NOx RECLAIM
Working Group Meeting

September 19, 2013

Agenda

- Welcome
- Survey Responses from Refinery Sector
- Survey Responses from Non-Refinery Sector
- 2023 Emissions and Emission Reductions
- Schedule

Survey Responses
Refinery Sector

Note: In this presentation, the concentrations are reported as corrected to 15% O2 for turbines/duct burners and ICEs. For other equipment categories, the concentrations are reported as corrected to 3% O2.

Survey Responses – Refinery Control Installed After 2005

- Expected: 50 SCRs Installed by 2011
- 6 SCRs Actually Installed, 4 met 2005 BARCT
  - ✓1 SCR for 3 heaters, 78 mmbtu/hr, **2.7 ppmv NOx**
  - ✓1 SCR for 1 heater, 85 mmbtu/hr, **3.5 ppmv NOx**
  - ✓1 SCR for FCCU: **85% reduction guaranteed, 15.7 ppmv**
  - ✓1 SCR for 1 heater, 41.3 mmbtu/hr, **4.1 ppmv NOx**
  - – 1 SCR for 1 boiler, 352 mmbtu/hr, 6 ppmv NOx
  - – 1 SCR for 1 boiler, 304 mmbtu/hr, 8.5 ppmv NOx

Survey Responses - Refinery Control Installed After 2005

- Low NOx Burners
  - Crude Heater, 35 mmbtu/hr, 10 ppmv NOx
  - Crude Heater, 40 mmbtu/hr, 14.45 ppmv NOx
  - Crude Heater, 85 mmbtu/hr, 15 ppmv NOx
- New SRU/TG with ULNB/Scrubber, **4 ppmv**
- New Boiler 245 mmbtu/hr/SCR, **5.4 ppmv**
- New Turbines/Duct Burners/SCR, **2.5 ppmv**

Survey Responses - Refinery FCCUs/CO Boilers

- 2005 BARCT = 85% Reduction
- Current Performance
  - 3 FCCUs w SCRs: **1.2 ppmv, 5.6 ppmv**, 14.8 ppmv
  - FCCU w Scrubber: 12.9 ppmv
  - 2 FCCUs w Less or No Control: 21 ppmv, 29 - 43 ppmv
- 2013 BARCT Under Consideration: **5 ppmv**
- Next Step: Cost Analysis with SCR, Scrubber, LoTOx, NOx Reducing Additives

Survey Responses - Refinery Boilers/Heaters

- 2005 BARCT: 5 ppmv - 12 ppmv
- Current Performance
  - 4 Heaters w SCR, 88 – 200 mmbtu/hr, **1.6 ppmv**
  - 3 Heaters w SCRs, 78 – 650 mmbtu/hr, **2.3 ppmv – 2.7 ppmv**
  - 2 Heaters w SCRs, 40 – 63 mmbtu/hr, **5 ppmv**
- 2013 BARCT Under Consideration
  - **2 ppmv** for >110 mmbtu/hr Boilers/Heaters
  - **5 ppmv** for 20-110 mmbtu/hr Heaters
  - **9 ppmv** for <20 mmbtu/hr Heaters
- Next Step: Cost Analysis SCR, ULNB, Sharing (5 ppmv w SCR cost-effective for 75 mmbtu/hr under Rule 1146)

Survey Responses - Refinery Turbines/Duct Burners

- 2000 BARCT: 62.275 lb/mmcf Refinery Gas
- 2005 BARCT: No New Level
- Current Performance
  - 2 Turbines w SCRs, **1.67 ppmv**
  - 10 Turbines/Duct Burners w SCRs, **2.5** – 3.5 ppmv
  - 9 Turbines/Duct Burners w SCRs, 4 ppmv – 6 ppmv
- 2013 BARCT Under Consideration: **2.5 ppmv**
- Next Step: Cost Analysis with SCR

Survey Responses - Refinery Sulfur Recovery/Tail Gas/Incinerators

- 2000 BARCT: Reported Value (RV)
- 2005 BARCT: No New Level
- Current Performance
  - 1 New SRU/TGU: **4 ppmv** w ULNB/Scrubber
  - 17 Existing SRU/TGUs: 7 ppmv – 55 ppmv
- 2013 BARCT Under Consideration: **80% Red**
- Next Step: Cost Analysis with ULNB, Scrubber, or Equivalent Control for Concurrent Reduction of NOx and SOx

Survey Responses - Refinery
Coke Calciner

- 2005 BARCT: 0.036 lb/mmbtu (30 ppmv)
- Current Performance: 64.95 ppmv
- 2013 BARCT Under Consideration: **80% Red**
- Next Step: Cost Analysis with Low Temperature SCR, Dry/Wet Scrubber, Multi-Pollutant Control for Concurrent Reduction of NOx, SOx and PM

Survey Responses - Refinery GHG Concurrent Reduction

- Estimate of **0.82 tpd** NOx Reduction
- 50%-60% Reductions Occurred Before 2010
- CARB Review to Be Completed - Late 2013
- Draft Report: Energy Efficiency and Co-Benefits Assessment of Large Industrial Sources - Refinery Sector
  www.arb.ca.gov/cc/energyaudits/publicreports.htm

Survey Responses
Non-Refinery Sector

Note: In this presentation, the concentrations are reported as corrected to 15% O2 for turbines/duct burners and ICEs. For other equipment categories, the concentrations are reported as corrected to 3% O2.

Survey Responses – Non-Refinery Gas Turbines/Duct Burners (Power Plant)

- BARCT Determined Under Rule 2005/2009
- Current Performance: 2 ppmv (Per Rule 2005/2009)
- 2013 BARCT Under Consideration: **No Further Control**

Survey Responses – Non-Refinery Gas Turbines (Non-Power Plant)

- 2005 BARCT: No New Level
- Current Performance
  - 3 Turbines at less than 10 ppmv
  - 4 Turbines between 20-25 ppmv
  - 10 Turbines between 50-100 ppmv
  - 3 Turbines above 100 ppmv
- 2013 BARCT Under Consideration: **2 ppmv**
- Next Step: Cost Analysis with SCR

Survey Responses – Non-Refinery Utility Boilers

- 2005 BARCT: 0.008 lb/mmbtu (7 ppmv)
- Current Performance: 5 to 7 ppmv (Per Rule 2009)
- 2013 BARCT Under Consideration: 2 ppmv @ 3% O_2 (Boilers w SCR) or 2 ppmv @15% O_2 (Gas Turbines w SCR)
- Next Step: Feasibility and Cost Effectiveness with SCR or Change to Gas Turbines (Repowering facilities will be taken into account)

Survey Responses – Non-Refinery Industrial Boilers

- 2005 BARCT: 9 – 12 ppmv
- Current Performance: 9 -12 ppmv
- 2013 BARCT Under Consideration: **5 ppmv**
- Next Step: Cost Analysis with Ultra Low NOx Burners (ULNB) and SCR
  (5 ppm w/SCR cost effective for 75 MMBTU/hr under Rule 1146)

Survey Responses – Non-Refinery Furnaces

- 2005 BARCT: 30 ppmv – 45 ppmv
- Current Performance
  - 2 units with SCR (1 unit at 15 ppmv)
  - 5 units w/out SCR (70-100 ppmv)
- 2013 BARCT Under Consideration: **80% Reduction**
- Next Step: Cost Analysis with SCR or Scrubber

Survey Responses – Non-Refinery Glass Melting Furnaces

- 2000 BARCT: 1.2 – 5.6 lbs/tons glass pulled
- 2005 BARCT: No New Level
- Current Performance
  - 3 glass melting furnaces
  - 2 are for container glass production
  - ~300-500 ppmv
- 2013 BARCT Under Consideration: **80% Reduction**
- Next Step: Cost Analysis with SCR, Scrubbing or Equivalent Control for Concurrent Reduction of NOx and SOx

Survey Responses – Non-Refinery Cement Kilns

- 2000 BARCT: 2.73 lb/ton clinker
- 2005 BARCT: No New Level
- Current Performance: 2.73 lb/ton clinker
- 2013 BARCT Under Consideration: **0.5 lb/ton clinker (80% Reduction)**
- Next Step: Feasibility and cost effectiveness with SNCR, SCR, Scrubbing or Equivalent Control for Concurrent Reduction of NOx and SOx

Survey Responses – Non-Refinery ICEs (Non-Power Plant)

- 2005 BARCT: No New Level
- Current Performance
  - < 11 ppmv with NSCR for rich burn ICEs
  - 40-150 ppmv for lean burn ICEs
  - 200-300 ppmv for diesel fired ICEs
- 2013 BARCT Under Consideration: **11 ppmv**
- Next Step: Feasibility and cost effectiveness with SCR

Survey Responses – Non-Refinery ICEs (Power Plant)

- 2005 BARCT: No New Level
- Current Performance: 24-200 ppmv
- 2013 BARCT Under Consideration: **11 ppmv**
- Next Step: Feasibility and cost effectiveness with SCR

Emissions and Emission Reductions

Methodology

- 2011 Audited Emissions = 20 tpd
- 2011 Emissions at 2005 BARCT

  = ∑(2011 Activity x 2005 BARCT)
- 2011 Emissions at 2013 BARCT

  = ∑(2011 Activity x 2013 BARCT)
- 2023 Emissions at 2013 BARCT

  = ∑(2011 Emissions at 2013 BARCT x GF)
- Detail Results on Spreadsheets
- RTC Reductions and Percent Shave = TBD

Emission Reductions from Remaining 240+ Facilities

- ICEs Subject to Rule 1110.2 = 0.1 tpd
- Other Boilers/Heaters = Under Consideration

Schedule

- Next Working Group Meeting: November
- Public Workshop: 75 Days from Public Hearing
- Public Hearing: 1st Quarter 2014