Agenda

- Progress of Rule Development
- Technology/BARCT Analysis
- Survey Data Overview
- Survey Data Analysis for Source Category
- Next Steps
Progress of Rule Development

Summary of Working Group #4 (9/12/18)

• Discussed fourth step of the BARCT technology assessment
• Focused on commercially available and emerging technologies
• Presented source specific rules for boilers/heaters, thermal oxidizers, and Incinerators

Since last Working Group Meeting

• Analyzed submitted survey data
• Coke calciner stakeholder meeting
• Meetings with control technology suppliers
• Request for Proposal (RFP) Board approval scheduled for release 12/7/18 (Contractor selection 2/8/19 and final report due 5/24/19)
• Continuing site visits and meetings with stakeholders and non-stakeholders to assess control technology transferability
BARCT Technology Assessment

- Other Regulatory Requirements
- Assessment of SCAQMD Regulatory Requirements
- Assessment of Emission Limits for Existing Units
- Assessment of Pollution Control Technologies
BARCT Analysis Approach Review

- Identify Emission Levels for Existing Units
- Assess Rules in Other Air Districts for same
- Technology Assessment
- Establishing the BARCT Emission Limit and other Considerations
- Cost Effectiveness
Survey Data Overview
Survey Data Overview

- Information gathered from survey used to determine:
  - Proposed BARCT limits
  - Cost-effectiveness analysis
- Provides staff with most up-to-date information for current equipment
  - Number of permitted equipment
    - Some equipment are not in operation, removed, or never built
  - Age of equipment and retrofit controls
  - Average heating value of fuel
  - Fuel usage
  - Utility of heater operated (% capacity utilized)
  - Currently installed control technology (if equipped)
  - Outlet NOx Emissions - what is currently being achieved
    - Compared to CEMS (RATA) and Source test data
  - Planned or scheduled installation of control technology
Refinery Fuel Gas (RFG)

Refinery/Process Fuel Gas
- Predominant fuel used is RFG and/or mixed gas (RFG and natural gas)
- RFG has different properties than pipeline-quality natural gas fuel
- RFG composition varies amongst refineries and over time
- Combustion characteristics of RFG
  - Higher heating value (HHV) also varies
  - Significantly higher heating value than natural gas (as high as 1400 Btu/scf) due to olefins
  - Thus burns hotter, more NOx
- RFG mixed with NG at fuel gas mix-drum to maintain consistent HV

Snapshot of fuel HHV at a given time. Data sampling from 53 pieces of equipment from each source category located at each facility.
The survey provided data and information for the following category of equipment:

- Process heaters and boilers
- Gas turbines
- FCCU
- SRU/TG Incinerators
- Thermal oxidizers and incinerators
- Coke calciner
- Auxiliary ICE (formerly primary ICE)
Survey Data Analysis
Process Heaters & Boilers
Process Heaters & Boilers

- Represents the largest source category of NOx emissions
  - 69% of total equipment (235 total)
- Located in a majority of processing units
- Heat generated from a fueled-fired process heater or boiler is provided by combustion
- Boilers and steam generators are devices that heat or boil water
- Process heaters heat process streams other than water to unit processing temperatures
- Refinery fuel gas and natural gas are predominant fuel
- Hydrogen reformer heaters use Pressure Swing Adsorber (PSA) off gas as primary fuel with RFG and NG as trim fuel (~90/10 ratio)
Process Heaters & Boilers

- Largest Source category for Rule 1109.1 NOx emissions at 2,974 tons/year (69%), but highest number of equipment.
- After further refinement of heater/boiler data, the following categories will be used:
  - Heaters (primary heaters & start-up/shutdown)
    - Crude processing (crude & coker units)
    - Hydroprocessing (hydrocracking, isomerization, and reformer units)
  - Boilers (excludes heat recovery boilers & CO boilers)
    - Utilities (steam generation)
  - Hydrogen reformer heaters
  - Sulfuric acid plant heaters (furnace & start-up/shutdown heaters)
- Each heater/boiler category will further be sub-divided into heater size category.
- Classification of NOx control:

<table>
<thead>
<tr>
<th>Control</th>
<th>Current Technology</th>
<th>Survey</th>
</tr>
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<tbody>
<tr>
<td>LNB</td>
<td>15 - 25 ppm</td>
<td>14 - 81 ppm</td>
</tr>
<tr>
<td>ULNB</td>
<td>9 - 15 ppm</td>
<td>19 - 60 ppm</td>
</tr>
</tbody>
</table>

- Definition of ULNB and LNB may have been different at time of installation.
  - Based on survey, burners were retrofitted on average 27 years ago.
### Process Heaters & Boilers Categories

#### Heaters
- **Primary heaters** - includes all heaters used in a majority of refinery processing units
- **Start-up/shutdown heaters** - heaters used only for start-up/shutdown (excludes FCCU Start-up heaters)

#### Boilers (steam generation)
- Fuel-fired boilers that produce plant steam from boiling water
- Does not include heat recovery steam boilers and CO boilers (heat input is from heat recovery)

#### Hydrogen reformer heaters
- Large heaters
- Primary fuel is PSA-off gas (composition consist of CO, methanol, and some H₂)
- Trim fuel can either be refinery gas or natural gas

#### Sulfuric acid plant heaters
- Furnaces - spent sulfuric acid is sprayed into furnace with fuel and air in the combustion process
- **Start-up/shutdown heaters** - exhaust from heaters are aggregated with furnace, used as preheat or used during maintenance activities
Process Heaters & Boilers by Size

Heaters and Boilers by Size (MMBtu/hr)

- <20: 26
- 20 to 40: 58
- >40 to 110: 74
- >110: 77

Total: 235
## Heaters & Boilers breakdown by Size & Category

<table>
<thead>
<tr>
<th>Size/Capacity (MMBtu/Hr)</th>
<th>Heaters</th>
<th>Boilers</th>
<th>Hydrogen Reformer Heaters</th>
<th>Sulfuric Acid Plant Heaters</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Furnace</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Start-up &amp; Shutdown Heaters</td>
<td></td>
</tr>
<tr>
<td>&lt;20</td>
<td>23</td>
<td>2</td>
<td></td>
<td>1</td>
<td>26</td>
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<tr>
<td>20 to 40</td>
<td>54</td>
<td>3</td>
<td></td>
<td>1</td>
<td>58</td>
</tr>
<tr>
<td>&gt;40 to 110</td>
<td>68</td>
<td>3</td>
<td></td>
<td>2</td>
<td>74</td>
</tr>
<tr>
<td>&gt;110</td>
<td>44</td>
<td>19</td>
<td>13</td>
<td>1</td>
<td>77</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>189</strong></td>
<td><strong>27</strong></td>
<td><strong>13</strong></td>
<td><strong>4</strong></td>
<td><strong>235</strong></td>
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</table>
## Primary Heaters

<table>
<thead>
<tr>
<th>Size/Capacity Range (MMBtu/hr)</th>
<th>Primary Heaters</th>
<th>LNB</th>
<th>Equipped with SCR</th>
<th>No Control</th>
<th>Average Age (years)*1</th>
<th>Avg. Num. of Burners</th>
<th>Avg. Flow Rate (dscf/min)</th>
<th>Average % Capacity</th>
<th>NOx Emissions Low (ppm)*2</th>
<th>NOx Emissions High (ppm)*2</th>
<th>2016 Emissions (tons/yr)</th>
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<tbody>
<tr>
<td>&lt;20</td>
<td>23</td>
<td>21</td>
<td>1</td>
<td>2</td>
<td>47</td>
<td>3</td>
<td>2,961</td>
<td>61%</td>
<td>4.4</td>
<td>68</td>
<td>25</td>
</tr>
<tr>
<td>20 to 40</td>
<td>54</td>
<td>53</td>
<td>8</td>
<td>1</td>
<td>39</td>
<td>10</td>
<td>6,410</td>
<td>59%</td>
<td>3.8</td>
<td>97</td>
<td>154</td>
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<tr>
<td>&gt;40 to 110</td>
<td>68</td>
<td>55</td>
<td>15</td>
<td>12</td>
<td>34</td>
<td>22</td>
<td>13,776</td>
<td>54%</td>
<td>2.8</td>
<td>113</td>
<td>669</td>
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<td>44</td>
<td>42</td>
<td>16</td>
<td>2</td>
<td>44</td>
<td>35</td>
<td>46,067</td>
<td>72%</td>
<td>2.6</td>
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<td>189</td>
<td>171</td>
<td>40</td>
<td>18</td>
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<td></td>
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<td></td>
<td></td>
<td>1,805</td>
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</table>

*1-Age averaged over reported installation year. Some equipment age not reported.  
*2-NOx emissions corrected to 3% O₂
Primary Heaters Summary

- Represents 61.3% of total heater annual NOx emissions
- Majority located in hydroprocessing units, followed by crude and coker units
- 7 heaters located in FCCU (non-startup heaters)
- Average age of equipment from 34 to 47 years
- Lowest NOx emissions (@3% O2)
  - <20 MMBTU/hr: 4.4 ppm (RFG, SCR)
  - 20 to 40 MMBtu/hr: 3.8 ppm (NG, LNB, and SCR)
  - >40 to <110 MMBtu/hr: 2.8 ppm (RFG, ULNB, SCR)
    - Low ppm achieved with ULNB and SCR
  - >110 MMBtu/hr: 2.6 ppm (RFG, LNB, SCR)
<table>
<thead>
<tr>
<th>Size/Capacity Range (MMBtu/hr)</th>
<th>Boilers</th>
<th>LNB</th>
<th>Equipped with SCR</th>
<th>No Control</th>
<th>Average Age (years)*1</th>
<th>Avg. Num. of Burners</th>
<th>Avg. Flow Rate (dscf/min)</th>
<th>Average % Capacity</th>
<th>NOx Emissions Low (ppm)*2</th>
<th>NOx Emissions High (ppm)*2</th>
<th>2016 Emissions (tons/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>846</td>
<td>54%</td>
<td>33</td>
<td>36</td>
<td>36</td>
<td>3.3</td>
</tr>
<tr>
<td>20 to 40</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>17</td>
<td>4,240</td>
<td>34%</td>
<td>7.3</td>
<td>9</td>
<td>9</td>
<td>0.4</td>
</tr>
<tr>
<td>&gt;40 to 110</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>5,417</td>
<td>28%</td>
<td>71</td>
<td>105</td>
<td>105</td>
<td>14</td>
</tr>
<tr>
<td>&gt;110</td>
<td>19</td>
<td>10</td>
<td>5</td>
<td>6</td>
<td>37</td>
<td>33,913</td>
<td>51%</td>
<td>4.4</td>
<td>141</td>
<td>141</td>
<td>721</td>
</tr>
<tr>
<td>Total</td>
<td>27</td>
<td>13</td>
<td>5</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>738.7</td>
</tr>
</tbody>
</table>

*1-Age averaged over reported installation year. Some equipment age not reported.
*2-NOx emissions corrected to 3% O₂.
Boilers Summary

- Represents 25% of total annual heaters & boilers emissions
- Does not include heat recovery steam boilers, only fuel-fired utilities boiler
- Majority of boilers are >110 MMBTU/hr
- Most boilers are used on average 28% to 54% of capacity
- 2 boilers are located in sulfur plant
- Lowest NOx Outlet (@3% O2)
  - < 20 MMBTU/hr: 30 ppm (NG, LNB)
  - 20 to 40 MMBTU/hr: 7.3 ppm (NG, LNB)
  - >40 to 110 MMBtu/hr: 71 ppm (RFG, no control)
  - >110 MMBtu/hr: 4.4 ppm (RFG, SCR)
<table>
<thead>
<tr>
<th>Size/Capacity Range (MMBtu/hr)</th>
<th>Hydrogen Reformer Heaters</th>
<th>LNB</th>
<th>Equipped with SCR</th>
<th>No Control</th>
<th>Average Age (years)*1</th>
<th>Avg. Num. of Burners</th>
<th>Average % Capacity</th>
<th>Avg. Flow Rate (dscf/min)</th>
<th>NOx Emissions Low (ppm)*2</th>
<th>NOx Emissions High (ppm)*2</th>
<th>2016 Emissions (tons/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤110</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;110</td>
<td>13</td>
<td>11</td>
<td>10</td>
<td>1</td>
<td>29</td>
<td>162</td>
<td>59%</td>
<td>106,845</td>
<td>4</td>
<td>70</td>
<td>366</td>
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<tr>
<td>Total</td>
<td>13</td>
<td>11</td>
<td>10</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>366</td>
</tr>
</tbody>
</table>

*1-Age averaged over reported installation year. Some equipment age not reported.
*2-NOx emissions corrected to 3% O₂
Hydrogen Reformer Heaters Summary

- Largest heaters in category, all >110 MMBtu/hr
- 12.4% of total annual heater and boiler emissions
- 12 hydrogen reformer heaters
  - One hydrogen reformer heater has gas turbine attached upstream, but share common stack
  - 13 total pieces of equipment
- Hydrogen reformer heaters are used on average 59% of capacity
- Primary Fuel is PSA off gas with either NG or RFG as trim fuel
- Largest volumetric flow rate of all heaters: ~106,845 dscf/min (average)
- Most are equipped with some form of NOx control or combination of controls
- One with no control is result of control system not operating as designed
- Lowest NOx emissions (@3% O2)
  - 780 MMBtu/hr : 4 ppm
- Equipment equipped with LNB and SCR achieve on average 5.7 ppm NOx
### Sulfuric Acid Plant Heaters

<table>
<thead>
<tr>
<th>Size/Capacity Range (MMBtu/hr)</th>
<th>Sulfuric Acid Plant Heaters</th>
<th>LNB</th>
<th>Equipped with SCR</th>
<th>No Control</th>
<th>Average Age (years)*</th>
<th>Avg. Num. of Burners</th>
<th>Avg. Flow Rate (dscf/min)</th>
<th>Average % Capacity</th>
<th>NOx Emissions Low (ppm)*</th>
<th>NOx Emissions High (ppm)*</th>
<th>2016 Emissions (tons/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>20 to 40</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td></td>
<td>25</td>
<td>1</td>
<td>2,500</td>
<td>50%</td>
<td>30</td>
<td>100</td>
<td>10.0</td>
</tr>
<tr>
<td>&gt;40 to 110</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
<td>25</td>
<td>1</td>
<td>2,500</td>
<td>50%</td>
<td>30</td>
<td>100</td>
<td>10.0</td>
</tr>
<tr>
<td>&gt;110</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
<td>25</td>
<td>1</td>
<td>2,500</td>
<td>50%</td>
<td>30</td>
<td>100</td>
<td>10.0</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>25</td>
<td>1</td>
<td>2,500</td>
<td>50%</td>
<td>30</td>
<td>100</td>
<td>10.0</td>
</tr>
</tbody>
</table>

*1-Age averaged over reported installation year. Some equipment age not reported.

*2-NOx emissions corrected to 3% O₂
Sulfuric Acid Heaters Summary

- 1.3% of total heater and boiler annual NOx emissions
- Two primary heaters (furnaces) are used approximately 49% to 66% of capacity
  - Spent sulfuric acid is sprayed with fuel during combustion process
- Two heaters are used as preheat or steam superheater (29 and 50 MMBtu/hr)
- Two start-up heaters used only during start-up or maintaining temperature during shutdown
- NOx Outlet (@3% O2)
  - 10 to < 20 MMBtu/hr - Permit limit of 190 ppm (start-up only)
  - 20 to 40 MMBtu/hr - 34 ppm (RFG, LNB)
  - >40 to 110 MMBtu/hr - 11 ppm (RFG, LNB)
  - >110 MMBtu/hr - 20 ppm (NG, no NOx control)
- No post-combustion NOx controls (survey)
- Some challenges of NOx control due to SOx emissions and exhaust temperature
- Continuing to evaluate controls options with system manufacturers
Heaters & Boilers Category Summary

• Largest source category of Rule 1109.1 NOx emissions at 2,974 tons/year (69%)
• Heaters/boilers are located in all major processing units including FCCU and Sulfur plants
• Primary factors impacting NOx emissions are:
  • Emission rates, time operated, percentage of full firing rate, and currently implemented control technologies
• Lowest achievable limits from combination of controls
  • Boilers and heaters that are equipped with both LNB and SCR achieve the lowest NOx emissions
• Oldest equipment tend to have no control, high ppm emissions
  • Oldest boiler 75 years old (no control, 96 ppm @ 3% O2)
  • Oldest heater 65 years old (no control, 47 ppm @ 3% O2)
Survey Data Analysis
Gas Turbines
## Gas Turbines - Combined Cycle

<table>
<thead>
<tr>
<th>Size (MMBTU/Hr)</th>
<th>Fuel Type</th>
<th>Control &amp; Year</th>
<th>NOx Permit Limit (ppm)</th>
<th>NH3 Permit Limit (ppm)</th>
<th>Survey NOx ppm</th>
<th>CEMS(RATA) NOx ppm @15% O2</th>
<th>Source Test NOx ppm @ 15% O2</th>
<th>Avg. Flow Rate (dscf/min)</th>
<th>% Capacity</th>
<th>2016 NOx Emissions (tons/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>508.6</td>
<td>Natural Gas</td>
<td>DLNB, SCR</td>
<td>2</td>
<td>5</td>
<td>1.1*</td>
<td>1.0</td>
<td>1.2</td>
<td>238,134</td>
<td>91.6</td>
<td>9.6</td>
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<td>Natural Gas</td>
<td>SCR, WI, 96</td>
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<td>20</td>
<td>6.4*</td>
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<td>5.1</td>
<td>248,724</td>
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<td>48.6</td>
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<td>Natural Gas</td>
<td>SCR, WI, 95</td>
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<td>20</td>
<td>8.2*</td>
<td>6.0</td>
<td>6.1</td>
<td>217,943</td>
<td>74.6</td>
<td>52.1</td>
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<tr>
<td>560</td>
<td>Natural Gas</td>
<td>SCR, WI, 95</td>
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<td>20</td>
<td>4.4*</td>
<td>2.8</td>
<td>7.7</td>
<td>237,330</td>
<td>84.3</td>
<td>44.4</td>
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<td>20</td>
<td>2.5</td>
<td>2.9</td>
<td>5</td>
<td>528,074</td>
<td>80.9</td>
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<td>5.7</td>
<td>5.9</td>
<td>6.5</td>
<td>311,586</td>
<td>67</td>
<td>50.3</td>
</tr>
</tbody>
</table>

**Total** | **522**

NOx: 1-hour average @15% oxygen, dry basis
CEMS and Source Test: 9 runs at 30 min each

*uncorrected

DLNB: Dry Low NOx Burner; DLE: Dry Low Emitter; WI: water/steam Injection; SCR: Selective Catalytic Reduction
### Gas Turbines - Simple Cycle

<table>
<thead>
<tr>
<th>Size (MMBTU/Hr)</th>
<th>Source</th>
<th>Fuel Type</th>
<th>Control &amp; Year</th>
<th>NOx Permit Limit (ppm)</th>
<th>NH3 Limit (ppm)</th>
<th>Survey NOx ppm @ 15% O2</th>
<th>CEMS (RATA) NOx ppm @15% O2</th>
<th>Source Test NOx ppm @15% O2</th>
<th>Avg. Flow Rate (dscf/min)</th>
<th>% Capacity</th>
<th>2016 NOx Emissions (tons/year)</th>
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</thead>
<tbody>
<tr>
<td>392</td>
<td>Major</td>
<td>Refinery Gas</td>
<td>SCR, WI</td>
<td>96</td>
<td>5</td>
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<td>218,518</td>
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</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td><strong>92.1</strong></td>
</tr>
</tbody>
</table>

NOx: 1-hour average @15 % oxygen, dry basis
CEMS and Source Test- 9 runs at 30 min each

WI: water/steam Injection; SCR: Selective Catalytic Reduction
Gas Turbines Category Summary

- Second largest source category of total annual NOx emissions at 14.4%
- Largest stack flow rate of all equipment
- Gas turbines are used 67% to 91% of capacity
- Compared NOx emissions from survey data, CEMS (RATA), and source test data
- 10 Combined cycle turbines (one not in operation since 2012, not included in table)
  - 5 fueled by natural gas
    - Lowest survey NOx emission at stack is 1.1 ppm (<2 ppm permit limit)
  - 5 fueled by refinery fuel gas
    - Lowest survey NOx emission is 2.4 ppm (<8 ppm permit limit)
- 3 Simple cycle
  - 2 gas turbines are equipped with heat recovery boilers
    - Approximately used 80% capacity
    - NOx emission is at 7.8 ppm
  - One cogen gas turbine combined with reformer heater, emissions are aggregated with heater (not in table, but included with hydrogen reformer heaters)
    - NOx emission at 4.5 ppm @ 3% O2
<table>
<thead>
<tr>
<th>Device ID</th>
<th>Size (MMBTU/Hr)</th>
<th>Fuel Type</th>
<th>Control</th>
<th>Device/Class</th>
<th>NOx Permit Limit (ppm)</th>
<th>NH3 Permit Limit (ppm)</th>
<th>Survey NOx ppm @3% O2*</th>
<th>CEMS (RATA) NOx ppm @3% O2</th>
<th>Source Test NOx ppm @3% O2</th>
<th>Avg. Flow Rate (dscf/min)</th>
<th>2016 NOx Emissions (tons/year)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
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<td>SCR</td>
<td>Regenerator</td>
<td>40</td>
<td>10</td>
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<td>186,153</td>
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<td>SCR</td>
<td>Regenerator</td>
<td>60</td>
<td>10</td>
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<td>CO Boiler</td>
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<td>90,259</td>
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<td>82</td>
<td>10</td>
<td>32.7</td>
<td>26.1</td>
<td>27.7</td>
<td>85,918</td>
<td>112.3</td>
</tr>
</tbody>
</table>

*7 day average @ 3% O2, dry basis

CEMS (RATA) and Source Test- 9 runs at 30 min each
FCCU Category Summary

- Third largest source category of total annual NOx emissions at 8.4%
- 5 total FCCU regenerator units
- 1 FCCU no longer in operation
- 3 equipped with SCR
- 2 equipped with CO boiler (not fired, used as heat recovery only)
- Lowest survey NOx emissions from FCCU is 1.2 ppm @ 3% O2
- 7 regenerator start-up/air heaters are included with FCCU
  - Start up heater emissions are aggregated under the FCC regenerator
  - Fueled by refinery fuel gas and/or natural gas
  - Start-up heater sizes range from 108 to 300 MMBtu/hr
  - 1.3% of heater capacity used per year
Survey Data Analysis
SRU/TG Incinerators
<table>
<thead>
<tr>
<th>Size (MMBTU/Hr)</th>
<th>Fuel Type</th>
<th>NOx Permit Limit (ppm)</th>
<th>Survey NOx ppm @ 3% O2</th>
<th>CEMS(RATA) NOx ppm @ 3% O2</th>
<th>Source Test NOx ppm @ 3% O2</th>
<th>Control</th>
<th>2016 NOx Emissions (tpy)</th>
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</table>

**Total** 142
SRU/TG Incinerators Category Summary

- 3.3% of total annual NOx emissions
- NOx emissions vary widely
  - Range from 4.2 ppm to 137 ppm
- 19 pieces of equipment in category
  - 16 Incinerators
  - 3 equipped with in-line stack heaters (combined with SRU incinerators)
  - 50% equipped with LNB
- No post combustion control (survey)
- Challenges due to SOx emissions
- Will consider control options feasibility and cost effectiveness of controls
Survey Data Analysis
Thermal Oxidizers and Incinerators
## Thermal Oxidizers and Incinerators

<table>
<thead>
<tr>
<th>Size (MMBTU/Hr)</th>
<th>Process Type</th>
<th>Fuel Type</th>
<th>Device/Class</th>
<th>NOx Permit Limit (ppm)</th>
<th>Survey NOx ppm @ 3% O2</th>
<th>Control</th>
<th>2016 NOx Emissions (tons/year)</th>
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</thead>
<tbody>
<tr>
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<td>Propane</td>
<td>Incinerator</td>
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<td>Thermal Oxidizer</td>
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<tr>
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<td>Soil Vapor</td>
<td>Natural Gas</td>
<td>Thermal Oxidizer</td>
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<td>46</td>
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<td>3.4</td>
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<tr>
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<td>Groundwater remediation</td>
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<td>Thermal Oxidizer</td>
<td>130 LBS/MMSCF</td>
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<td>Low NOx Burner</td>
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<tr>
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<td></td>
<td><strong>25.95</strong></td>
</tr>
</tbody>
</table>
Thermal Oxidizers and Incinerators Category Summary

- 14 pieces of equipment
- Accounts for 0.6% of total annual NOx emissions
- Size range from 1 to 30 MMBtu/hr
- 57% are equipped with LNB (survey)
- Usage and hours of operation vary widely
- NOx emissions varies from 4.2 ppm to 9.7 ppm
- Capacity varies and is dependent upon location and unit
Coke Calciner
• Will continue to hold separate meeting with stakeholder to discuss BARCT limits, cost effectiveness, and control technologies
• Next proposed meeting: 12/14/18 during upcoming site visit
• Will discuss with stakeholder
Auxiliary Internal Combustion Engines
• Three auxiliary internal combustion engines (ICE)
• Initially classified as primary ICE
• Survey data indicates that engines are used to power cogeneration systems during start-ups only
• Low use (approximately 10 hours a year)
• 2016 NOx emissions less than 0.45 tons a year
• Will consider cost-effectiveness of installing NOx controls
Next Steps

1. Release RFP for 3rd Party BARCT Validation
2. Select 3rd Party BARCT Validation
3. Establish BARCT Limits
4. Cost Effectiveness
5. Develop Rule Concepts
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