Environmental Permitting of CHP & District Energy: Lessons Learned and Lead Times

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Overview

- Environmental Permitting for CHP usually limited to air permitting with state environmental agency such as MassDEP, but large projects can be more involved.
- Larger projects may also require broader environmental review such as Mass Environmental Policy Act (MEPA)/Environmental Impact Reports (DEIR/FEIR).
- We will cover some recent examples of a variety of CHP projects in Massachusetts with lead times for environmental approvals and lessons learned – add on-air pollution controls required, emission limits (State and Federal), testing and monitoring, noise considerations and local approvals.

Recent CHP/District Energy projects in Massachusetts

1. Manufacturer with Title V operating permit in Western MA – 6.5 MW Solar Taurus 60 turbine with HRSG, compressed natural gas (CNG) with ULSD backup, 29 MMBTU/hr. duct burner, CNG or propane.

2. Manufacturer with Title V operating permit in MA – 4.1 MW Solar Centaur 40 turbine with HRSG, 36 MMBTU/hr. duct burner, natural gas only fuel for both.

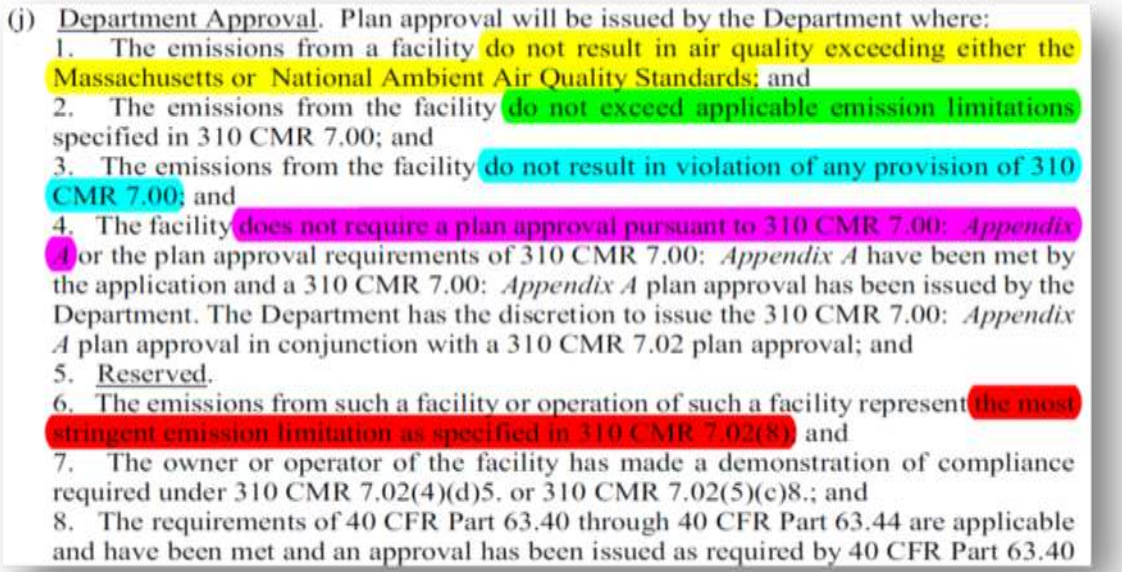
3. Manufacturer with no Title V operating permit in Southeastern MA – 2.0 MW IC engine with heat recovery, natural gas only fuel.

Recent CHP/District Energy projects in Massachusetts

4. Harvard University – Blackstone Station in Cambridge, MA – 7.5 MW Solar Taurus 70 turbine with HRSG, natural gas with ULSD backup, 51 MMBTU/hr. duct burner [*see presentation by Michael X. Macrae, PhD, Harvard University and AJ Jablonowski, P.E. of Epsilon for Air Permitting Case Study in Session 5C on 6/30*].

5. MATEP – Boston, MA – 14.4 MW turbine (such as Siemens SGT 400) with HRSG, natural gas with USLD backup, 39 MMBTU/hr duct burner, PSD (major modification) and MEPA.

Massachusetts Air Permitting Process



(j) Department Approval. Plan approval will be issued by the Department where:

1. The emissions from a facility do not result in air quality exceeding either the Massachusetts or National Ambient Air Quality Standards; and
2. The emissions from the facility do not exceed applicable emission limitations specified in 310 CMR 7.00; and
3. The emissions from the facility do not result in violation of any provision of 310 CMR 7.00; and
4. The facility does not require a plan approval pursuant to 310 CMR 7.00: *Appendix A* or the plan approval requirements of 310 CMR 7.00: *Appendix A* have been met by the application and a 310 CMR 7.00: *Appendix A* plan approval has been issued by the Department. The Department has the discretion to issue the 310 CMR 7.00: *Appendix A* plan approval in conjunction with a 310 CMR 7.02 plan approval; and
5. Reserved.
6. The emissions from such a facility or operation of such a facility represent the most stringent emission limitation as specified in 310 CMR 7.02(8); and
7. The owner or operator of the facility has made a demonstration of compliance required under 310 CMR 7.02(4)(d)5. or 310 CMR 7.02(5)(c)8.; and
8. The requirements of 40 CFR Part 63.40 through 40 CFR Part 63.44 are applicable and have been met and an approval has been issued as required by 40 CFR Part 63.40

Ambient Air Quality Analysis 310 CMR 7.02 (3)(j)(1)

Environmental Results Program (ERP) 310 CMR 7.26(43)

Noise Analysis 310 CMR 7.10 – limit of 10 dBA above ambient

Non-Attainment New Source Review (NSR) 310 CMR 7.00 App A

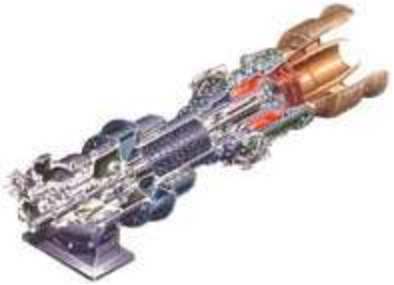
Best Available Control Technology (BACT) 310 CMR 7.02(8)

Air Emissions and Controls for Turbines, Duct Burners and Engines

POLLUTANT	SOURCE	ADD-ON CONTROLS
Nitrogen Oxides (NOx)	High-temperature combustion of nitrogen in air	Selective Catalytic Reduction (SCR); uses ammonia to reverse the reaction
Carbon Monoxide (CO)	Incomplete combustion	Oxidation catalyst
Volatile Organic Compounds (VOC)	Incomplete combustion	Oxidation catalyst
Sulfur Dioxide (SO_2)	Sulfur in fuel	None, low sulfur fuels (gas, ULSD)
Carbon Dioxide (CO_2)	Carbon in fuel	None, CHP increases efficiency (lb/MWh) for all pollutants
Particulate Matter (PM)	Incomplete combustion, other sources	None, clean fuels
Ammonia (NH_3)	Unreacted reagent from SCR	Minimize slip through design, process control

Manufacturers' Example's 1 and 2

- Two projects currently under construction at existing older factories – replacing old No. 6 oil fired boilers. NOx and SO_2 potential emissions from boilers make these major sources with Title V operating permits.
  1) Manufacturer in Western MA – 6.5 MW Solar Taurus 60 turbine with HRSG, compressed natural gas (CNG) with ULSD backup, 29 MMBTU/hr. duct burner, CNG or propane.



  2) Manufacturer in MA – 4.1 MW Solar Centaur 40 turbine with HRSG, 36 MMBTU/hr. duct burner, gas only fuel for both.

Manufacturers' Example 1 and 2 (cont.)

- Both projects kicked off about June, 2014. Reviewed existing permits, potential emissions, actual emissions, preliminary design of CHP – developed permitting plan.

- Initially tried to use MassDEP Environmental Results Program (ERP) for turbines, essentially a general permit with certification after startup.

- Duct burner (DB) at Title V facilities cannot use ERP (310 CMR 7.26 (30)) for boilers, so need pre-construction plan approval (310 CMR 7.02) at least a Limited Plan Approval (LPA) for duct burners (310 CMR 7.02 (4)).

Manufacturers' Example 1 and 2 (cont.)

- DEP initially agreed in pre-application meeting to LPA for DB and ERP for turbines in 2014, but changed their mind after review of LPA application and required upgrade to Comprehensive Plan Approval (CPA) for turbine and DB.

- CPA requires a top-down BACT analysis including combined emissions from duct burner and turbine at stack since the SCR and oxidation catalyst control both together. DB emission limits much lower than ERP for boilers – DEP regulations suggest ERP limits are BACT but reserve right for case-by-case BACT .

Manufacturers' Example 1 and 2 (cont.)

- Negotiated approvals allowing operational flexibility using stack total lb/hr and lb/MMBTU limits from CT and DB (rather than individually). Use of ERP limits for turbine allowed for about 1 ppm higher NOx, CO and VOC than BACT. Better reliability for transients, upsets.

- Emission limits equivalent to approx. 3 ppm NOx (gas), 6 ppm NOx (oil); 3 ppm CO (gas), 5 ppm CO (oil), 4 ppm VOC (gas), 10 ppm VOC (oil), 0.015 lb/MMBTU PM (gas), 0.034 lb/MMBTU (oil), 2 ppm ammonia slip.

- Air modeling avoided using ERP prescribed stack height of 1.5 x height of building (310 CMR 7.26(42)(d)(4)(c)).

Manufacturers' Example 1 and 2 (cont.)

- Use process emissions monitoring for NOx and CO instead of CEMs (less compliance risk, lower operating costs but same equipment).

- Stack testing required at both facilities after startup and annually to demonstrate compliance with NOx, CO, VOC, PM and ammonia emission limits, including Federal NSPS limits (annual for NOx and CO). Startup before Dec, 2015. Stack testing within 90-180 days.

- Baseline sound measurements made at both sites, extensive sound modeling and iterations of noise mitigation to minimize offsite noise impacts. One of the projects limited to 6 dBA increase offsite by local approval. A sound measurement program required by DEP upon startup for this facility. Other is further from neighbors and not required by DEP, but will test for performance documentation.

SE Mass Example 3

- Manufacturer with plants in Southeastern MA. Had added a 2 MW engine based CHP in 2008 at one plant. Current project is to do the same at second plant.

- A new gas fired Caterpillar IC engine with heat recovery and SCR/oxidation catalyst will be installed in next few months. CHP will achieve up to 85% overall efficiency.

SE Mass Example 3(continued)

- ERP (310 CMR 7.26(43) is being used for this case. The performance standard for gas fired engines are: 0.15 lb NOx/MWh, 1.0 lb CO/MWh, 1650 lb CO_2/Mwh. ERP certification filed within 60 days after startup.

- An air permit some years ago for another project had included the engine as an ERP unit plus required a design of 10 ppmdv @15%O_2 for ammonia slip.

- NOx, CO, VOC (excluding formaldehyde) are limited by 40 CFR Subpart JJJJ to 1.0 g/bhp-hr for NOx, 2.0 g/bhp-hr for CO and 0.7 g/bhp-hr for VOC.

SE Mass Example 3(continued)

- Air modeling required by ERP if stack less than 1.5 times height of any structure within 5L, where L is height of structure. An existing structure would result in a the height higher than desired using ERP formula, so air modeling was conducted to arrive at a stack height of 31' AGL while meeting NAAQS. Air modeling results kept on file.

- Stack testing required after startup to demonstrate compliance with Federal NSPS limits. A stack test protocol submitted to EPA. No stack testing required for ERP, though DEP reserves the right to require testing at any time.

SE Mass Example 3(continued)

- Recommended use of process emissions monitoring for NOx. Use this and process data from EPA stack test for CO and VOC as credible evidence of compliance for internal records.

- Baseline sound measurements made at site, extensive sound modeling and iterations of noise mitigation to minimize offsite noise impacts and comply with MassDEP noise policy limit of 10 dBA above lowest existing ambient and no pure tones. Measure after startup to demonstrate compliance for internal records and ERP certifcation.

Harvard – Example 4

- Harvard University – Blackstone Station in Cambridge, MA – 7.5 MW Solar Taurus 70 turbine with HRSG, natural gas with ULSD backup, 51 MMBTU/hr. duct burner– tour today or Wed. *[see presentation by Michael X. Macrae, PhD, Harvard University and AJ Jablonowski, P.E. of Epsilon for Air Permitting Case Study in Session 5C on 6/30].*

Harvard – Example 4(continued)

- In March of 2008, MassDEP proposed regulations “to encourage the installation of CHP systems” because CHP systems “will reduce greenhouse gas and other emissions, reduce fossil fuel usage and enable cost savings.” The regulations include “a methodology that enables the applicant to adjust the emission limitation for a CHP system and take into account emissions that will not be created by omitting a conventional separate system (e.g. boiler) to generate the same thermal output.”
- The project is the largest to-date to utilize special Massachusetts air permitting regulations designed to encourage CHP.

Harvard – Example 4 (continued)

- Harvard proposed to use the CHP regulation credits when calculating proposed short-term emission limits, but continue to comply with stricter top-case BACT for long-term limits. The CHP regulations were promulgated as 310 CMR 7.26(45), which in-turn references the Environmental Results Program (ERP) pollutant-specific emission limits in 310 CMR 7.26(43).

- This approach allows resiliency and flexibility during transient and upset conditions, while achieving best available emission rates over the long-term.

Harvard – Example 4 (continued)

- Using the MassDEP CHP regulation allows a credit only for pollutants specifically listed in the reg (no VOC).
- Costs of add-on pollution controls not reasonably avoided using credit. Harvard installed Best Available Control Technology, and used the CHP regulation only for short-term operating flexibility.
- Campus a major source of NOx, PM, so need to track modification with campus wide inventory to keep below major modification thresholds. Needed tighter $PM_{2.5}$ limit for CHP to stay below 10 tpy threshold for PSD.

MATEP – Example 5

- Longwood Medical Area Total Energy Plant – Boston MA – tour Wed.
- Proposed 14.4 MW Siemens SGT 400 or Solar Titan 130 or equiv turbine with HRSG, natural gas with ULSD backup, 39 MMBTU/hr duct burner.

MATEP – Example 5 (continued)

- Too large to use the MassDEP CHP regulation (>10 MW).
- Triggered federal Prevention of Significant Deterioration (PSD) permitting, administered by MassDEP, for particulate matter and CO_2.
- Separate MassDEP plan approval and PSD permit applications; parallel review – approx. one year timeline.
- Triggered MEPA Environmental Impact Report – in parallel with PSD review.
- Emission limits from MassDEP top-case BACT guidance, with NOx, CO, NH_3 CEMS, COMS.
- Plantwide modeling for NAAQS, project modeling for Mass. air toxics.
- Noise monitoring and modeling.

MATEP – Example 5 (continued)

- PSD and MEPA review includes additional Environmental Justice requirements.
- Enhanced public outreach:
  - Factsheet translated to four languages
  - Interpreters at MEPA public scoping session – evening session
  - Posted in local newspapers, (four languages), local library
  - Extended MEPA comment period
- Documented no disproportionately high and adverse human health or environmental effects of the project on areas with minority populations and low-income populations because all predicted project impacts are below Significant Impact Levels (SILs).

Lead Times

- Depending on size, location, and circumstances of CHP project, can take anywhere from a few months to a few years to obtain necessary pre-construction environmental approvals.
- Even for an ERP certification that is not a pre-construction approval, significant lead time is required during the design phase to determine noise requirements, conduct iterative noise modeling, conduct air dispersion modeling to determine stack test, scope out and schedule EPA stack testing and make sure the engine and air controls meet all standards.
- For projects needing pre-construction approval, build in schedule for early pre-application meeting with DEP and allow time to change approach especially if the “easy” route is too good to be true.
- For more complicated, major projects it can take six months of design, pre-application meeting, application prep, followed by a year of DEP and MEPA review to obtain approvals.

Lessons Learned

- Regulatory requirements are becoming increasingly stringent and even beneficial projects can be challenging.

- The environmental requirements need to be an integral part of overall design and built into schedule.

- Details of emissions controls, stack characteristics (diameter, flow, temp), noise controls are needed early on to complete applications. Get vendor guarantees for all anticipated air permit requirements.

Lessons Learned

- Consider if and how the units will be stack tested and monitored during operations.
- Put environmental permitting into overall schedule and drive data requirements as part of overall design.
- Determine if other approvals are required such as MEPA, local planning, zoning, etc.
- For larger sources, early look at facility wide emissions tracking, PSD, NANSR – avoid if possible to streamline.