Recent Air Permitting Issues for Natural Gas Combined Cycle Power Plants

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AECOM

Introductions

- Bob Hall is a Senior Chemical/Air Quality Engineer with 29 years of air permitting experience with AECOM. He has been working throughout the U.S. on emissions, Best Available Control Technology, and regulatory issues for gas turbine projects since 1995.
- Jeff Connors is a senior air quality meteorologist with 15 years of modeling and air permitting experience. He has worked as air quality lead for gas turbine projects in the Eastern United States over the past 5 years. Mr. Connors has been significantly involved on AECOM project teams that worked on AERMOD's low wind speed model evaluations which led to recent model formulation changes by EPA. He also has extensive experience with Class I area modeling issues.

Agenda

- Technical Issues
  - Greenhouse Gas Best Available Control Technology (BACT)
  - Start-Up / Shut-Down Emissions
  - $PM_{2.5}$ Emissions
- Dispersion Modeling
  - Compliance with the 1-hour NO_2 National Ambient Air Quality Standard (NAAQS)
  - Compliance with the 24-hour Annual $PM_{2.5}$ National Ambient Air Quality Standard (NAAQS)

Technical Issues

Bob Hall

Greenhouse Gas Best Available Control Technology Carbon Capture and Sequestration

- 2011 EPA Guidance - CCS is an add-on air pollution control technology that is “available”
  - Guidance generally interpreted to require a site specific cost analysis
  - Permit applications state that CCS is not technically feasible and not an available technology
    - Large scale, high volume
    - Capture from flue gas with low (3.5% to 5%) CO_2 concentration
    - Availability of storage sites
  - Applications also include a site specific cost analysis (DOE/NETL analyses:
    - Capture: Cost and Performance Baseline for Fossil Energy Plants, Vol. 1, DOE/NETL-2007/1281, May 2007
    - Transport and storage: Carbon Dioxide Transport and Storage Costs in NETL Studies, Revision 2, DOE/NETL-2013/1614, March 2013

Greenhouse Gas Best Available Control Technology CCS (cont.)

- Proposed 40 CFR Part 60 Subpart KKKK NSPS (January 8, 2014)
  - EPA: We do not consider CCS to be the Best System of Emission Reduction because of insufficient information to determine technical feasibility and because of adverse impacts on electricity prices
  - No cost analysis
- Continue to include site specific cost analysis for CCS?

Greenhouse Gas Best Available Control Technology Energy Efficiency

- Plant features – compressor, combustor, turbine, tuning, reduction in heat losses, etc.

- Permit limits
  - Heat rate: 7,000 Btu/KWh to 7,800Btu/kWh
  - Emissions: 890 lb/kWh to 1,000 lb/kWh
  - Variations: turbine model, duct burning, other engineering issues, lower or higher heating value, net or gross output, detailed compliance requirements

Greenhouse Gas Best Available Control Technology Energy Efficiency

- Example permit limits
  - Heat Rate Permit Limit
    - New performance: 6,600 Btu/kWh based on higher heating value, net output, and ISO conditions
    - Efficiency losses due to combustion turbine degradation
    - Margin to account for degradation of balance or plant equipment
    - Long term degradation of steam turbine, HRSG, air cooled condenser, etc.
    - .Permit limit: 7,400 Btu/kWh at full load adjusted to ISO conditions.
      - Initial performance test and once every five years
      - ASME PTC 46-1996
  - Continuous performance (lb/MWh)
    - Additional margin to account for low load operation and start-up/shutdown events
    - 900 lb CO_2/MWh as a 12-month rolling average based on CEMS

Start-Up/Shutdown

- SU/SD are normal operations
- Primary focus is NOx, CO, VOCs
  - NOx and CO are monitored by CEMS
- Combustion turbine emissions as a function of load are well defined
- Start-up procedures/hold points vary: vendors, A/E, project owners
- Effect of emission controls
- Must anticipate operating requirements
- Permit limits vary: durations only, duration and emissions, each event or average over 12 months
- NOx and CO can be dispersion modeling/ambient impact issues (1-hour impacts)

PM_{10} and $PM_{2.5}$ Emissions

- EPA Methods 5 or 201A and 202 (condensable $PM_{10}/PM_{2.5}$)
  - EPA Method 202 first promulgated in 1991
    - Starting in 1995 some agencies required condensable PM_{10} but some did not
    - Many problems with the test method
    - Stack test data not available
    - Guarantees only for filterable emissions
  - EPA finalized a revised test method in December 2010
    - Vendor guarantees are available
    - Larger frame turbines
      - Total $PM_{10}/PM_{2.5}$ emissions are 8 lb/hr to 12 lb/hr without duct burning
      - Additional 2 to 4 lb/hr for duct burning
  - October 12, 2012 Final Rule
    - 40 CFR 51.166(b)(49)(i)(b): $PM_{2.5}$ emissions and PM_{10} emissions shall include gaseous emissions from a source or activity which condense to form particulate matter at ambient temperatures. On or after January1, 2011, such condensable particulate matter shall be accounted for in applicability determinations and in establishing emissions limitations for $PM_{2.5}$ and PM_{10} in PSD permits

Dispersion Modeling

Jeff Connors

Dispersion Modeling …

- Where the plant is located will often dictate how difficult the air dispersion modeling analysis will be
- EPA has recently promulgated newer, more stringent, NAAQS
  - New 1-hour NO_2 and $PM_{2.5}$ have created additional modeling challenges for new combined cycle power plants
  - New 1-hour SO_2 less of a concern for gas fired power plants
- 1-hour NO_2 (188 ug/m3)
  - Form of the standard is the 98^{th} percentile of 1-hour daily maximum concentrations, averaged over 3 years
- 24-hour and Annual $PM_{2.5}$
  - Form of the standards
    - 24-hour = the 98th percentile, averaged over 3 years
    - Annual = annual mean, averaged over 3 years

Dispersion Modeling …

- **Location of Plant**
  - For Class I Area Impacts:
    - Distance to Class I area will dictate level of analysis required to assess impacts of acid deposition and regional haze
      - Located within 50km → much greater level of analysis could be required
      - Located beyond 50km → could screen out of having to do acid deposition and regional haze modeling using FLM Q/D screening technique
      - Located within 10km → for pollutants not triggering PSD review, must show 24-hour modeled impacts is less than 1 ug/m3 or PSD review is required for that pollutant
    - PSD increment analysis will always be required for Class I areas (typically within 300 km)
  - For Class II Area Impacts:
    - More closely located to populated:
      - Larger background source inventories
      - Higher ambient background
  - Very remote locations may require 1 year pre-construction ambient monitoring program for MET and criteria pollutants if representative data is not available

Dispersion Modeling …

- **1-hour NO_2 NAAQS**
  - Very difficult to be insignificant with SIL set at 7.5 ug/m3
  - Multi-source modeling almost always necessary
  - Multi-source modeling may include sources that overlap with modeled receptors causing modeled impacts to exceed the NAAQS
  - Often need to diagnose and solve modeled violations
    - Does the "project" source significantly contribute???
    - Is the background source causing the impact being modeling correctly???
  - Modeled violations "allowed" if "project" source is shown to have an insignificant impact to the modeled violation
    - This strategy is becoming more common and NAAQS are ratcheted down
  - Typical problems sources include low-level combustion sources (e.g. fuel gas heater, diesel generators, fire water pumps, etc)
  - Elevated startup emissions can also cause issues with modeling compliance

Dispersion Modeling …

- **24-hour and Annual $PM_{2.5}$ NAAQS**
  - United States Court of Appeals for the District of Columbia Circuit granted a request from the EPA to vacate $PM_{2.5}$ SIL for purposes to avoiding multi-source modeling
  - SIL modeling not necessary → proceed directly to multi-source modeling (varies from state to state)
  - Annual NAAQS has now become more restrictive since it has been lowered from 15 to 12 ug/m3 (background commonly 9-11 ug/m3)
    - Does not leave a lot of room for modeled component in the NAAQS compliance assessments
  - Latest $PM_{2.5}$ modeling guidance from EPA requires applicants to address secondary $PM_{2.5}$ (due to emissions of primary NOx and SO_2)
    - Needs to be addressed, but has not been a fatal issue for new combined cycle power plants

Thank You

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