Updates From an In-Depth Hot Water System Replacement Project in a Full-Service Restaurant

Restrooms

Kitchen

Heater

Bar

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SITE DESCRIPTION:

Full-Service Restaurant and Bar

• PG&E Site:
  – Medium sized FSR, built in 2011
  – Store size of 5,650 ft², including the patio
  – Open lunch and dinner (7 days/week)

• Goals of Replacement Hot Water System Project:
  – Monitor hot water heater and each point-of-use for energy and water consumption
  – Calculate heater efficiency, recirculation line heat loss, and overall system efficiency
  – Identify system deficiencies and analyze delivery performance
  – Upgrade system components and measure savings
Recirculation System Heat Loss

- Cold, hot and return lines in very close proximity
- 360 ft. recirculation loop above false ceiling in kitchen and below slab to reach the bar
- Recirculation loop completely uninsulated
- 18 gallons of water in pipe
Baseline System (from plumbing drawings)

- Restrooms
  - Lavatory sinks
  - Hand sink
  - HS

- Garage
  - 140°F Recirc loop
  - Mop sink

- Kitchen
  - 1-Comp
  - 3-Comp
  - HS
  - Pre-rinse sink

- Bar
  - Blender sink
  - 4-Comp
  - HS
Baseline System (as installed)

- Hand sink
- Kitchen
- 3-Comp
- 135°F Heater out →
- 130°F Recirc return

- 200 ft. recirculation loop
- 11 gallons of water in pipe
Recirculation Line Heat Loss Analysis

- Christmas Day analysis from 3pm-midnight (No water use conditions)
- Avg heater outlet – recirc return temperature (135.5°F – 130.4°F)
- Recirc. flow rate: 3.4 gpm
- Recirc. Heat loss = 8440 Btu/h

![Graph showing water flow rate and temperature over time]
Water Heater + Recirc. Line Energy Use

- Heat loss: Heater 5,190 Btu/h, Recirc 8,440 Btu/h, total = 13,630 Btu/h
- Duty cycle (no water use condition): 48%
- Electricity use: Heater 0.02 kW, Recirc 0.08 kW
- Electricity cost: Heater $30, Recirc $125, Demand $25 Total $180
- Gas cost: Heater $1,200, Total energy cost to operate recirc: $1,380
Average Daily Hot Water Use

Total = 854 gal/day
Efficiency at the Point-of-Use

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar 4-Comp Left Sink</td>
<td>30%</td>
</tr>
<tr>
<td>Bar 4-Comp Right Sink</td>
<td>44%</td>
</tr>
<tr>
<td>Bar Hand Sink</td>
<td>31%</td>
</tr>
<tr>
<td>Bar Pitcher Sink</td>
<td>30%</td>
</tr>
<tr>
<td>Mop Sink</td>
<td>53%</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>55%</td>
</tr>
<tr>
<td>Pre-Rinse Spray Valve</td>
<td>46%</td>
</tr>
<tr>
<td>Dishroom Hand Sink</td>
<td>46%</td>
</tr>
<tr>
<td>Dishroom 3-Comp Sink</td>
<td>55%</td>
</tr>
<tr>
<td>Cookline Hand Sink</td>
<td>32%</td>
</tr>
<tr>
<td>Prep- Hand Sink</td>
<td>36%</td>
</tr>
<tr>
<td>1-Comp Sink</td>
<td>50%</td>
</tr>
<tr>
<td>Men’s Lavatory</td>
<td>35%</td>
</tr>
<tr>
<td>Women’s Lavatory</td>
<td>44%</td>
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</tbody>
</table>
Point-of-Use Delivery Temperature

- Bar 4-Comp Left Sink: 115°F
- Bar 4-Comp Right Sink: 110°F
- Bar Hand Sink: 96°F
- Bar Pitcher Sink: 94°F
- Mop Sink: 120°F
- Dishwasher: 122°F
- Dishroom Spray Valve: 112°F
- Dishroom Hand Sink: 123°F
- Cookline Hand Sink: 70°F
- Prep Hand Sink: 96°F
- 1-Comp Sink: 101°F
- Men’s Lavatory: 115°F
- Women’s Lavatory: 110°F
Delivery Performance at Bar 4-Compartment Sink

- Time elapsed before temperature reaches 120°F: 80 seconds
- Water used before temperature reaches 120°F: 4 gallons
- Measured flow rate: 3.5 gpm
Delivery Performance at Women’s Lavatory

Five draws, totalling 0.3 gallons, before 100°F was reached.

- Hot Water Used
- Hot Water Temperature (°F)
Delivery Performance at Women’s Lavatory

- Hot Water Used
- Hot Water Temperature (°F)

Time elapsed before temperature reaches 100°F: 13 seconds
Water used before temperature reaches 100°F: 0.2 gallons
Measured flow rate: 0.95 gpm
Annual Hot Water Costs

• Total Cost: $21,730
  • Water Cost: $9,300
  • Gas Cost: $2,860
  • Electricity Cost and Demand Charge: $9,570

Recirc. Pump and Recirc. Line Costs:
Gas cost $1,200
Electricity cost $125
Demand charge $20

Water Costs:
AVG. 855 gal/d
Water and Sewer $9,300

Water Heating Costs:
Gas cost $1,660
Electricity cost $55
Demand charge $5

Dishwasher Costs:
Electricity cost $7,050
Demand charge $2,320
Optimized Hot Water System

- 190 ft. D’mand circulation loop
- 6 gallons of water in pipe
Reduced Gas Load of Optimized System

Existing: 2 Rinnai R94LSi, 2008 model
- Input Gas Rate of 199,000 Btu/h
- Rated at 84% TE, Power 79W, 2W Standby
- Maximum winter flow rate of 7.8 gpm at 85°F temperature rise (140°F - 55°F), 3.9 gpm each

Replacement: 1 IntelliHot iQ250, 2014 model
- Input Gas Rate of 250,000 Btu/h
- Rated at 96% TE, Power 500W, 8W Standby
- Maximum winter flow rate of 6.9 gpm at 70°F temperature rise (125°F - 55°F)
Electrical Load Addition to Optimized System

3 Hand Sink POU Heaters

- Accumix model MT004277T
- 4.1kW @ 277V 1-phase, 14.8 Amps on #14 wire
- Provides a 56°F rise at 0.5 gpm, reduced from 1.5 gpm
- Unit will easily supply hot water between 100-108°F in winter when cold water supply temperature is lowest
- 0.3 GPM turn-on water flow rate
- No scalding or temperature spikes
- Top mount water fittings
- Ideal unit specifications for commercial lavatory sinks
- Unit is UPC 413.1 Code Compliant
- The integrated mixing valve meets ASSE 1070-2004
Electrical Load Addition to Optimized System

Bar 4 Comp Sink and Bar Hand Sink = 24 kW

- Series Three model EDO24480T2T FS
- 24kW @ 480V 3-phase, 29 Amps/phase on #10 wire
- Provides a 66°F rise at 2.5 gpm or 55°F rise at 3.0 gpm
- Outlet Temperature factory set at 120°F
No Added Electrical Load for Dishwasher Change Out

Existing: CMA-180
- 12 kW booster which provides a 40°F Rise
- 7 kW tank heater
- 0.96 Gal/Rack
- 52 Gal/Hour
- Minimum 60 sec cycle
- Electrical: 208V 1 Phase 78 Amps or 3 Phase 49 Amps

Replacement: Champion Genesis DH5000 with Heat Recovery
- 10 kW booster which provides a 70°F Rise
- 5 kW tank heater
- 0.83 Gal/Rack
- 31 Gal/Hour
- Minimum 90 sec cycle
- Electrical: 208V 1 Phase 79 Amps or 3 Phase 48 Amps
Recirculation Pump Change Out

Existing: Grunfos Pump
• Operates 24/7
• Fixed Speed

Replacement: D’Mand Kontrols S3-100
• Pump activates with motion sensor on last kitchen hand sink before the return line
Thank you for your Attention!

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