AIHce 2007 Roundtable 207

“Hot” Issues In The Electric Utilities:

Fly-Ash Exposures at Refuse-Derived Fuel (RDF) Electric Generating Plants

Presented by:
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Fly-Ash Exposures at Refuse-Derived Fuel Electric Generating Plants

• General description of Refuse-Derived Fuel or RDF
  - Focus on trace quantities of regulated toxic metals
• Description of Xcel Energy’s three Waste-to-Energy Plants
• Tasks involving exposure to RDF fly-ash
  - Boiler cleaning
  - Scaffold Build
  - Boiler maintenance and repairs (cutting, grinding, welding)
• Exposure assessment results
Municipal Solid Waste (MSW)

- Collected from residential and commercial sites

- Typical composition*
  - 34% Cellulose (Paper)
  - 13% Yard waste
  - 12% Plastics
  - 7.9% Metals
  - 5.7% Wood
  - 5.2% Glass

*Source US EPA, Office of Solid Waste
Municipal Solid Waste Continued

• MSW
  - Residential and commercial waste
  - No hazardous wastes
  - No medical waste
  - Recyclable materials removed

• Xcel Energy’s MSW fuel sources:
  - Eastern Twin Cities suburbs
  - Southeastern Wisconsin
Processing MSW

- Unsorted MSW is dropped at the site (tipping floor)
- MSW is then loaded into primary shredders

- Various process steps
  - Removal of non-combustibles (glass and metals)
  - Magnetic and mechanical separators
  - A series of air classifiers

- Create a Refuse-Derived Fuel or RDF “fluff”
RDF Composition

Selected Toxic Metals*

Arsenic: 1 to 10 ppm

Cadmium: <1 to 3 ppm

Hex. chromium: No data

Lead: 100 to 300 ppm
RDF Fly-Ash Composition

Selected Toxic Metals*

Arsenic: 35 to 130 ppm
Cadmium: 10 to 25 ppm
Hex. Chromium: 6 to 11 ppm
Lead: 900 to 1500 ppm
Waste-To-Energy Plants

• Three facilities located in Minnesota and Wisconsin
  - Burn mostly RDF
• Fuel is non-pelletized “fluff”

• Thermal content @ 11 Million Btu/ton
  - Coal: 20 to 30 Million Btu/ton

• Each plant processes ~30 Tons/hour

• Each plant generates between 20 and 30 Mw of electricity
RDF Combustion Facilities Continued

• Retrofitted coal-fired boilers (40s vintage and modified in 80s)
  - 4 Traveling grate boilers (combustion occurs on top of a grate)
  - 2 Fluidized bed boilers (suspended sand)

• 20 to 30 employees support daily operations

• All major maintenance performed in-house (Special Construction)
  - Boiler cleaning
  - Boiler tube repair and maintenance
  - Non-boiler equipment maintenance
Boiler Repairs

• Unit removed from service

• 24 to 48 hrs. to cool (aided by ID fans)

• Objective
  - Dislodge large obstructions (fused fly-ash)
  - Clear fly-ash between tubes & gas paths
  - Remove accumulation on tube surfaces
  - Repair/replace boiler tubes

• Explosive cleaning first (dislodges clinkers)

• Fly-ash, clinker debris, etc. are removed
Scaffold Build

• Provide working platforms
  - Cleaning crews
  - Inspectors
  - Boilermakers

• Boiler is dirty

• Creates airborne fly-ash
<table>
<thead>
<tr>
<th>Metal</th>
<th>N=</th>
<th>Arith. Mean</th>
<th>Geo. Mean</th>
<th>% &gt;PEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead: (50 µg./M.³)</td>
<td>13</td>
<td>230.0</td>
<td>192.4</td>
<td>75</td>
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<tr>
<td>Cadmium: (5 µg./M.³)</td>
<td>9</td>
<td>2.97</td>
<td>1.43</td>
<td>0</td>
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<tr>
<td>Arsenic: (10 µg./M.³)</td>
<td>9</td>
<td>2.16</td>
<td>0.39</td>
<td>0</td>
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</table>
Boiler Cleaning

- Air-lancing tube banks
- Produce high pressure-high velocity air
- Air penetrates between tubes
- High airborne dust levels
• Air Chiseling Boiler Tube Surfaces

• Poking with metal bar
Air Lancing

- Backpass
- Cleaning between tubes

- Fire box/furnace
- Preparation for repairs
<table>
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<th>Geo. Mean</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Arsenic: (10 µg./M.³)</td>
<td>27</td>
<td>26.9</td>
<td>9.07</td>
<td>44.4</td>
</tr>
<tr>
<td>Cadmium: (5 µg./M.³)</td>
<td>34</td>
<td>26.4</td>
<td>11.64</td>
<td>52.9</td>
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<tr>
<td>Lead: (50 µg./M.³)</td>
<td>36</td>
<td>781.1</td>
<td>597.9</td>
<td>100</td>
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</table>
Exposure Assessment Results: Cleaning

- Hexavalent chromium results
- 5.0 µg ./M.³ (new OSHA PEL)

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<table>
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<tr>
<td>Mean 8-hr TWA:</td>
<td>4.3 µg ./M.³</td>
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<tr>
<td>GM 8-hr. TWA:</td>
<td>1.6 µg ./M.³</td>
</tr>
<tr>
<td>% &gt;= PEL:</td>
<td>13%</td>
</tr>
<tr>
<td>N:</td>
<td>23</td>
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</table>
Boiler Repair & Maintenance

- Boilermakers
- Cutting & welding tasks
- Boiler tube repair
- Fused residue on tubes
- Welding consumables
  - Not contain these metals
- Only general ventilation
  - Induced draft fan
  - No LEV
Boiler Tubes Removed

Note Residue
# Boilermakers Exposure Assessment Results

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<th>Geo. Mean</th>
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</thead>
<tbody>
<tr>
<td>Arsenic: (10 µg./M.³)</td>
<td>25</td>
<td>1.40</td>
<td>1.1</td>
<td>0.0</td>
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<tr>
<td>Cadmium: (5 µg./M.³)</td>
<td>25</td>
<td>9.72</td>
<td>2.04</td>
<td>32</td>
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<tr>
<td>Lead: (50 µg./M.³)</td>
<td>23</td>
<td>90.1</td>
<td>79.5</td>
<td>78.3</td>
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</table>
Regulatory Obligations

• Historical data indicates exposures exceed regulatory limits
  - Action Limits (~50% of the PELs)
  - Permissible Exposure Limits (PELs)
  - Ex. Lead 100% above PELs

• Periodic exposure assessments:
  - Exposure assessments performed regularly
  - Quarterly (depending upon outage schedules)
  - Limited Cr+6 data collected to-date
Regulatory Obligations Continued

- Medical Surveillance:
  - Implemented an annual program (traveling maintenance crews)
  - 3rd plant maintains a boiler entry log (less than 30 days/year)

- Implemented engineering controls:
  - Explosive cleaning (reduce number of days and intensity)
  - Induced draft fans

- Training:
  - Crews receive annual multiple toxic metals training
Questions ??