Board of Directors Report

on

Key Indicators of MWRA Performance

for

Fourth Quarter FY2014

Frederick A. Laskay, Executive Director
Michael J. Hennessey, Chief Operating Officer
September 17, 2014
Main Line Valves Exercised

Target = 92 valves monthly or 1,100 annually

<table>
<thead>
<tr>
<th>Type of Valve</th>
<th>Inventory #</th>
<th>FY14 to Date</th>
<th>FY14 Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Line Valves</td>
<td>2,092</td>
<td>97.7%</td>
<td>95%</td>
</tr>
<tr>
<td>Blow-Off Valves</td>
<td>1,206</td>
<td>95.1%</td>
<td>95%</td>
</tr>
<tr>
<td>Air Release Valves</td>
<td>1,335</td>
<td>93.1%</td>
<td>95%</td>
</tr>
<tr>
<td>Control Valves</td>
<td>48</td>
<td>100.0%</td>
<td>95%</td>
</tr>
</tbody>
</table>
Wastewater Pipeline and Structure Inspections and Maintenance

**Inverted Siphon Cleaning**

- **Target**: 3 monthly or 36 / 33% of the system annually

**Pipeline Cleaning**

- **Target**: 3 miles monthly or 36 miles annually

**Graphs**

- **Inverted Siphon Cleaning**
  - YTD Actual

- **Pipeline Cleaning**
  - YTD Actual

**Legend**

- Monthly Cleaning
- Hydraulic Cleaning
- Mechanical Cleaning
Renewable Energy at MWRA

Savings and Revenue Totals for Renewable Energy Production, FY14

- Solar
- Wind
- Hydro
- Steam

Renewable Energy Certificates Value, $

- Solar
- Wind
- Hydro
- Steam
Workforce Management

Filled Position Tracking

Positions Filled by Hires/Promotions
FY14-YTD

<table>
<thead>
<tr>
<th></th>
<th>Pr/Trns</th>
<th>Hires</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY11</td>
<td>48 (62%)</td>
<td>30 (38%)</td>
<td>78</td>
</tr>
<tr>
<td>FY12</td>
<td>42 (61%)</td>
<td>27 (39%)</td>
<td>69</td>
</tr>
<tr>
<td>FY13</td>
<td>82 (64%)</td>
<td>47 (36%)</td>
<td>129</td>
</tr>
<tr>
<td>FY14</td>
<td>111 (69%)</td>
<td>51 (31%)</td>
<td>162</td>
</tr>
</tbody>
</table>
Presentation to the

Board of Directors

Existing and Future
Combined Heat and Power (CHP)
at DITP

September 17, 2014
Staff efforts have helped reduced plant electrical demand by 10%

- Process Optimization
- Installation of new energy efficient equipment
Maximizing On-Site Green Energy Production is a priority for MWRA

- 23% of DITP’s total electricity demand met by green energy
- 60% of DITP’s energy needs (heat + power) met by Digester Gas (62.5% for all)
• Anaerobic Digestion:
  – 240 dtpd solid in, 100 dtpd to FRSA for pellet conversion
  – Digas generated on average is 60% methane

• OSTPP: Bottom-Cycle Generation
  – Digas – 95% utilized
  – 95% of heat demand met by Digas ($17.6 million annually) (remainder by Fuel Oil)
  – 25.1 M kWh generation from Steam Turbine ($2.4 million annually)
- **Bottom Cycle Generation**
  - Heat First – 60% efficient
    - Generate Steam then Hot Water
  - Power Second – 9% efficient
    - Generate Electricity from Steam

- New BPSTG / Steam Bypass Valve improves steam to electricity conversion process by extracting more heat per unit steam
New BPSTG / Steam Bypass Valve improve steam to electricity conversion process

- 18% improvement (10.6% efficiency overall)
- +1.3 MW increase in generation from steam generators
- Sustainable May - November
- Should see an increase of +4.5 M kWh / year
- ~30 M kWh total/year from steam (25.1 M kWh currently)
CHP Study Objectives – CDM Smith Residuals Technology Assessment

- Develop engineering and economics for new CHP
- Compare and recommend more efficient generation technologies
  - Internal Combustion Engines
  - Gas Turbines
- Develop Simple Payback Analysis / Economic benefits
- Evaluate implementation options
Internal Combustion Engines versus Gas Turbines

- Exhaust emissions (NOx, CO) – GT ↓
- Space required (Capacity) – GT ↓
- Capital and operating costs – GT ↓
- Energy efficiency (Electricity and Heat) ↔
- Flexibility – GT ↑
CHP Technology Change

- Change from Bottom to Top cycle generation
- Improve efficiency
- Increased electrical production
- Better use of all digas - summer months
- Continue to meet plant heating needs

CHP Benefit from Co Digestion

- Expected 29-42% increase in biogas
- Results in more electrical output
- Heat demand increase 5-10%
- Electrical demand increase <2%
## Cost Benefit Analysis – Simple Payback

### Payback Without and With Co-Digestion

<table>
<thead>
<tr>
<th>Parameter</th>
<th>OSTPP with 1 Gas Turbine*</th>
<th>OSTPP with 1 Gas Turbine* With Co-digestion</th>
<th>3 Gas Turbines*</th>
<th>3 Gas Turbines* With Co-digestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Cost</td>
<td>$24.9 M</td>
<td>$24.9 M</td>
<td>$75.0 M</td>
<td>$75.0 M</td>
</tr>
<tr>
<td>Annual O&amp;M Cost</td>
<td>$2.2 M/yr</td>
<td>$2.2 M/yr</td>
<td>$1.6 M/yr</td>
<td>$1.6 M/yr</td>
</tr>
<tr>
<td>Annual Electrical Savings</td>
<td>$5.2 M/yr</td>
<td>$7.0 M/yr</td>
<td>$11.4 M/yr</td>
<td>$14.7 M/yr</td>
</tr>
<tr>
<td>Net Annual Savings</td>
<td>$3.0 M/yr</td>
<td>$4.8 M/yr</td>
<td>$9.8 M/yr</td>
<td>$13.1 M/yr</td>
</tr>
<tr>
<td>Simple Payback Period</td>
<td>8 years</td>
<td>5 years</td>
<td>8 years</td>
<td>6 years</td>
</tr>
</tbody>
</table>

- Single Gas Turbine capacity: 4.6 MW
- Payback does not include potential funding for green energy projects to pay for the capital.
Potential Energy Benefit with CHP

Existing Thermal Plant

- 23% green generation* (18% w/digas)
- 75% purchased electricity

CHP with 3 Gas Turbines – Co-Digestion

- Can reverse energy profile
- More sustainable
- 77% green generation* (72% w/digas)
- 21% purchased electricity

*Note: 1.5% generation by CTG backup power.
Recommendation

- Gas Turbine CHP is recommended technology
- Staff will move forward with design to
  - Confirm economics
  - Investigate additional equipment needed
  - Review economics with and without co-digestion
  - Confirm full implementation approach
  - Develop specific gas system changes
  - Develop plans and specs for bidding new CHP
Massachusetts Water Resources Authority

Presentation to the

Board of Directors

Struvite , Scum, Sludge, and Grit Removal Contract

September 17, 2014
Struvite Removal

Cause
- Struvite forms a pipe scale and consists of phosphate, ammonia, and magnesium
- Struvite coats digested sludge pipelines
  - Digester overflow box piping
  - Centrifuge piping
- Difficult to remove

Prevention
- Ferric chloride added to control

Remediation
- Specialized equipment and services in confined spaces needed for removal
Scum, Sludge and Grit Removal

• Removal of severe blockages beyond in house capability in:
  • Gravity thickeners
  • Primary clarifiers
  • Influent channels
  • Scum receiving wells
• Vactor trucks and boxes used
• Off site material disposal
Presentation to the

Board of Directors

Deer Island Clarifier Rehabilitation
Contract 7394

September 17, 2014
Condition of Concrete
Massachusetts Water Resources Authority

Presentation to the

Board of Directors

Beacon Street Line:
Water Pipeline Repair
Contract 7474

September 17, 2014
Beacon Street Line - Brookline

- 48-inch cement mortar lined cast-iron pipe

- Constructed in the 1870s; it is part of MWRA’s Boston Low Service System

- A significant portion of it is located underneath the MBTA’s Beacon Street Green Line tracks

- The Beacon Street Line provides important the Longwood Medical area
Beacon Street Line - Brookline
Location of Access Pits

ACCESS PIT # 1

ACCESS PIT # 2

CFRP Installation
Presentation to the

Board of Directors

Spot Pond Water Storage Facility
Contract 6457, Change Order 7

September 17, 2014
Spot Pond Tank and Ravine Road Piping
Remove Ledge to Install 36-Inch Pipelines and Valve Vaults at Ravine Road
Remove 87 Linear Feet of 16-Inch-Diameter, Cast-Iron Water Main and Replace with Restrained-Joint, Ductile-Iron Pipe
Massachusetts Water Resources Authority

Presentation to the

Board of Directors

Gillis Pump Station Short-Term Improvements
Contract 7260, Change Order 3

September 17, 2014
Additional Valve Work
Ledge Croppings Inside Excavated Pit
Selector Switch for Three VFD Bypasses