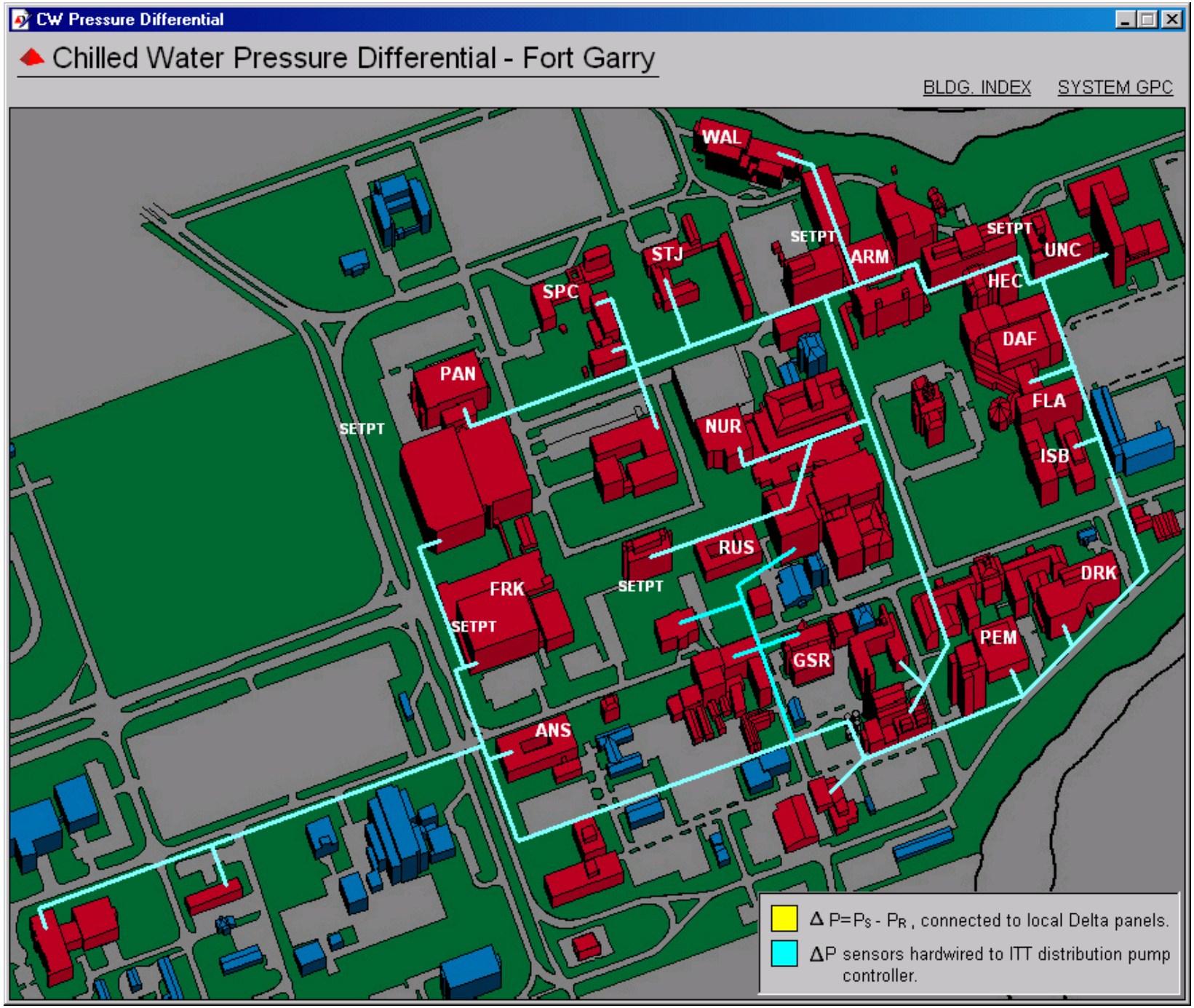
District Heat Recovery System

University of Manitoba

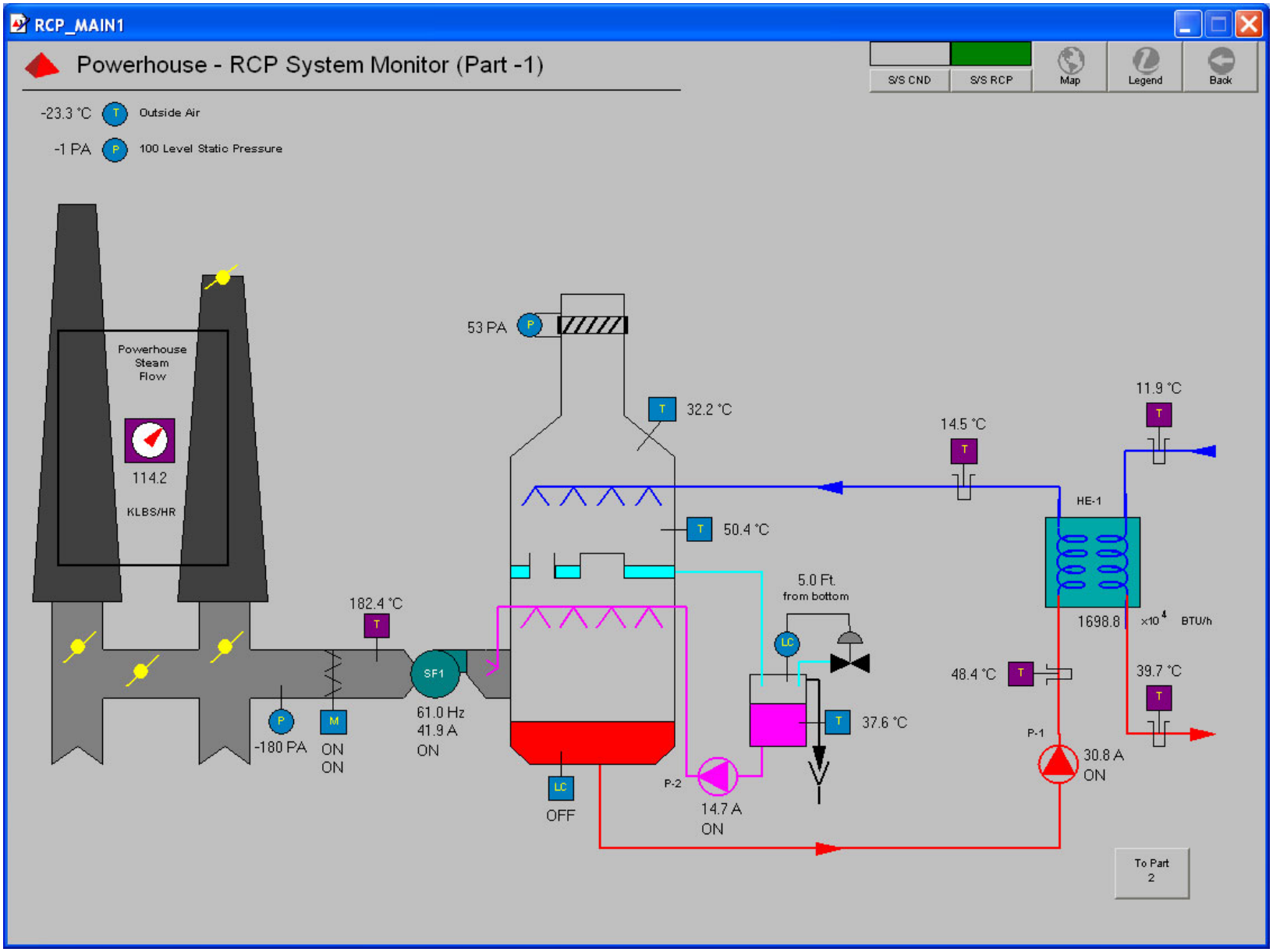
Throughout the Fort Garry Campus, waste heat is collected and transferred to locations requiring heat.



The same pipes that distribute chilled water for air conditioning during the cooling season are used to distribute recovered heat during the heating season.

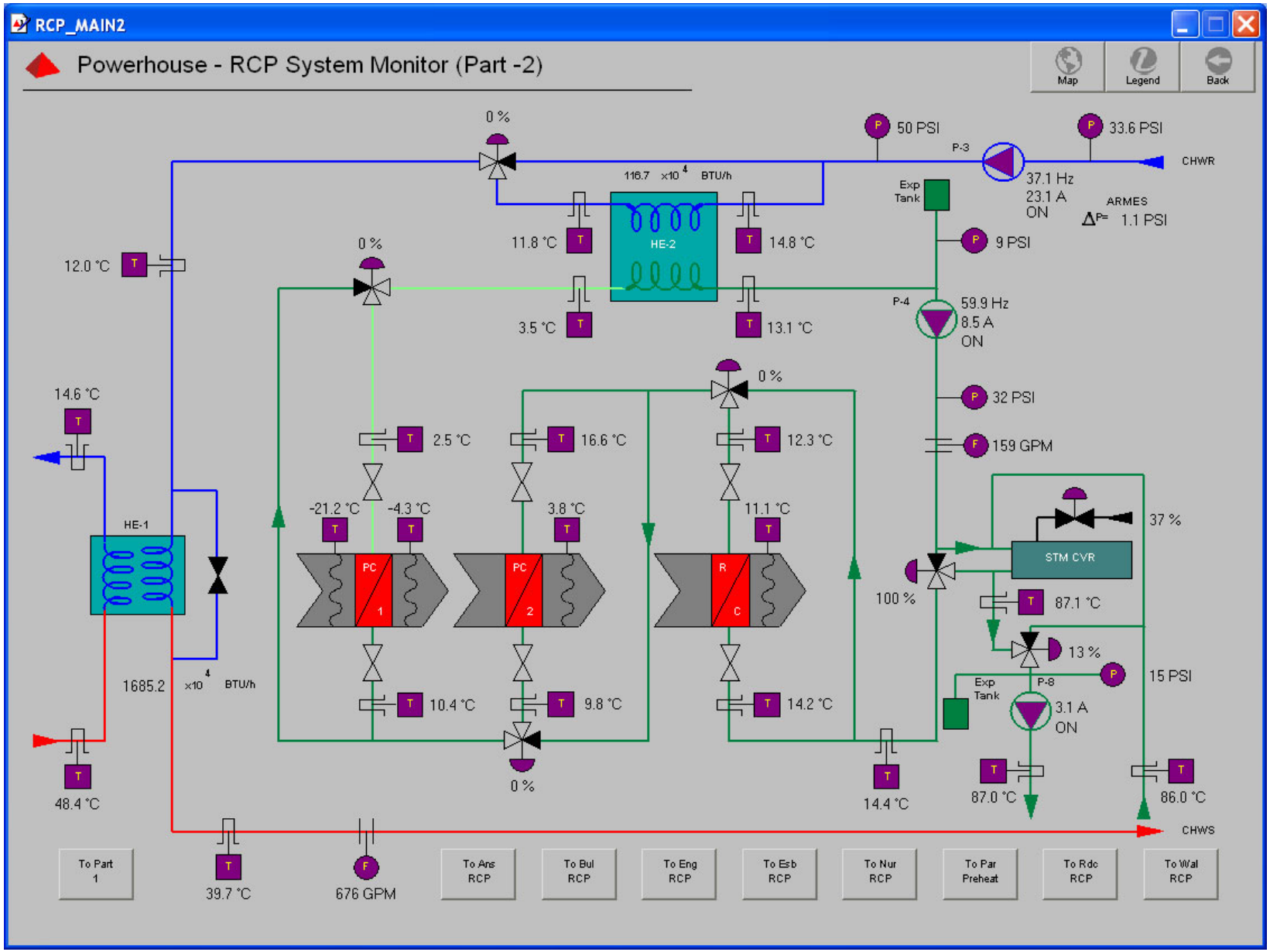


Most of the heat is recovered from the flue gases exhausted from the boilers located in the Central Energy Plant. These boilers burn natural gas to produce the steam used to heat all University facilities. Heat is extracted from the flue gas using a Recuperator. The maximum Recuperator capacity is 19.4 mmBtus per hour (enough heat for over 240 homes)!

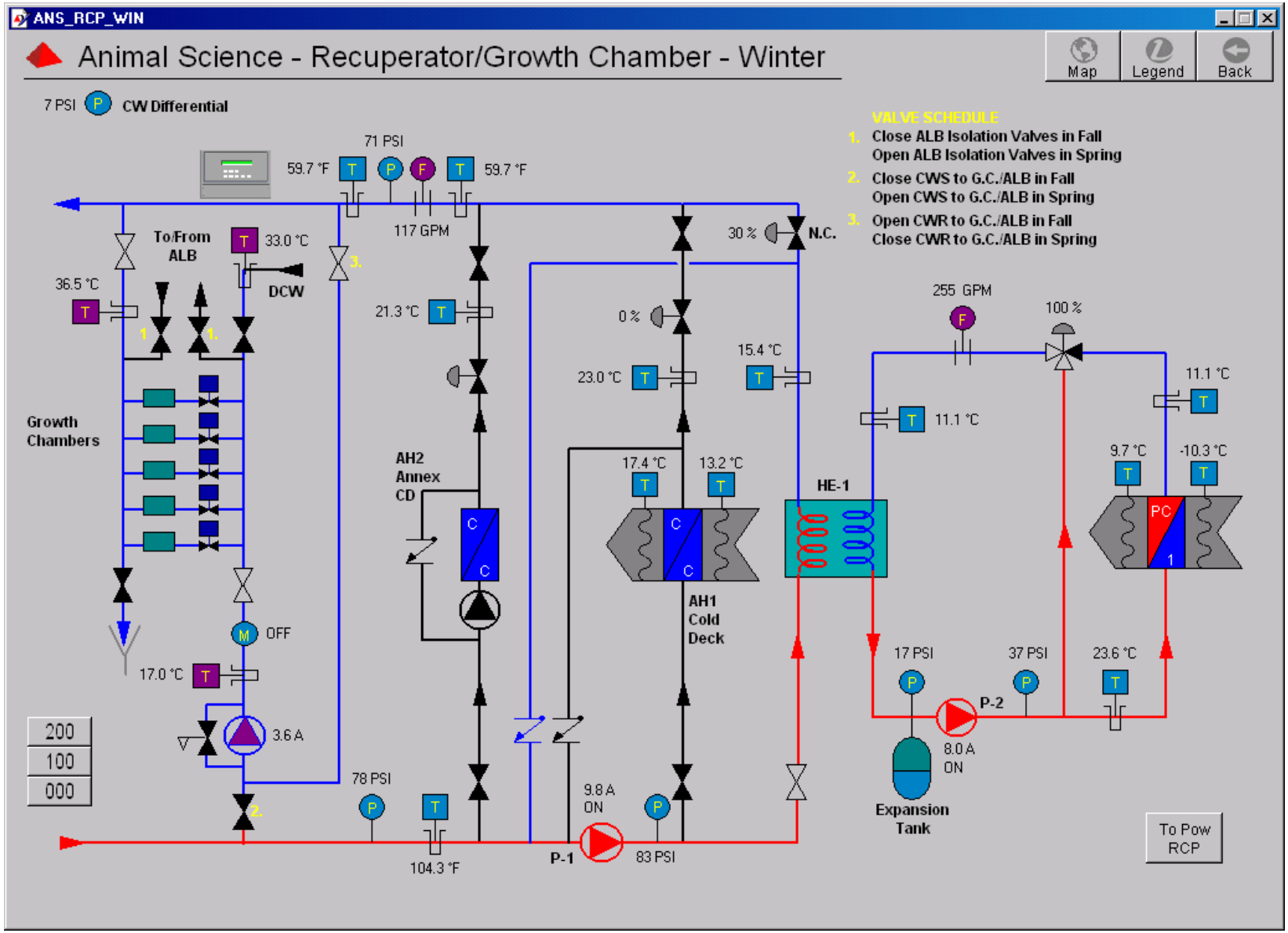


The recovery process is very simple. Water is sprayed into the flue gas. The flue gas cools as it warms the water spray. As the gas cools, water vapour in the gas (created by burning natural gas) begins to condense. The bulk of the recovered energy comes from the energy released from the water phase change, from vapour to liquid.

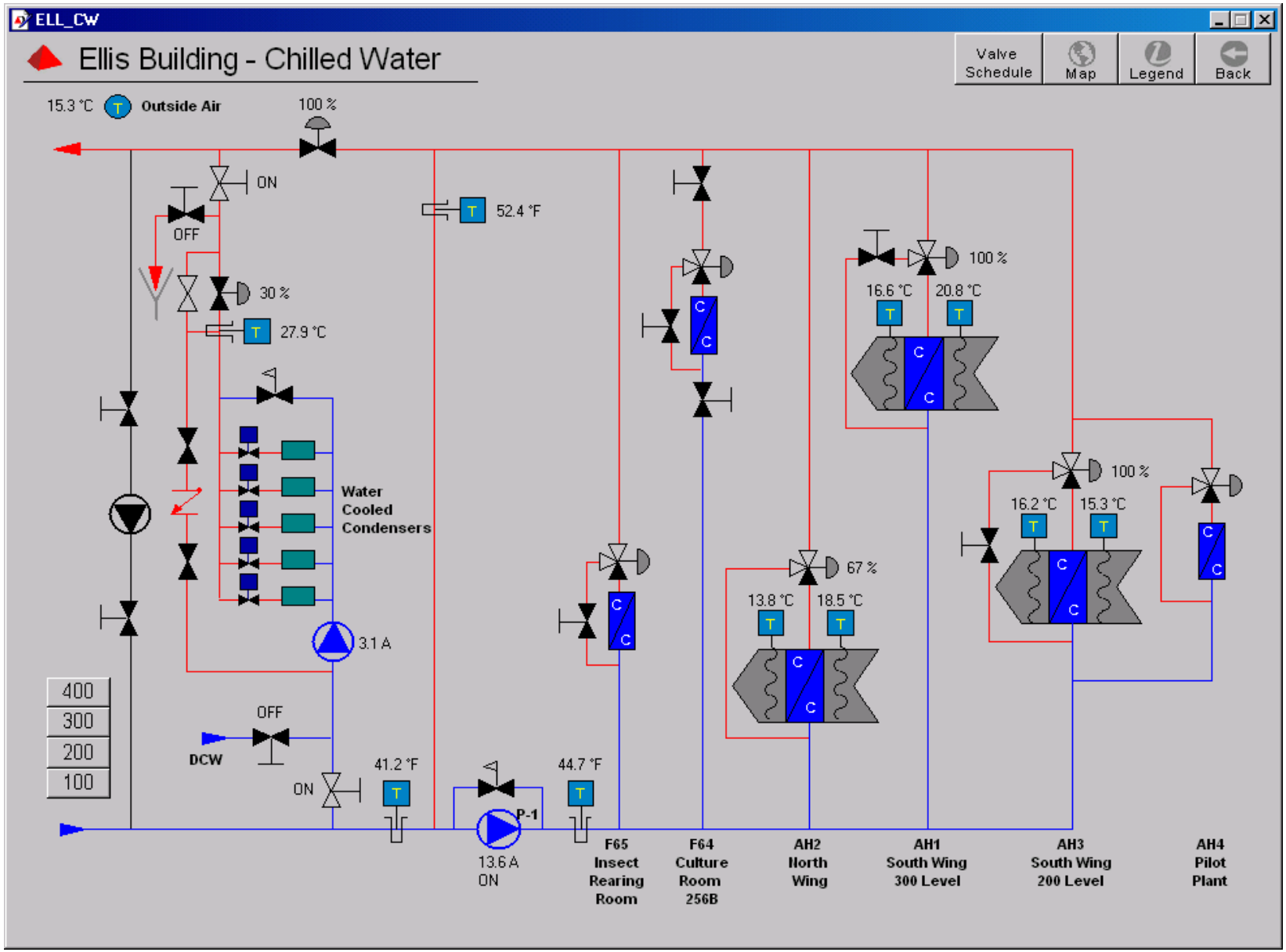
The heat is transferred into the chilled water distribution piping and pumped out to the campus.



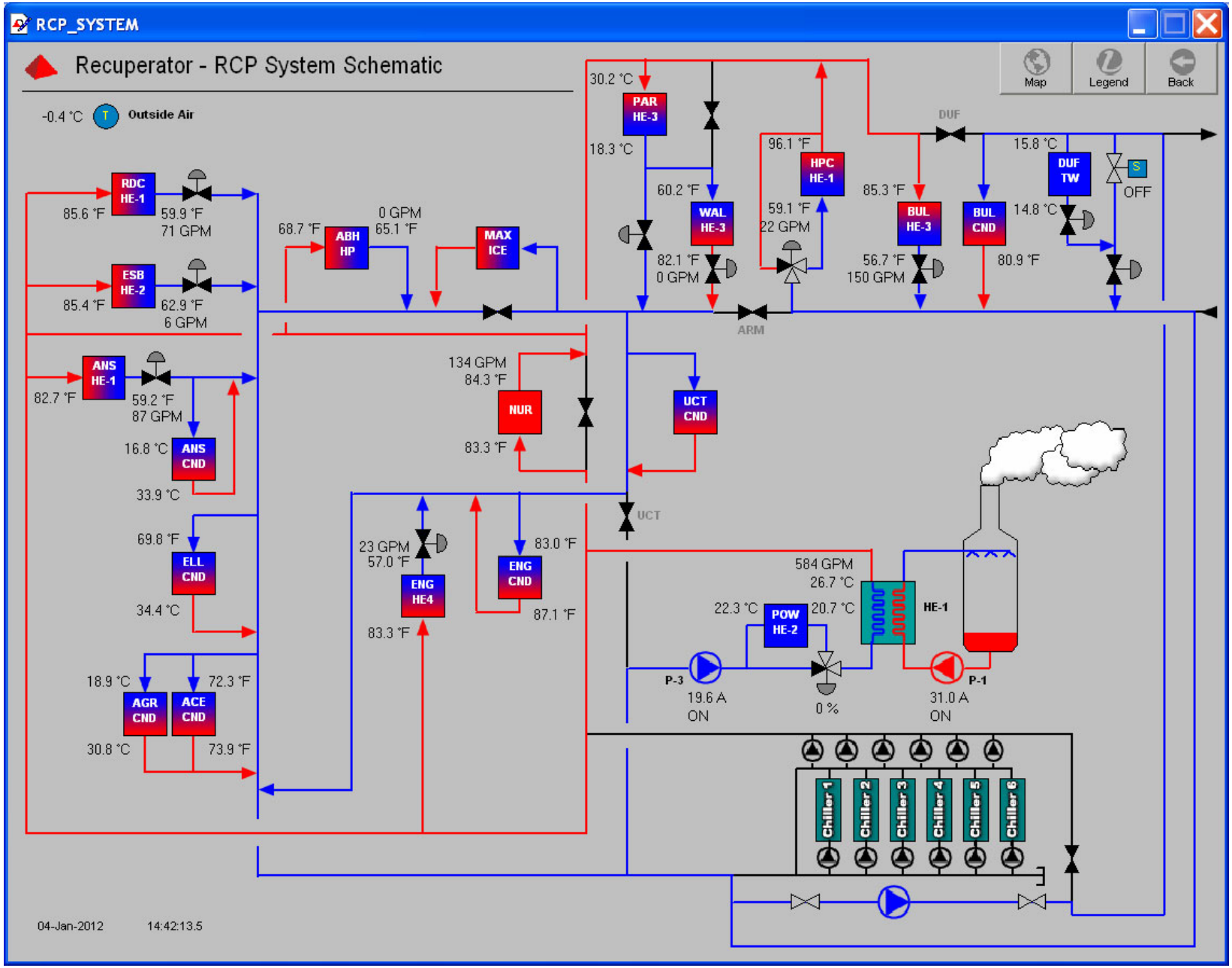
Additional heat is recovered from numerous water-cooled condensers scattered throughout the campus. Total combined capacity is 1.5 mmBtu/h.



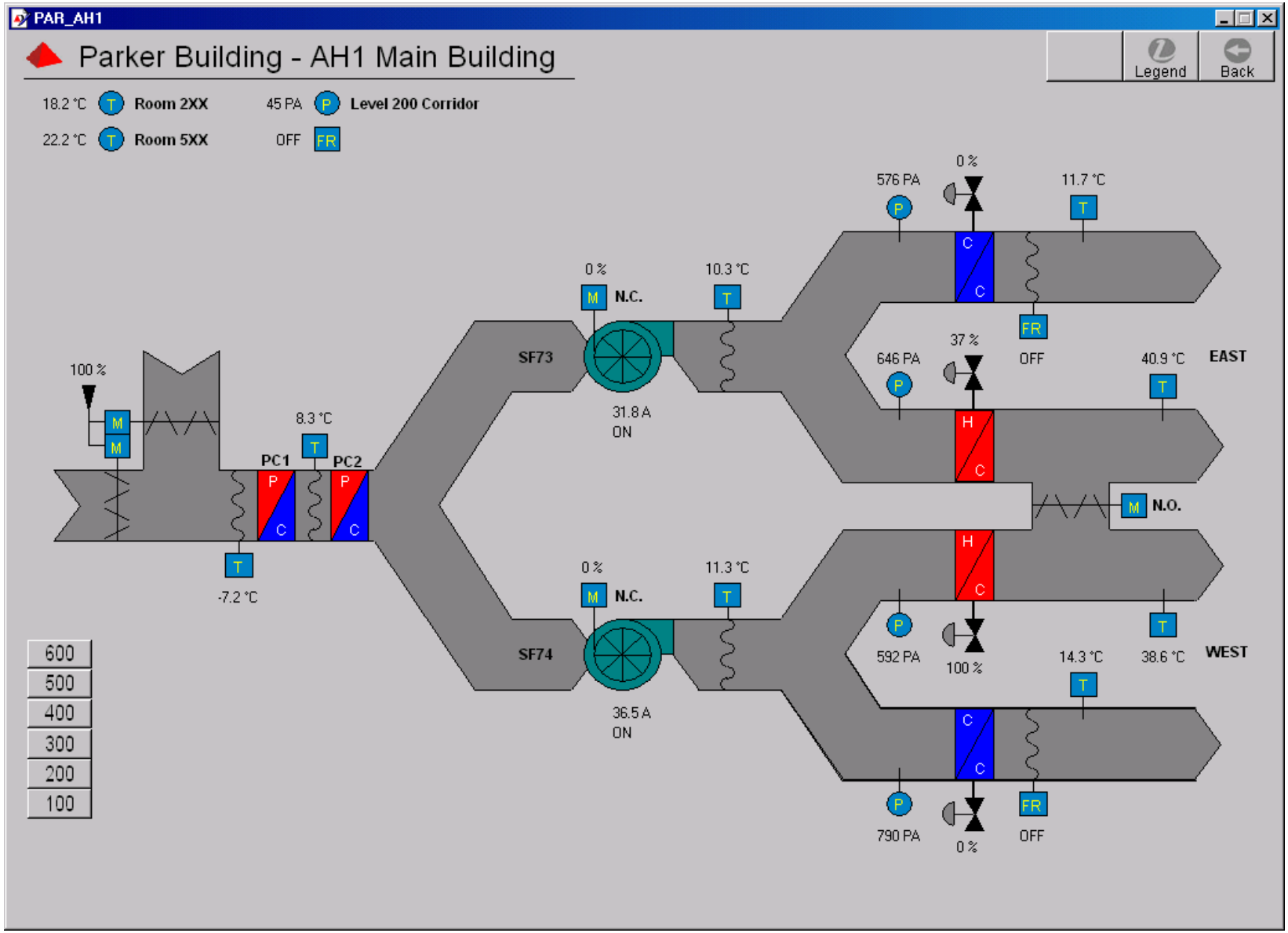
Heat is collected from water-cooled condensers located in the following buildings: Animal Science, Ellis, Agriculture, Crop Science, and Wallace.


ELL_CW
Ellis Building - Chilled Water
Valve Schedule
Map
Legend
Back
15.3 °C
Outside Air
100 %
ON
OFF
52.4 °F
30 %
27.9 °C
Water Cooled Condensers
3.1 A
400
300
200
100
OFF
DCW
ON
41.2 °F
44.7 °F
P-1
13.6 A
ON
F65 Insect Rearing Room
F64 Culture Room 256B
AH2 North Wing
AH1 South Wing 300 Level
AH3 South Wing 200 Level
AH4 Pilot Plant
100 %
16.6 °C
20.8 °C
67 %
13.8 °C
18.5 °C
100 %
16.2 °C
15.3 °C

In FY2007/08, low grade condenser heat was added from Buller, Max Bell, Engineering 1, and the McQuade Structures Lab. Significant heating loads were added in Buller and the Aboriginal House.

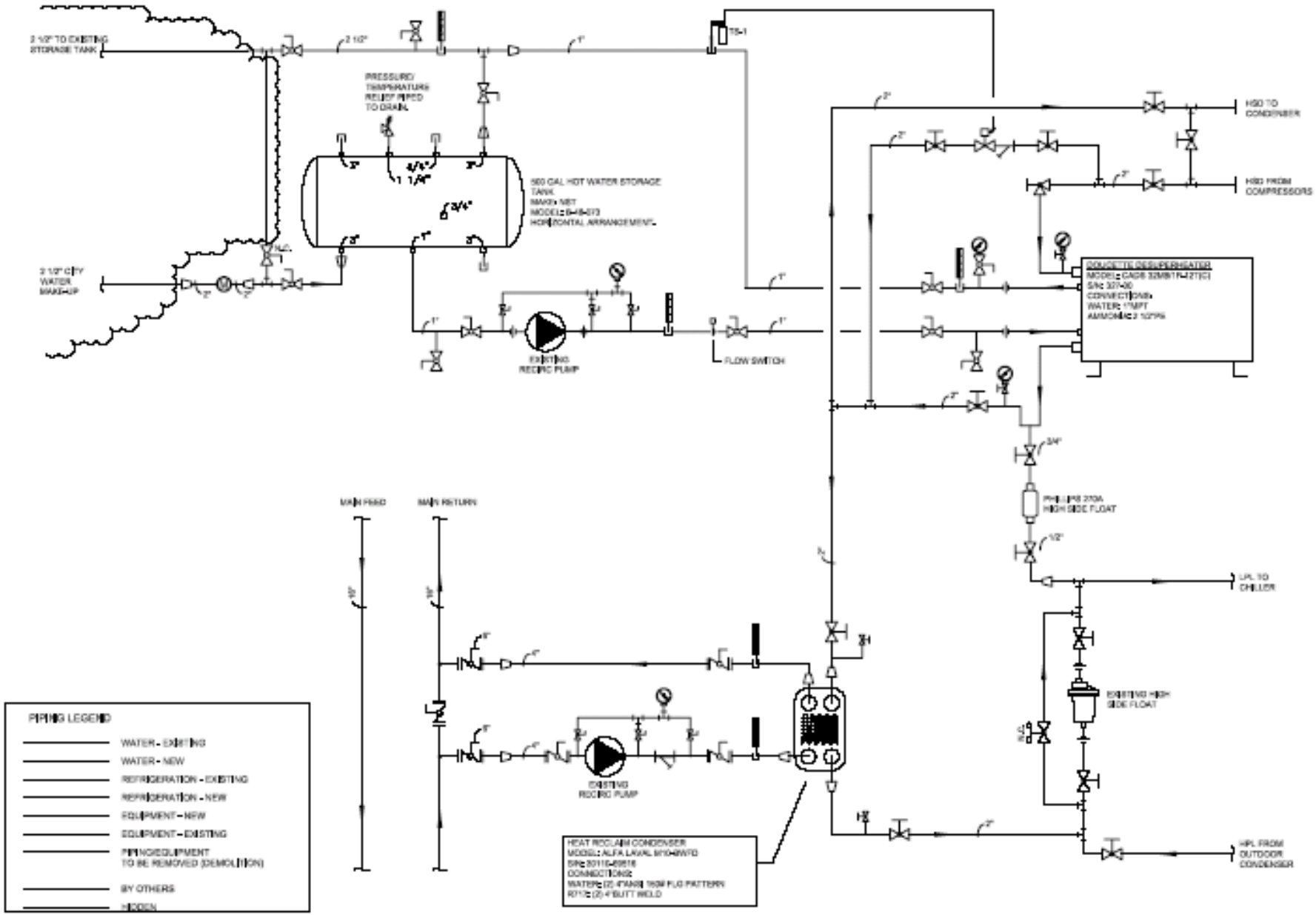


Most of the heat is used to preheat outside air. In laboratories, considerable make-up is required to offset the air exhausted by fumehoods. Connected load capacities greatly exceed the waste heat available.



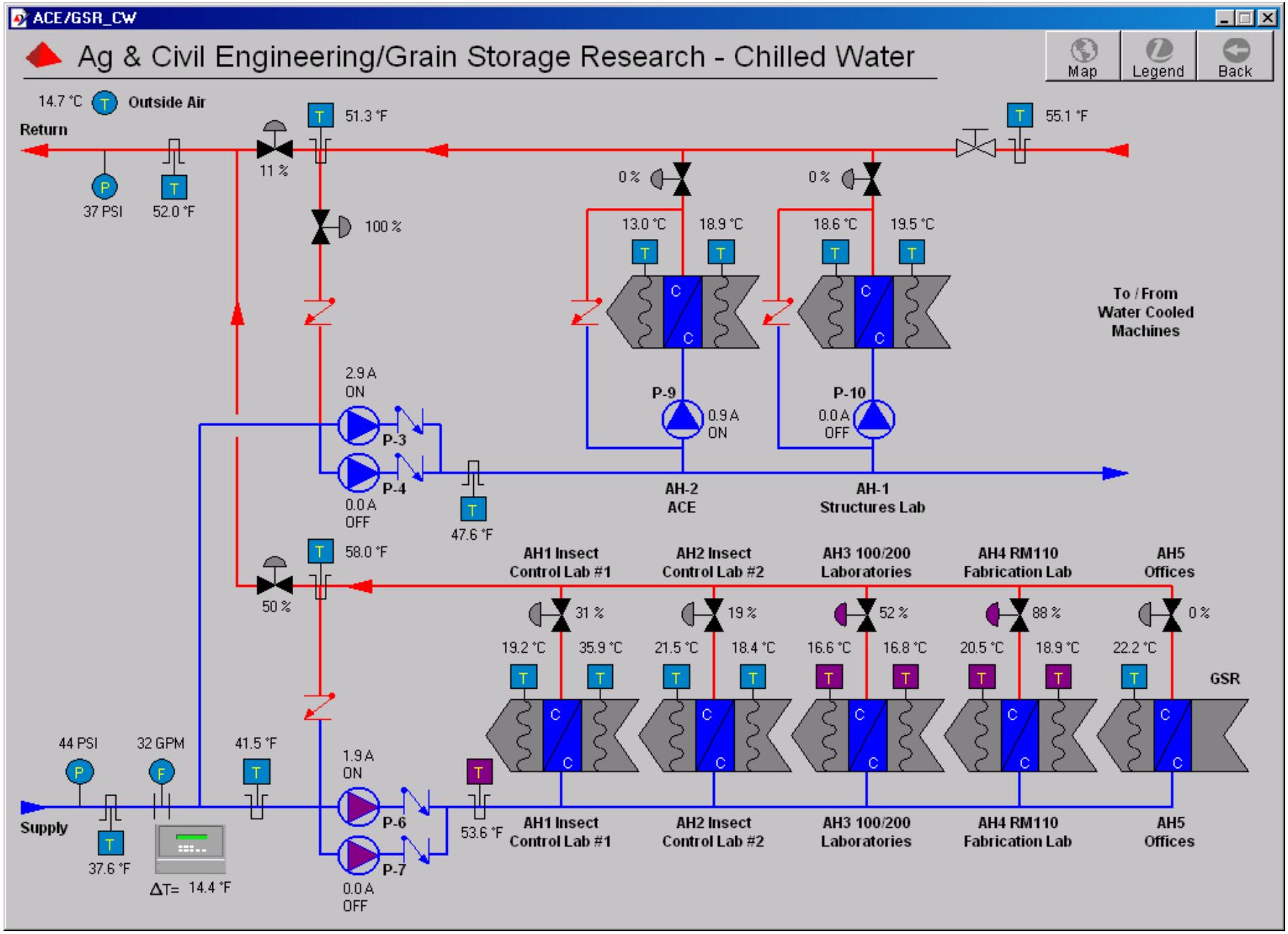
Heat is extracted to preheat make-up air in the Parker Chemistry building, the Animal Science building, the Richardson Centre, the Environmental Safety building, and the Mauro Residence. A Recuperator preheat coil was added to the Buller Biology building as part of an extensive facility upgrade in FY2007/08.

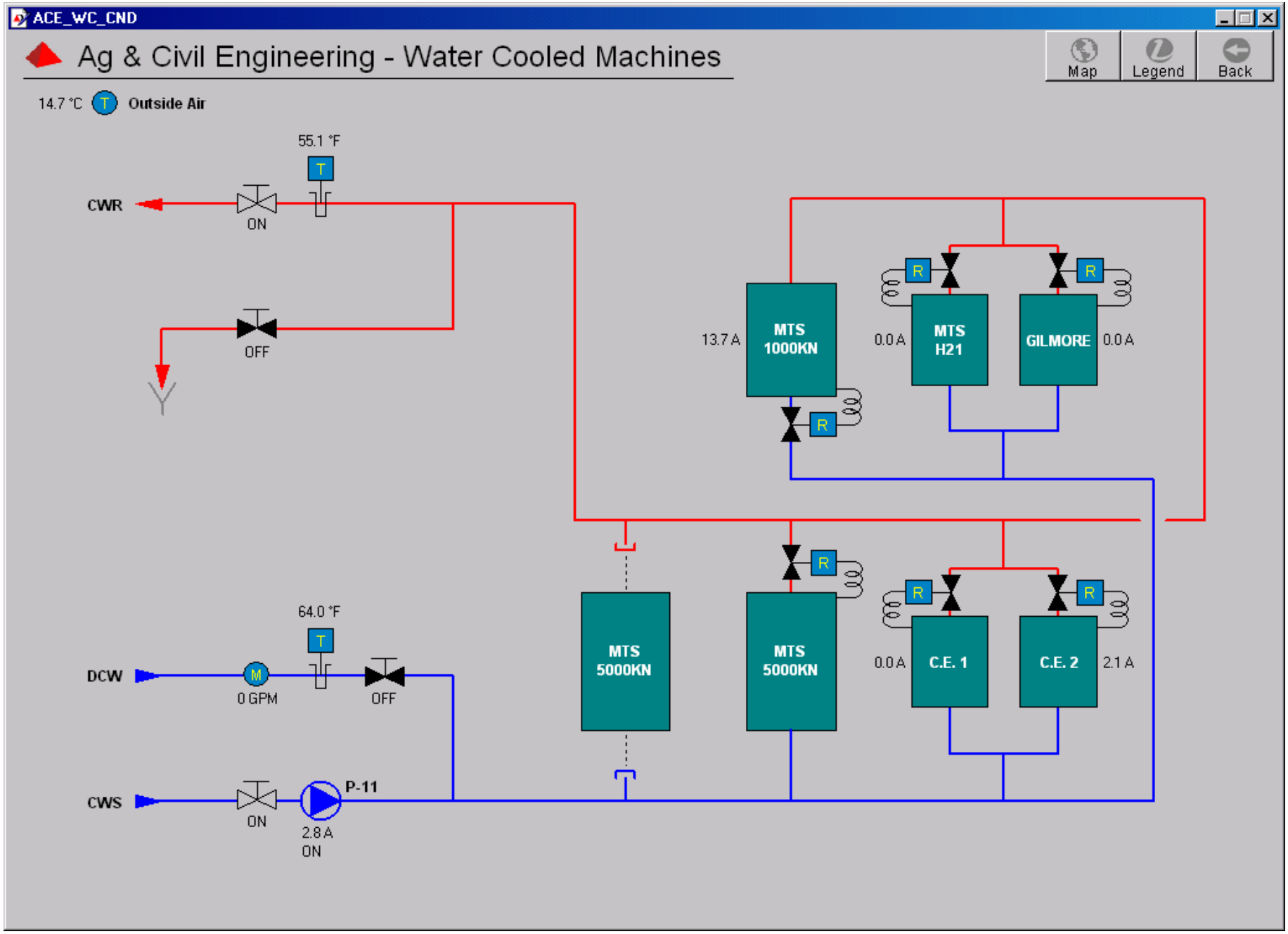
Heat recovery equipment purchased with funding from the Federal Refrigeration Action Program for Buildings was installed to recover waste heat from the Max Bell Centre Ice Rink in FY2007/08. Maximum Ice Plant recovery capacity is 1.2 mmBtu/h. During the heating season, this low-grade waste heat is transferred into the district heat recovery loop.



Throughout the year, a de-superheater is used to preheat domestic hot water for Max Bell and the Investors Group Athletic Centre.

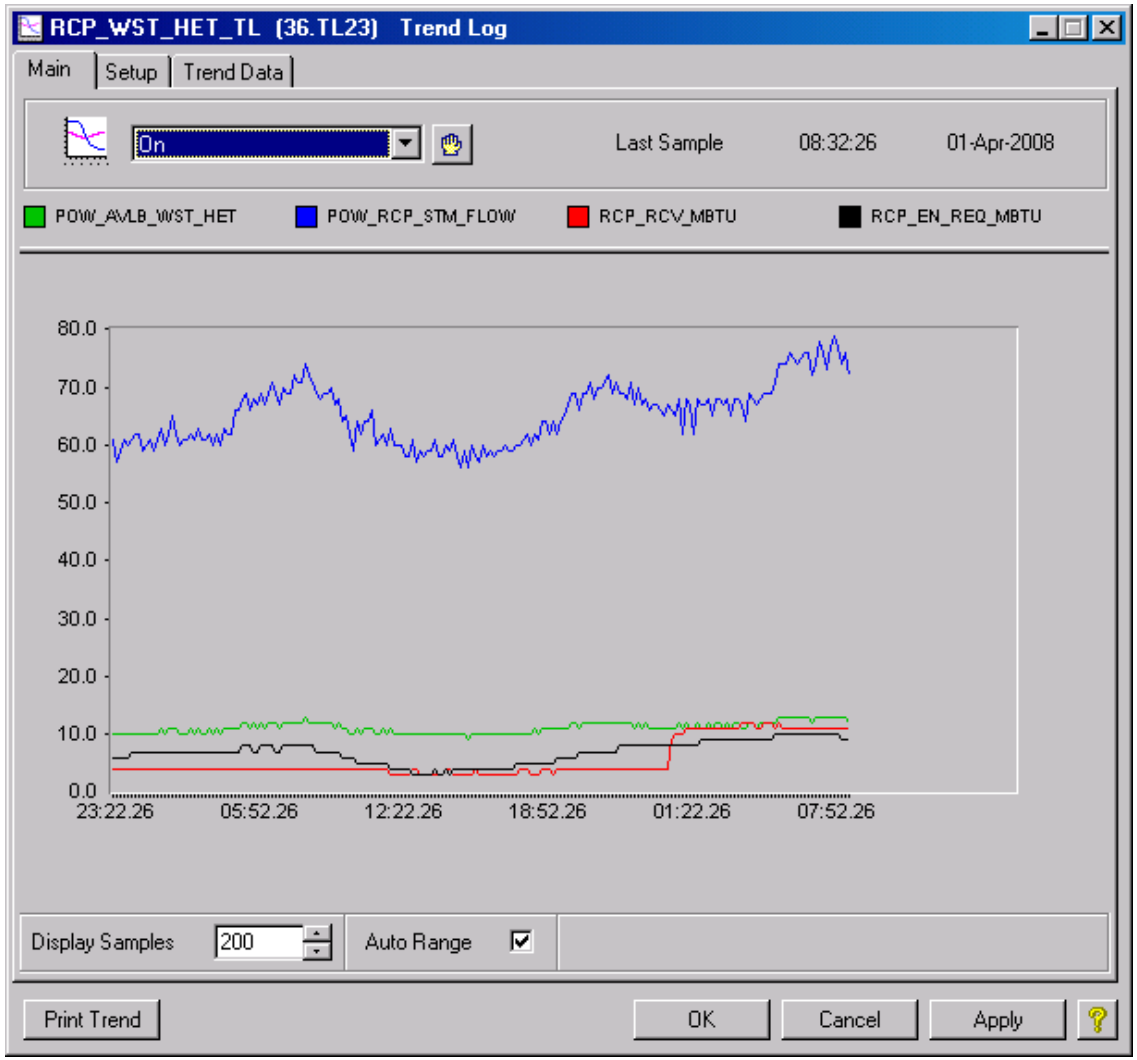
Water-cooled equipment in the Structures Lab was successfully switched from City water to chilled water on September 11, 2008.




ACE_WC_CND
Ag & Civil Engineering - Water Cooled Machines
Map
Legend
Back
14.7 °C
T
Outside Air
55.1 °F
T
CWR
ON
OFF
13.7 A
MTS 1000KN
R
R
0.0 A
MTS H21
R
GILMORE
0.0 A
R
64.0 °F
T
DCW
M
0 GPM
OFF
MTS 5000KN
MTS 5000KN
R
R
R
0.0 A
C.E. 1
C.E. 2
2.1 A
CWS
ON
P-11
2.8 A
ON

Lessons Learns / Expansions / Tweaks

1. The Recuperator supply water temperature setpoint schedule was modified to better track the actual load. Delta controllers were upgraded in 2020 to Version 3 hardware. This allows information to be shared between controllers. Building valve positions from remote locations are used to reset the Recuperator supply water setpoint.



Line Legend:

Blue – Steam Production (in klbm/hr)

Green – Waste Heat Available in Flue Gas (in mmBtu/hr)

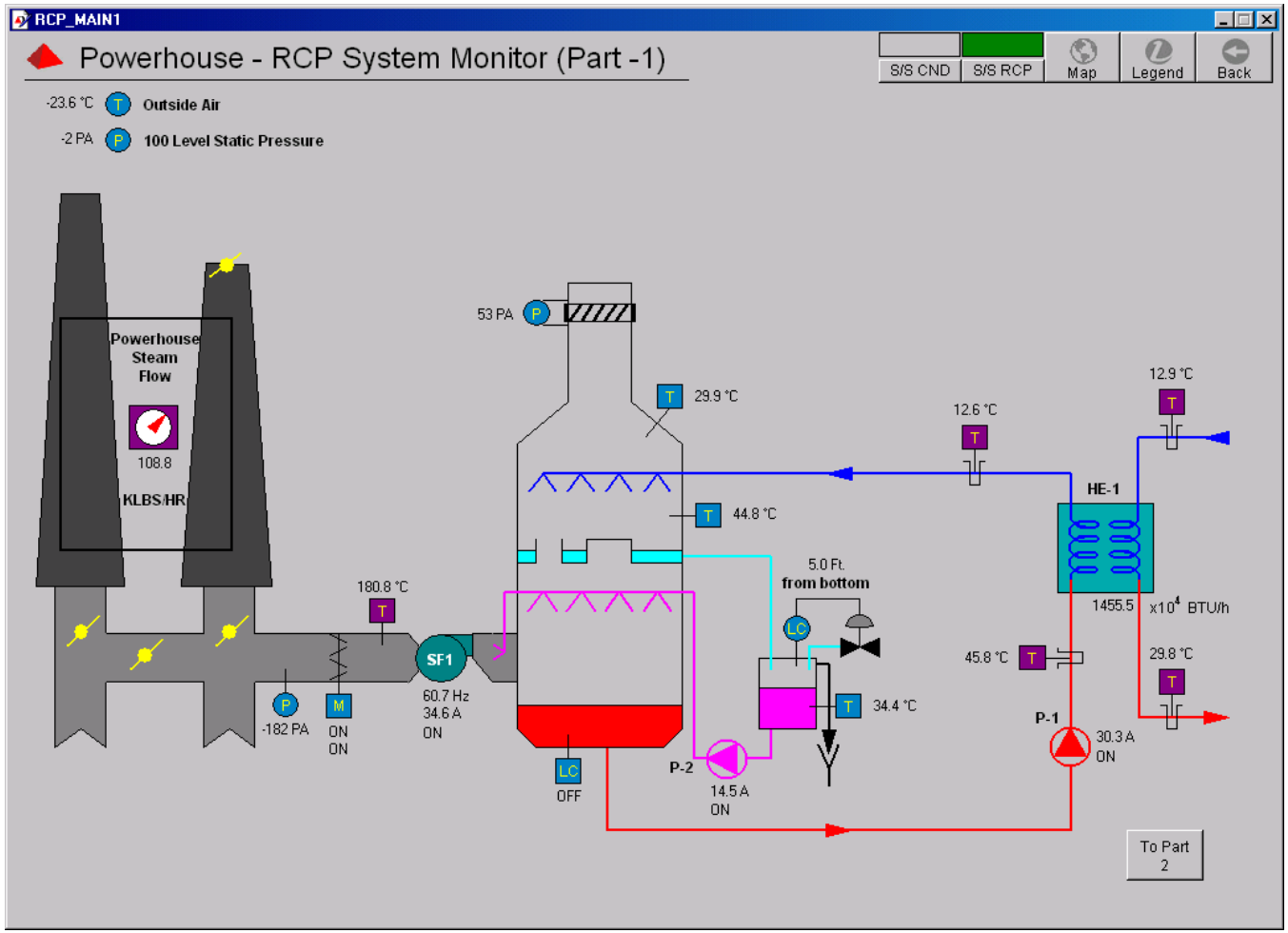
Black – Heat Required by Connected Loads (in mmBtu/hr)

Red – Recuperator Energy Input (in mmBtu/hr)

Sometimes when it was mild outside, the Recuperator was injecting too little heat.The heat required by the connected loads exceeded the energy input by the Recuperator. We ran out of pump capacity and Parker/Wallace were starved for flow.

Sometimes when it was colder outside, the Recuperator injected too much heat.The Recuperator injected more heat than the connected loads required.The water-cooled condensers overheated because the minimum flow required at Animal Science returned water that was too warm.

2. Recuperator supply fan speed was increased to maximum capacity.



When it was cold outside and the Recuperator was running flat out, the 50 hp supply fan motor was only drawing 34.6 Amps.

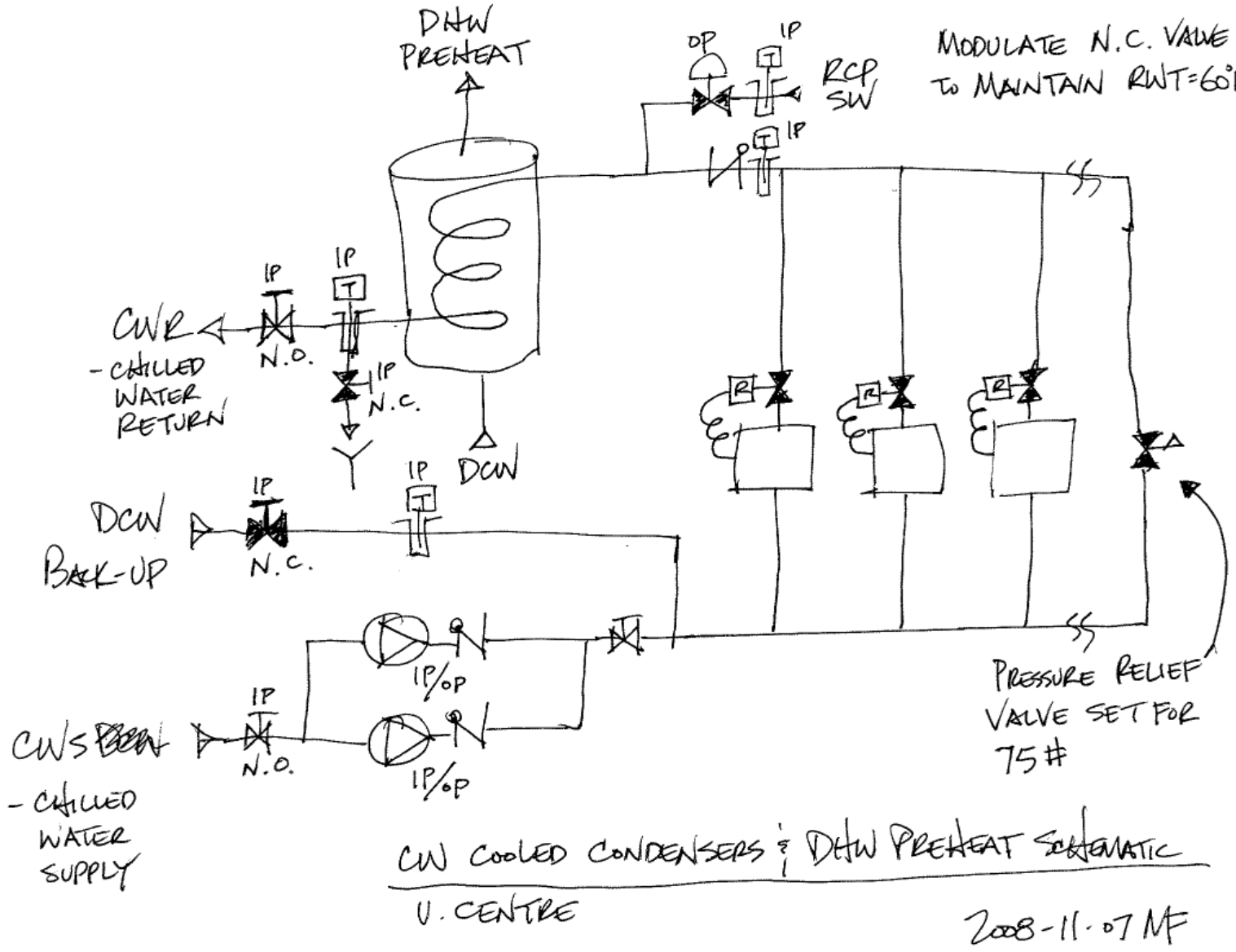
Hot flue gas is less dense than room temperature air and the motor power required to move it is significantly less.

We were not near the end of the fan curve so we increased the pulley size to move more air through the Recuperator. More flue gas increased Recuperator maximum capacity.

Plenum pressure controls were already in place to prevent the supply fan from drawing too much air and down drafting the chimney.

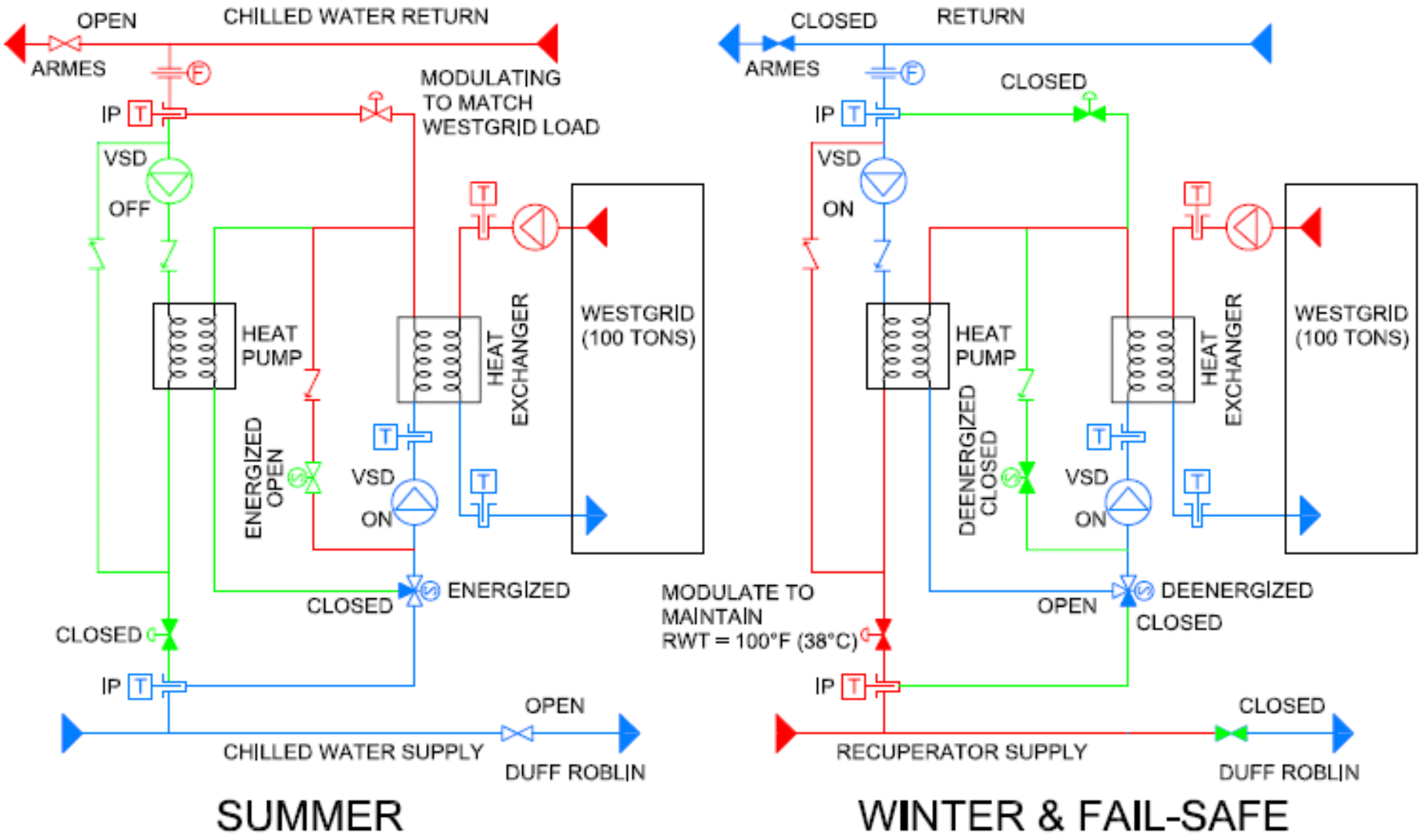
3. We stopped wasting water and energy in University Centre

All walk-in coolers and freezers (24 tons of cooling load) located in University Centre were connected to the district heat recovery loop in 2014. Heat extracted from the coolers was previously transferred into the City water, and then dumped down the drain. Before the recovered heat leaves the building, it is used to preheat domestic hot water. Any residual heat is transferred into the campus district heat recovery loop. This building also uses Recuperator supply water to preheat domestic hot water. Domestic Hot Water preheating is one of the few connected loads that does not vary with outside air temperature.



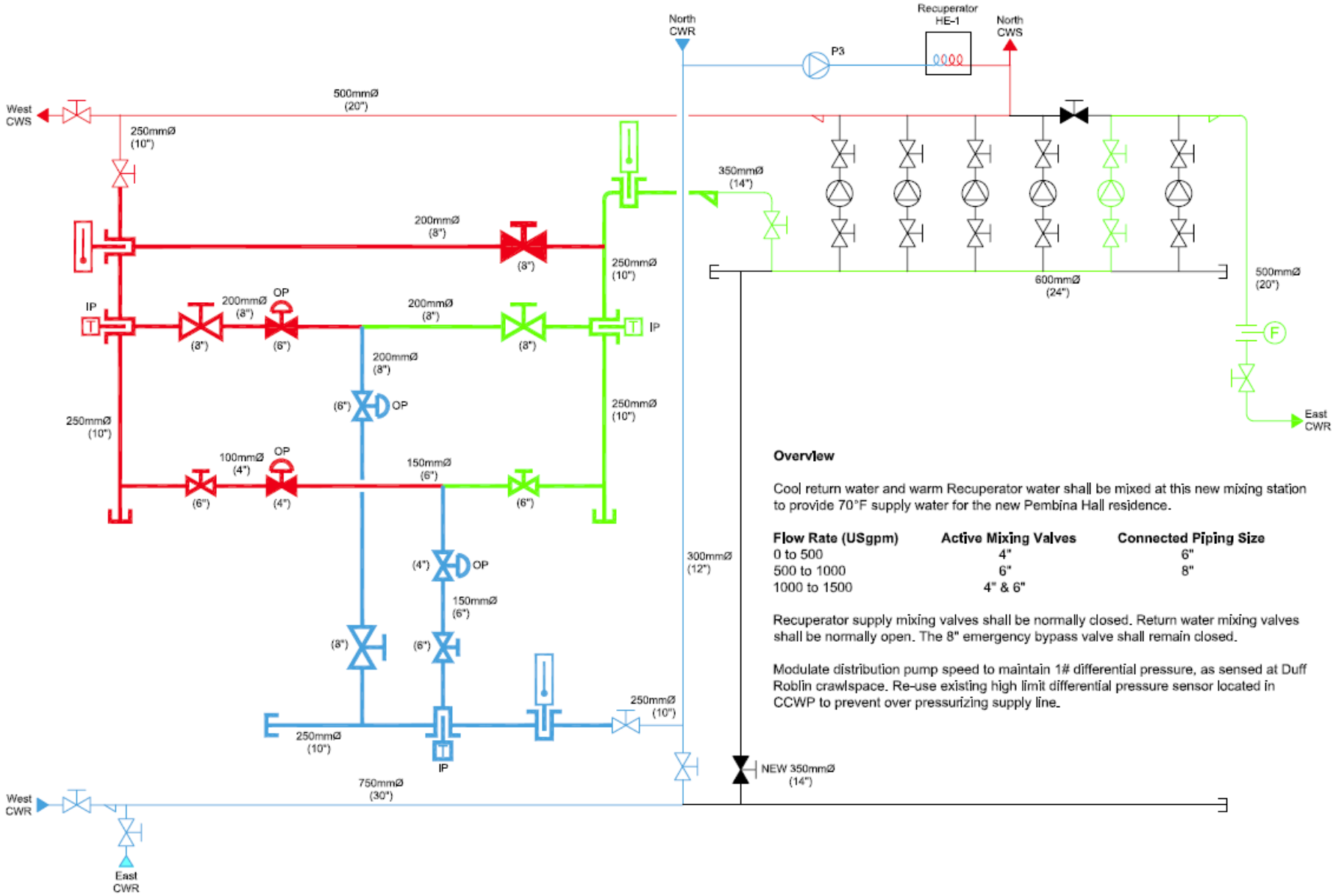
4. We recover the Waste Heat from the High Performance Computer Centre

We began recovering the waste heat from the new High Performance Computer Centre in 2010. Four heat pumps are used to concentrate the waste heat so that it can be injected into the supply line at 100 DegF. Maximum capacity for this building will be 1.7 mmBtus/h and we recover over $80,000 per heating season. Filters were added in 2016 to prevent debris from collecting in the heat pump heat exchangers. Basket filters were added to UM standard specifications for future installations.



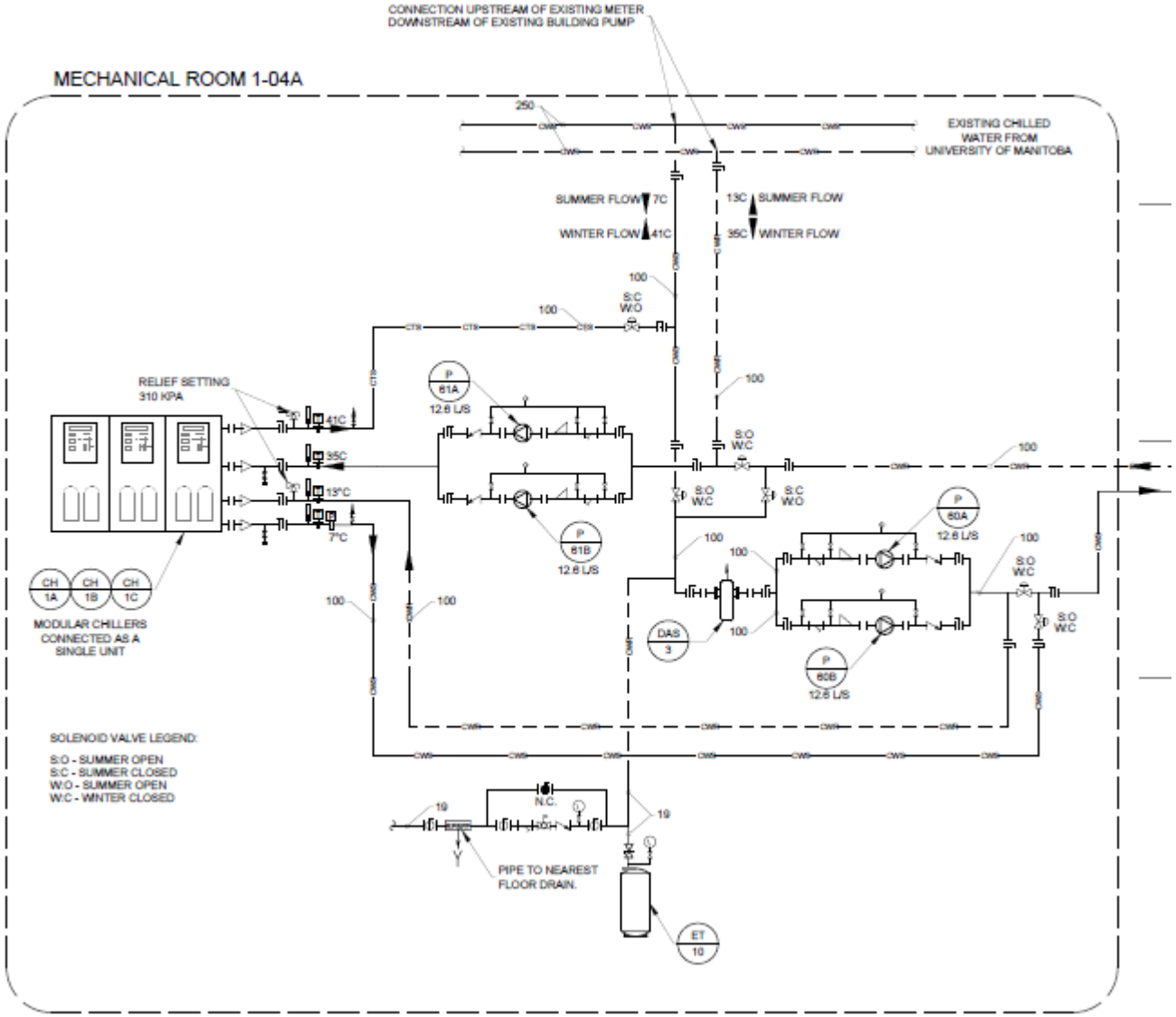
5. We installed a mixing station to use recovered heat in the new Pembina Hall Residence in 2011

There are nearly 400 heat pumps providing heating and cooling for each dorm room in this residence. Heat pumps allow us to move waste heat around the building from rooms with too much heat to rooms that need supplemental heating. When it is extremely cold outside, waste heat from the campus district loop is injected into the residence loop.



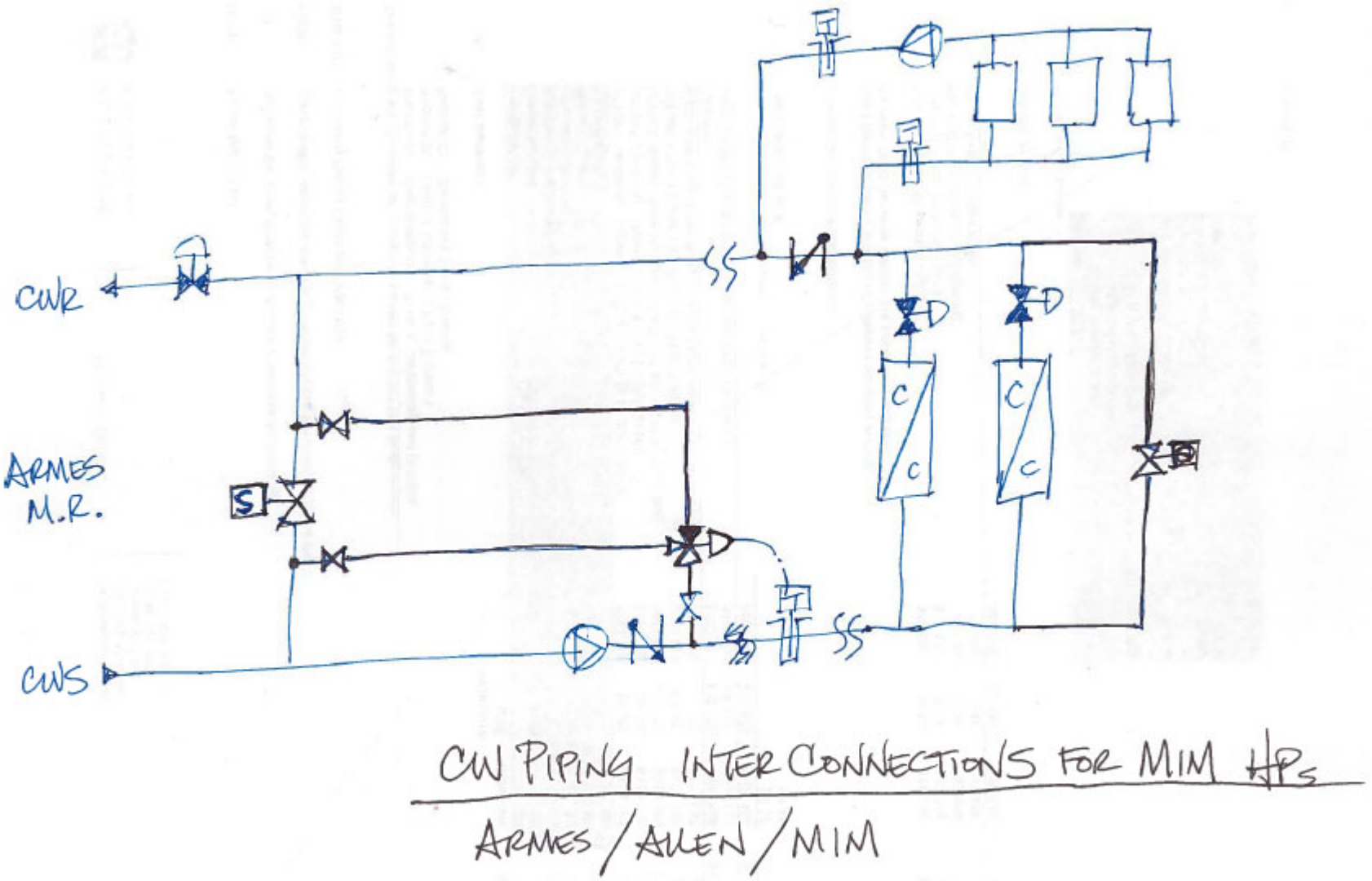
6. Recover Waste Heat from IT Server Rooms

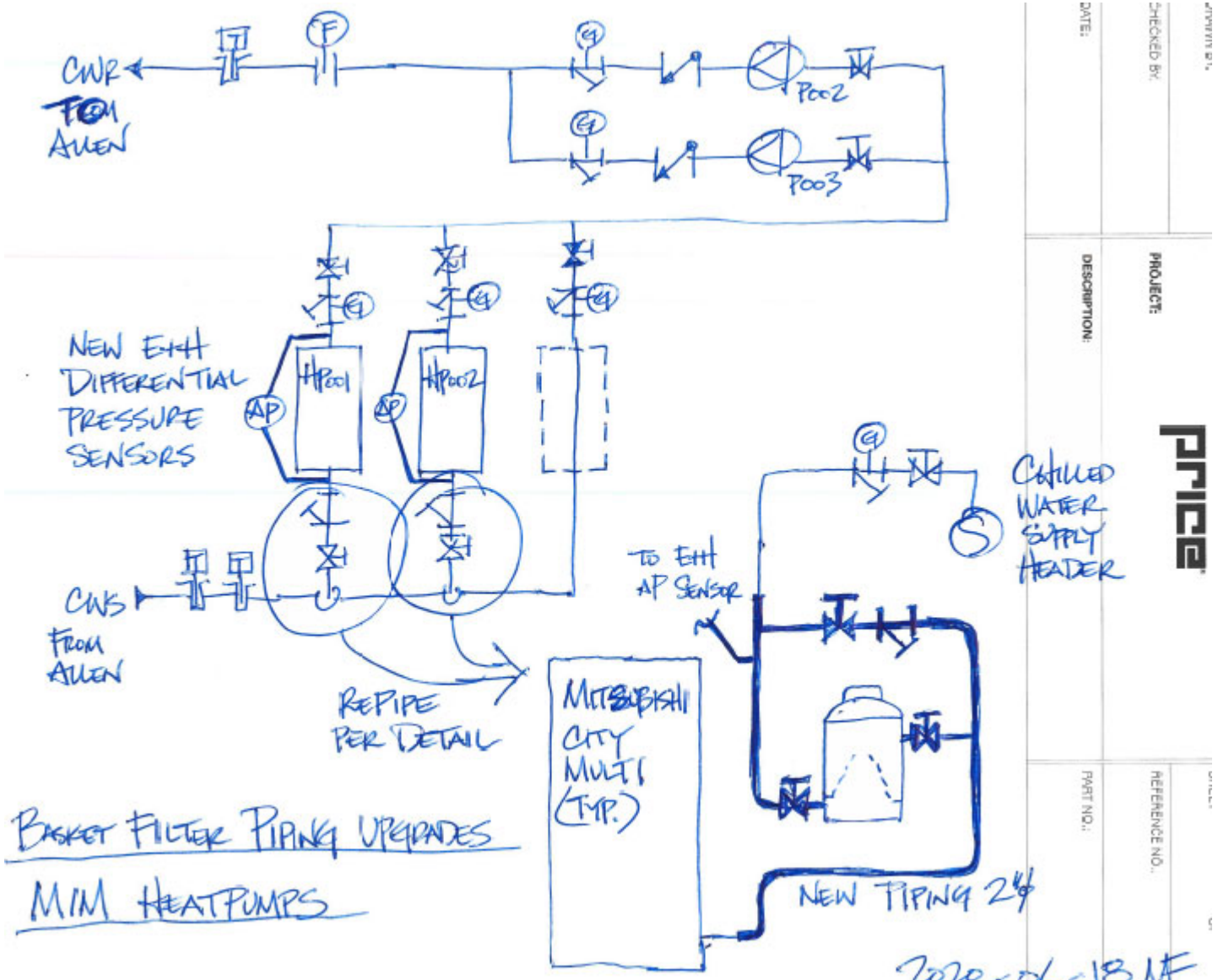
Design is underway to recover 720,000 Btus/hr from IT server rooms in the Freshwater Institute



7. Heat and Cool Materials Institute of Manitoba (MIM) with waste heat.

Installed in 2015. Filters added in 2018.





DATE:
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DESCRIPTION:
PROJECT:
PRICE
PART NO.:
REFERENCE NO.:

8. Central Energy Plant Upgrades

CEP upgrades will be cost-shared between UM and the Federal government under the Investing in Canada Infrastructure Program (ICIP). $36.1M will be invested before summer 2025 to recover all available flue-gas waste heat. CEP recovery could exceed 25 mmBtus/hr