IDEA Campus Energy Conference
HW Conversion Lessons Learned

- University of Rochester - Founded 1850 - Rochester, NY
- 9,470 Full Time Students + 3,000 Researchers
- 12+ MGSF (600+ acres), 9 MGSF connected to CU
- 800 bed Medical Center & Children's Hospital

River Campus

Central Utilities

Medical Center

Brief History of District Hot Water Heating at University of Rochester

1927 – Original Central Steam Plant and Campus District Heating built using coal fired boilers.

1998 – Steam boilers converted from coal to natural gas with oil backup

2005 - 25 MW Cogeneration Plant and Hot Water Distribution System Installed to Part of Campus

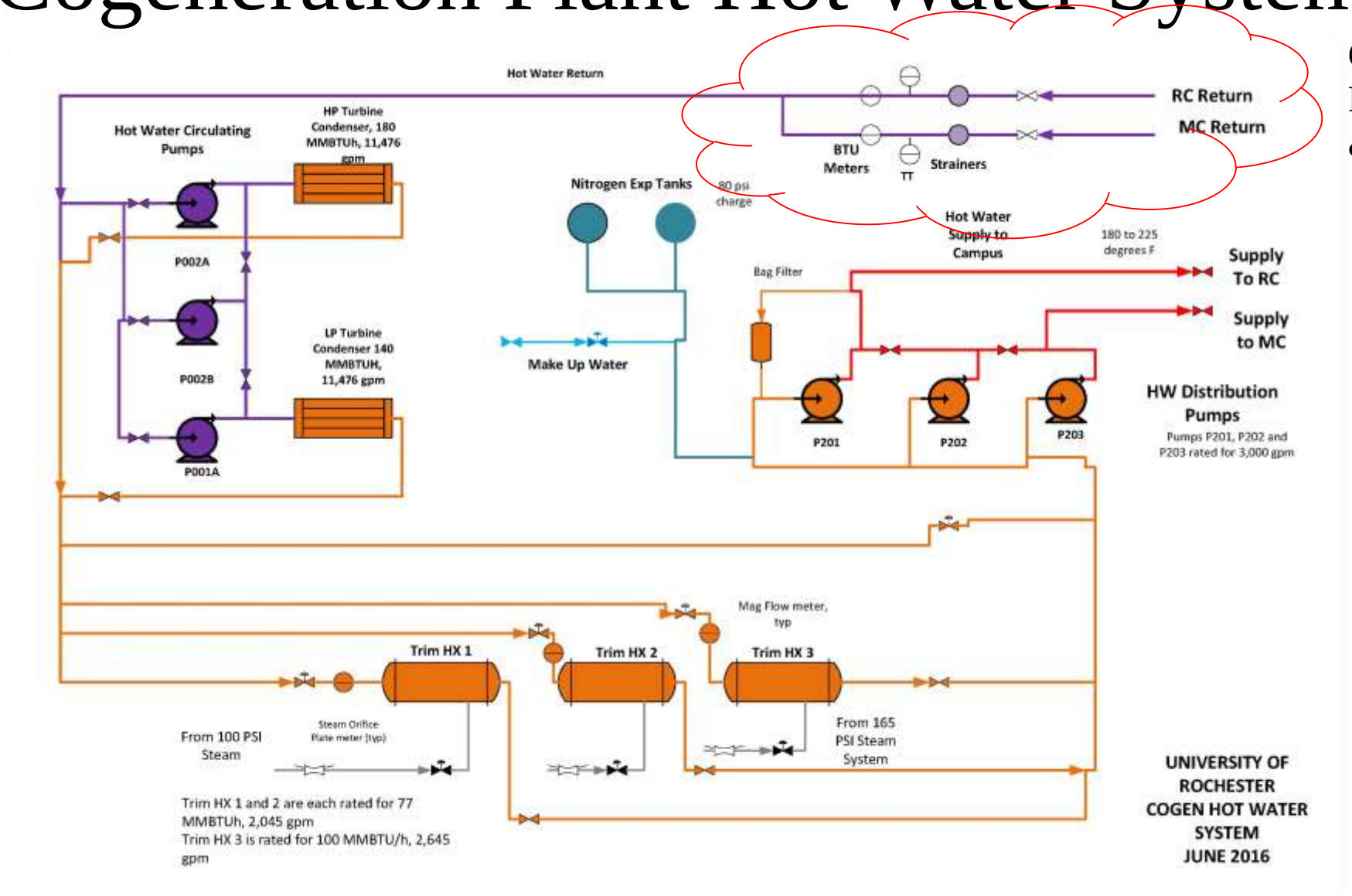
Initial 2005 Cogen DHW Project Scope:

- 9,526 lf of pre-insulated direct bury, steel piping (1,261 MC and 8,265 RC)
- 7,425 lf of interior steel piping (5,395 MC and 2,030 RC)
- 118 Heat Exchangers (54 MC and 64 RC)
- Served 42% of campus heat in 2006
- Total Cogen Construction Costs $50M

U of R HW Progress 2005 - present

- 2005 initial Cogen plant Built
- Initial “easy” buildings converted to HW
- 2015 - Frat quad conversion (9 buildings)
- 2016 - FDB Conversion
- 2017 - NYS optics Conversion
- Redundant loops identified and installation begun
- Steam line failures and building renovations provide opportunities
- 2018 – Spurrier Gym and Fauver Stadium

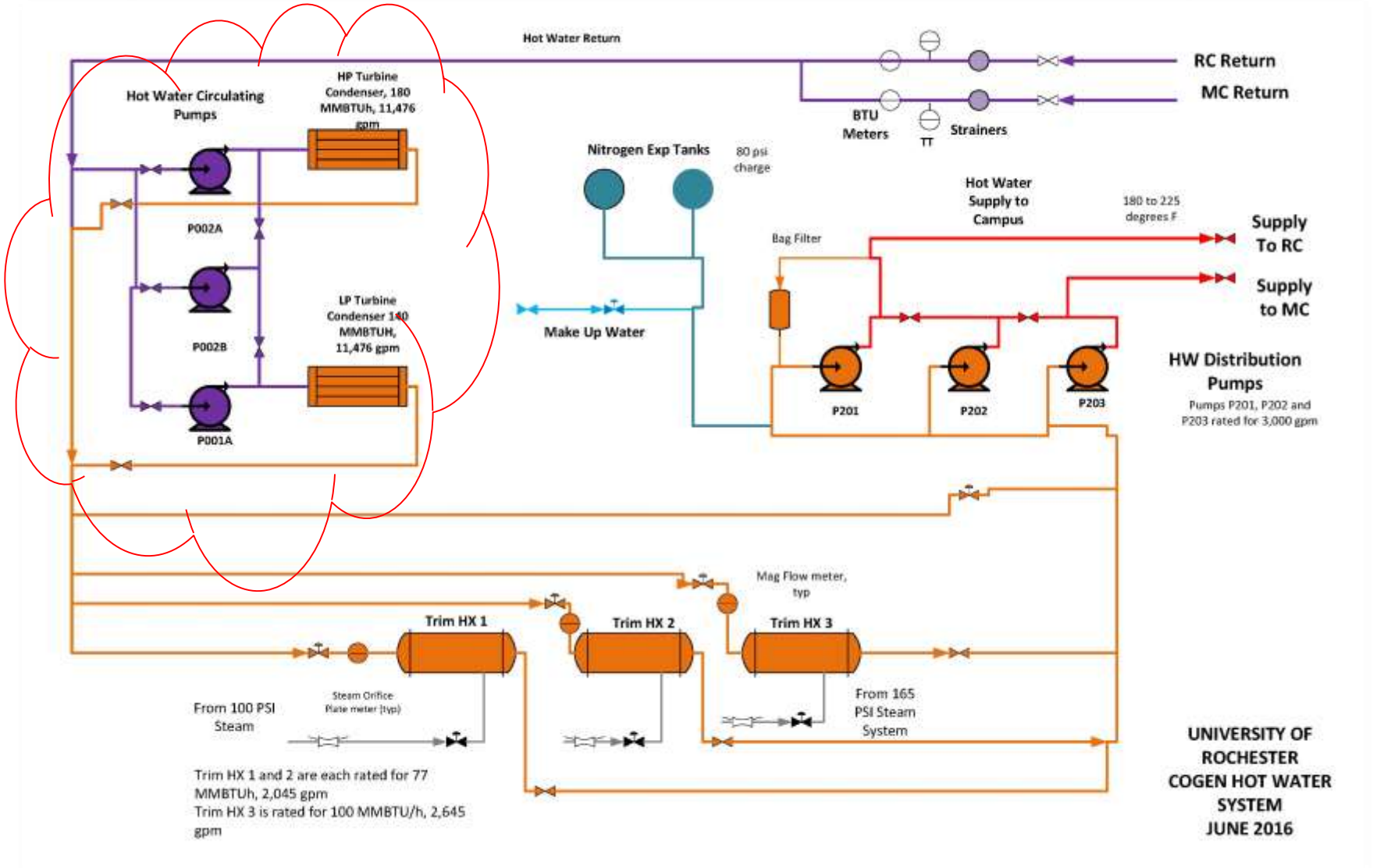
Cogeneration Plant Hot Water System



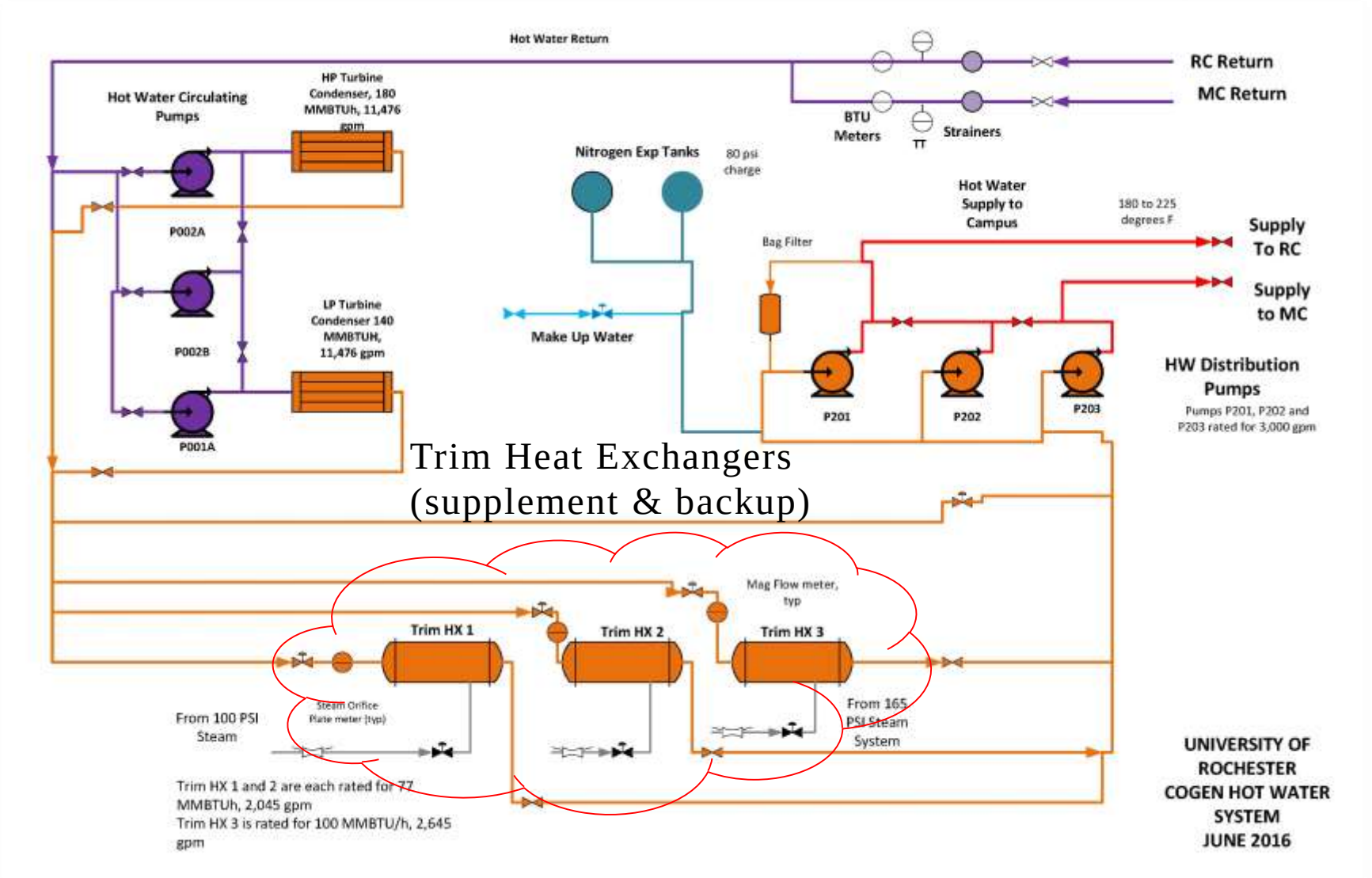
Cogen Return & BTU

Cogeneration Plant Hot Water System

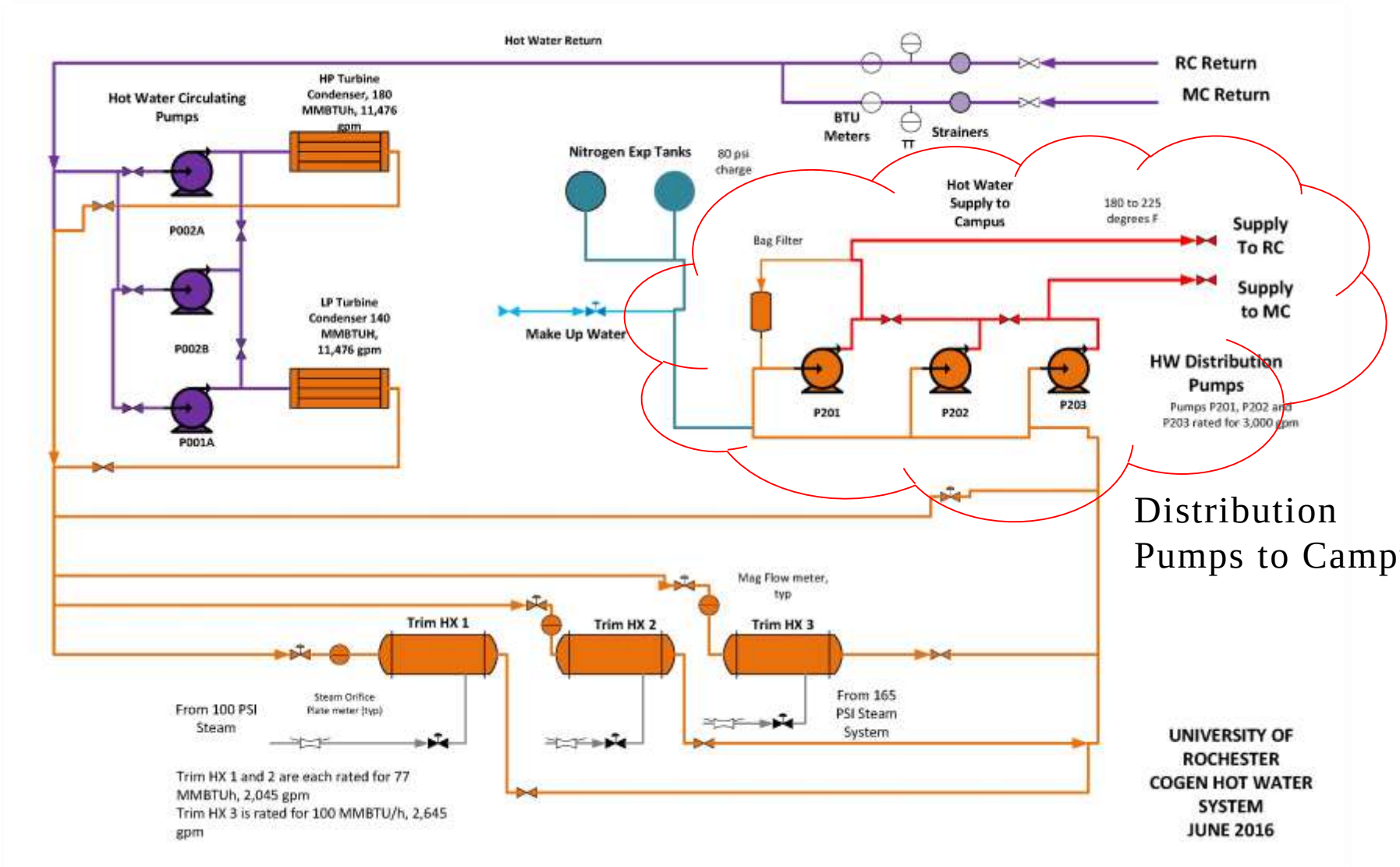
Primary HW Pumps & Turbine Condensers



Cogeneration Plant Hot Water System

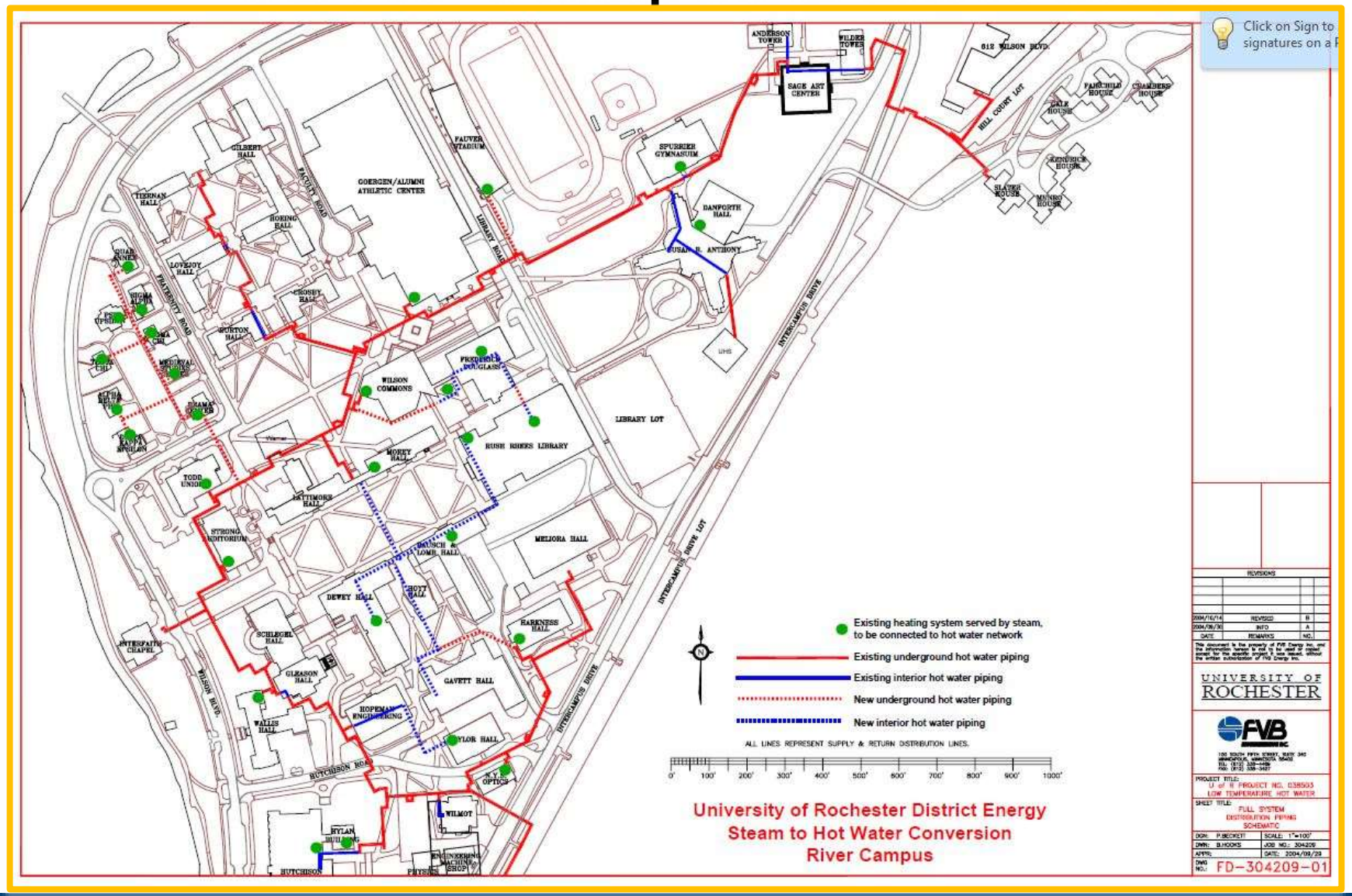


Cogeneration Plant Hot Water System

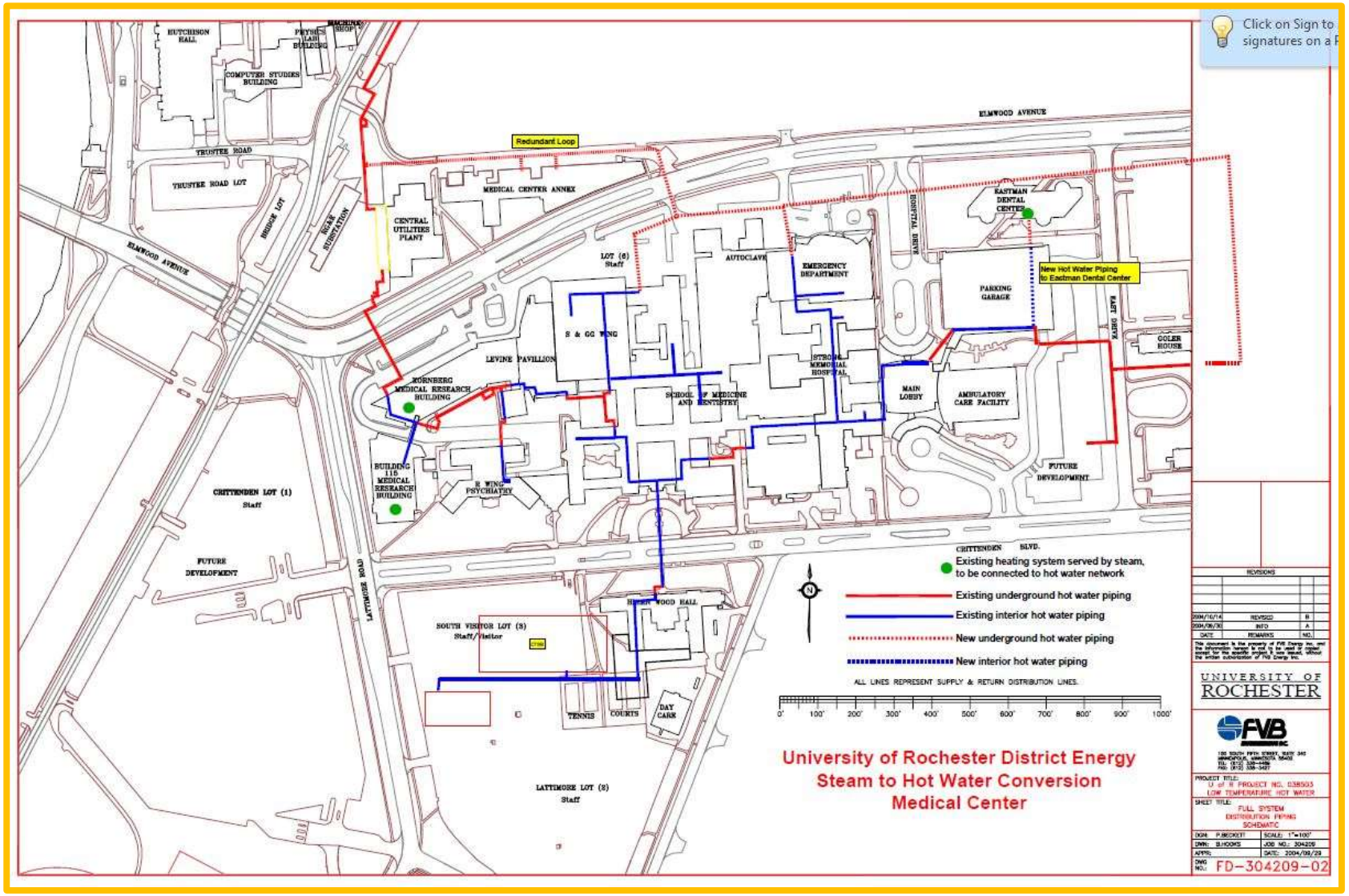


Distribution Pumps to Campus

River Campus Distribution

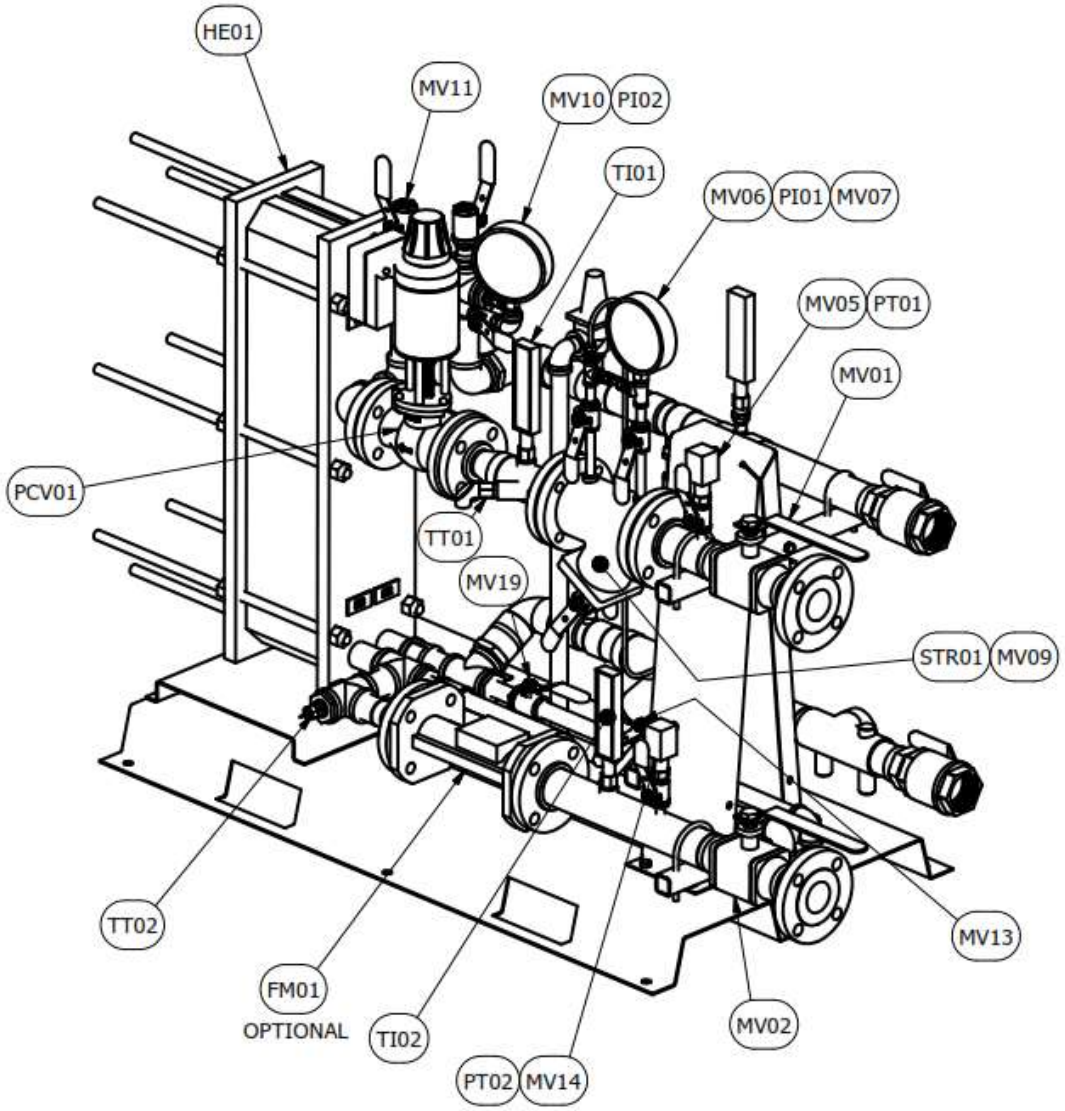


Medical Center Distribution



Energy Transfer Station HEX Skid

Factory Assembled District HW HX Skid

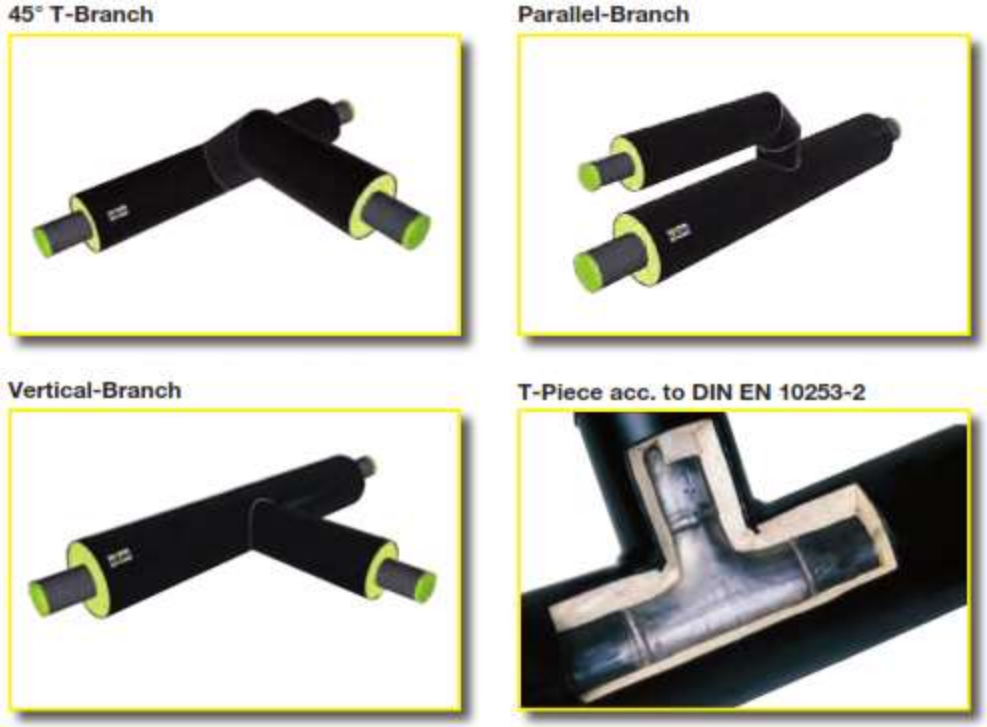


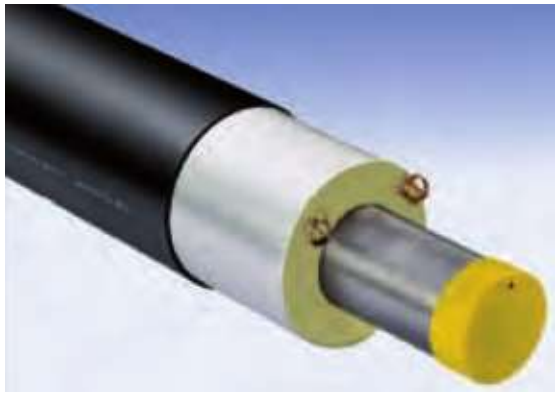
Key components:

- Heat exchanger
- Energy meter
- Control valve
- Strainers
- Isolation valves
- Instrumentation
- Controller

Pre-insulated EN253 District Heating DPS

- Fully bonded system
- Tested in accordance with EN standards
- Thin-walled steel carrier piping
- Integrated leak detection
- Isolation valves: Pre-insulated, direct buried weld-end ball valve



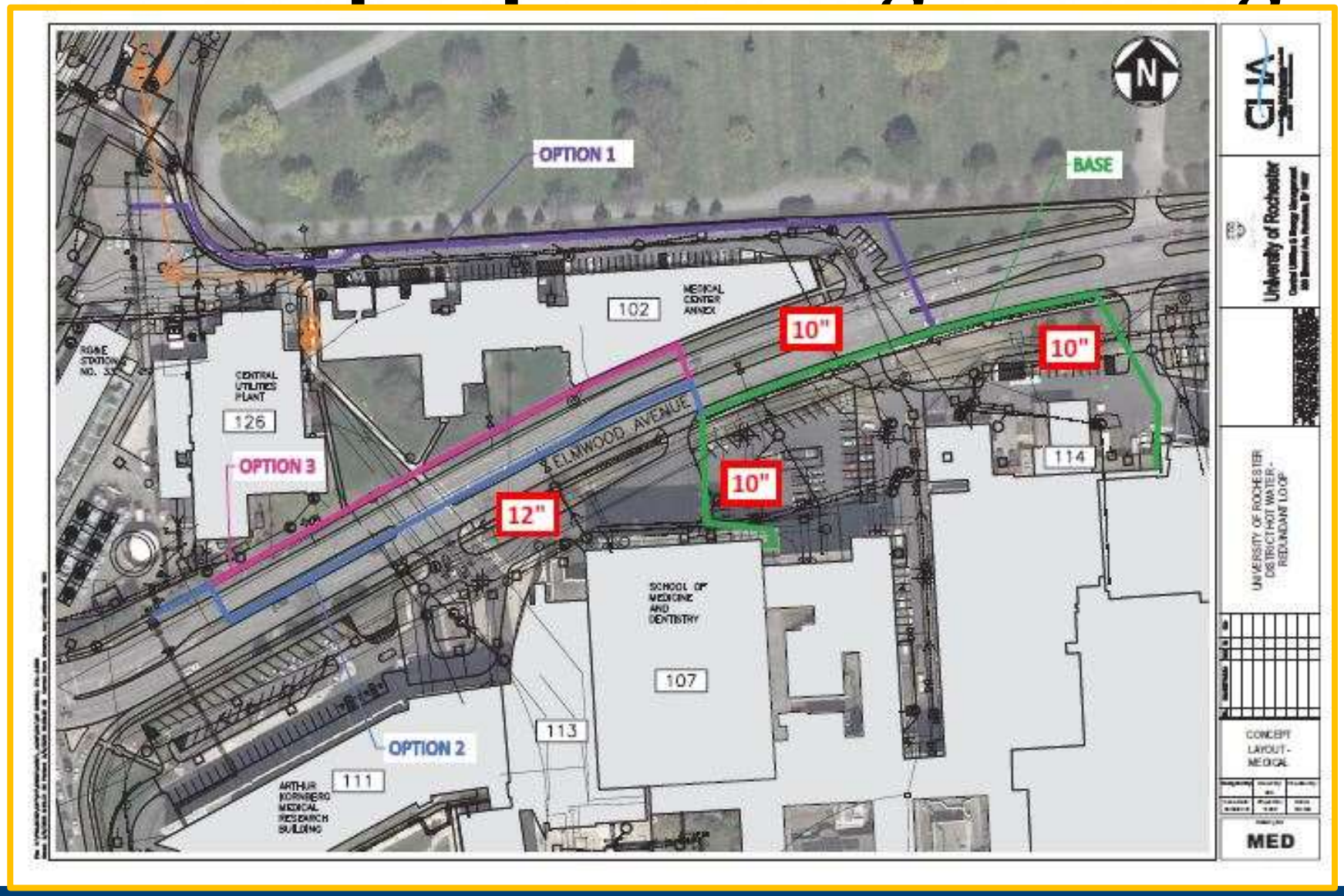


District HW Piping Installation to Bldg 2015

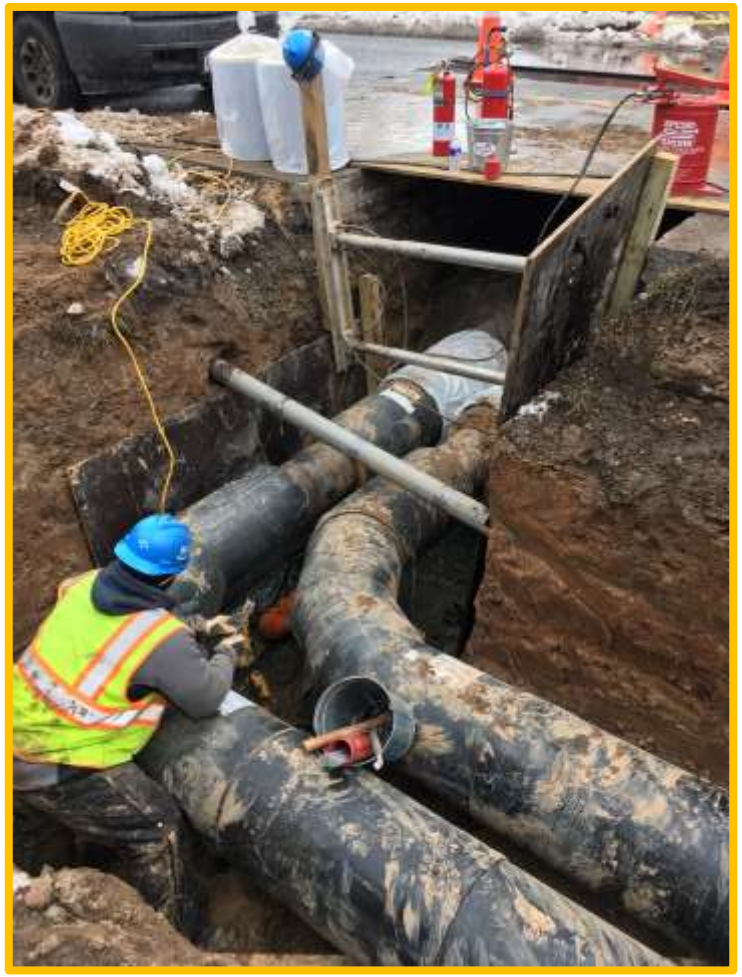
MC HW Loop Pipe Routing & Sizing

Design Challenges:

- Property and Easement Issues
- Municipal permitting
- Cycle track Construction
- Modeling dictated 12-inch trunk with (2) 10” branches to connect to nodes left from previous projects
- ED expansion project



Pipe Install 2016



Genesee Dorm – DHW Relocation

- 300 +/- LF Relocation project to facilitate new dorm construction

MC Redundant Main – Phase 1

- Elmwood Ave Road Crossing (100,000 ADT)
- 700 +/- LF of supply and return Logstor piping

2017 12” Piping Installation

MC Redundant Main – Phase 2

- Complete Plant Tie in and connect MC mech room
- 500 +/- LF of supply and return Logstor piping

MC Redundant Main – Construction Challenges

- Congested Construction Corridor
- MPT and pedestrian impacts
- Material component specialties
- Utility conflicts necessitating additional material orders
- 3-Month material delivery Europe from
- Weather
- Challenging Schedule

Frat Quad HW DPS – Overall Layout

- **Detailed design prepared by experienced Design Firm working with Logstor piping saved the day.**
- **3 month construction turnaround**
- **On time and on budget**
- **3d laser scanned trench for excellent utility location preservation**
- **Valve location in SAM to eliminate UG structure**

DHW Encountered Problem – Poor Drainage

- Spurrier Hall - Building penetrations details are critical points for corrosion.
  - Salt laden runoff from sidewalk winter treatment on sidewalk above piping caused corrosion of sched 40 steel carrying pipe at exterior wall
  - Original enclosures were not easily removable for inspection
  - Constructed watertight enclosure with engineered wall penetration details.

DHW Problems – Construction Pipe Hits

- Wegman Hall – DHW Pipe installed at 48-inches
  - Excavation for water main relocation pierced DHW pipe casing and dented carrying pipe. 10-lf of pipe replaced with (2) “BX” casing kits (full HDPE shrink fitting) on each end.
- Genesee Dorm - DHW Pipe installed at 42-inches
  - Excavation for retaining wall pierced DHW pipe casing at 90-deg elbow. Bend replaced with 5 lf of pipe on each end. 3-month delivery on 6-inch elbow.

DHW Problems – Improper Install

- SRB Building – limited DHW design and installation experience

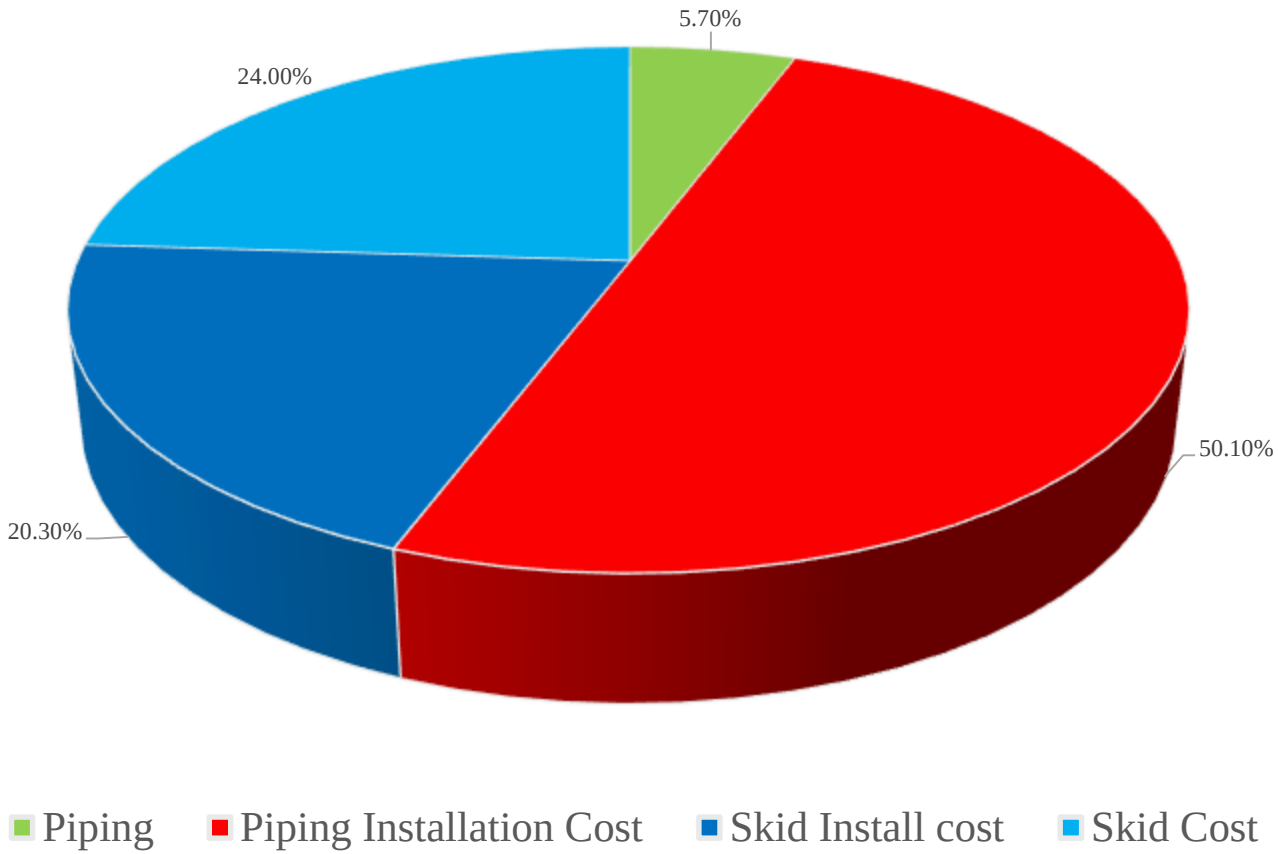
Piping was installed as part of adjacent building site work Improper repair after a utility hit caused damage to the DHW piping.

DHW Problems – Improper Install

Unsuitable backfill contributed to failure. Recycled Concrete containing Portland Cement reactivated, restraining flexible elements of the system.

Full replacement of 700 lf of piping being designed for 2018 construction

Frat Skid Project Cost ($1.3M) Distribution



U of R Hot Water Lessons Learned to Date

- The thin wall pipe can be difficult to weld, need to pre-certify welders.
- U of R radiographs all welds in buried pipe and hydrostatically tests to 350 pisg
- Control valves on building Heat Exchangers are key, need tight shutoff and large turndown
- Domestic Hot Water heating requires properly sized recirculation loop thru HX to dissipate stored heat after valve closure. Hi/low mixing valves added as extra layer of scalding protection
- Looped systems preferred to avoid system shutdowns for local repairs.
- Buried valves are deteriorating due to road salt, many valves become inoperable
- Proper sand backfill of Logstor pipe is critical to prevent outer jacket damage
- European pipe orders and 'extra' pipe and fittings deliveries can be delayed, held at customs
- "Drain" fittings should be minimized. "Vents" & "Roomy" manholes essential for refilling
- Brazed plate HXs are considered 'throw away' - to date minimal issues
- 3d Scanning the opened trench allows for capture of utility location for GIS development
- Looking to try pre-stressed pipe in next pipe to eliminate expansion loops

Future Issues/Challenges for U of R:

- 22 Campus Buildings still need to be connected to Hot Water System or complete 100% conversion of HVAC system to hot water that are still using steam
- $20 million (US) estimated in building HVAC hot water conversions needed: convert air handler coils from steam to hot water, replace steam radiators and steam unit heaters to hot water units, install HXs and piping
- Build the case for energy efficiency and greenhouse gas reduction with hot water conversion
- 12 years into plan 10 year plan to retire the aging steam system on River Campus