Distributed Generation

The Ozone Transport Commission
Technology and Innovations Committee

March 2001

Ozone Transport Commission
Distributed Generation Initiative

March 6, 2001

BACKGROUND

The electric power industry is currently in a period of enormous change. In many States, the vertically integrated power industry of the past is giving way to a competitive environment where power generation and distribution are performed by separate companies. A host of new and transformed companies are starting to compete in the electricity generation business; in the past, large regulated monopolies had exclusive rights in their service territories.

The restructured electric power industry raises opportunities and challenges for air quality regulators. In the new business environment, State air agencies will have opportunities to foster the development of new, clean power generation including power from: fuel cells, microturbines, and highly efficient combined cycle plants fired by natural gas. Agencies may also have opportunities to promote power generation from renewable resources, such as wind power and photovoltaics. Air agencies may be challenged, however, to control the growth of emissions from small, relatively high emitting sources, such as diesel generators.

In the restructured power industry, commercial businesses may find it technically feasible and economically profitable to generate their own electricity rather than buy it from a generation company that supplies power over the electrical grid. This type of on-site generation is generally referred to as "distributed generation," since the sites of power generation are "distributed" over a large geographical area. Distributed generation differs markedly from the old utility model where power was generated at large "central station" power plants and transmitted to commercial customers via a transmission and distribution network. Market analysts believe businesses will find distributed generation attractive because it will provide electric power reliability and will allow the business to save on electricity costs. Businesses may save on electricity costs by using their on-site power generating capability during periods when grid supplied power is most expensive, for example during periods of peak demand.

Distributed generation units can be low emitting sources, such as fuel cells and microturbines, or high emitting sources, such as stationary diesel engines. Air quality regulators must be vigilant to ensure that new forms of electricity generation replacing central station power are at least as clean as the power they are replacing. This is especially true in the case of distributed generation where the size of new generating units may be smaller than the permit size thresholds (applicability limits) in some States.

THE AVAILABILITY OF DISTRIBUTED GENERATION TECHNOLOGIES

Several different technologies are available to generate power in the distributed generation market today. The proven method of producing power on-site is through the use of generators that run on diesel fuel. Diesel generator sets, the diesel engine and its associated generator, have long been used to provide back-up power for facilities where the delivery of power was critical, as in the case of hospitals or communication centers, or where reliable electricity supply was important to the commercial viability of an enterprise. Diesel generators have also provided electricity at remote locations where it is not feasible or cost effective to bring electrical lines to the remote facility.

While diesel generators are well proven and commercially available, several new technologies are entering the market or will enter the market in the near future. One company now offers a 75 kilowatt (kW) microturbine that delivers on-site power. Other vendors are developing microturbines for the distributed generation market and these new products will soon be available. Microturbines operate on natural gas.

Fuel cells are another technology that shows promise in the distributed generation market. A number of fuel cell demonstration projects and field tests are underway and a limited number of them are commercially available. Fuel cells can operate on a variety of fuels, but commercial fuel cells for the distributed generation market are expected to use natural gas as their fuel.

As microturbines and fuel cells are purchased and installed, it is anticipated that manufacturing costs will come down and these technologies will become economically feasible for a wider market. Diesel engine manufacturers may respond to competition from microturbine and fuel cell manufacturers by lowering costs and improving the environmental performance of their engines.

INITIAL MARKET FOR DISTRIBUTED GENERATION TECHNOLOGIES

Economics will play a key role in determining which businesses or business sectors will pursue distributed generation. Market analysts believe the following types of businesses are likely to install on-site power systems:

- Businesses that need absolute power reliability; e.g., credit card companies, companies with critically important computer systems, etc.;
- Businesses that need high quality electricity; e.g., computer chip manufacturers;
- Overseas markets; areas where power systems are poor or unreliable;
- Remote applications; e.g., resorts, houses far from transmission/distribution lines, overseas facilities.

These businesses may find on-site power generation an attractive financial or business alternative. As use of distributed generation grows, economies of scale will likely lower the cost of manufacturing distributed generation equipment.

AIR QUALITY POLICY IMPLICATIONS

In designing a comprehensive policy to address distributed generation, it is important to be aware of the market penetration of the various technologies and their associated emissions. Since diesel generators are already commercially available and they produce relatively large amounts of nitrogen oxides (NOx) and particulate emissions, any air quality policy that addresses distributed generation must ensure that these devices become cleaner or, if they do achieve wide use, their emissions are controlled.

On the other hand, incentives need to be developed to encourage lower emitting technologies, such as microturbines and fuel cells.

EMISSIONS REDUCTIONS

In recent tests, NOx emissions from stationary diesel engines ranged between about 11 to 45 pounds (lbs) of NOx per megawatt-hour (MWhr) of electricity produced. Many electric generating units subject to Phase II of the OTC Memorandum of Understanding for regional stationary source NOx reductions achieve a NOx emission rate of about 3 lbs of NOx/MWhr. By comparison, diesel engines emit NOx at about 3.7 to 15 times the rate of "typical" Phase II sources. This indicates why a migration to diesel engines for power generation would result in impaired air quality.

Improved engines, improved fuels and "end of pipe" controls can greatly reduce emissions from diesel engines. Fostering these improvements and controls should also be considered in a comprehensive program directed at small power generation units.

Air quality control strategies that target distributed generation technologies will result in reductions in NOx, volatile organic compounds (VOC), sulfur dioxide (SO2), particulate matter (PM), and toxic emissions.

CONTROL OPTIONS

State or regional air quality programs could promote low emitting technologies and limit the spread of high emitting technologies by taking the following actions.

- Develop State/regional verification programs for distributed generation technologies. States could require that fuel cell, microturbine and diesel engine manufacturers demonstrate that their equipment operates below rigorous emission standards. States could agree to regional verification standards, which would include limits for NOx, SO2, and PM; fuel requirements; and/or control equipment requirements.

- States could provide funding, low cost loans or other incentive programs to companies who install and use low emitting technologies.

- States could use their permitting processes to foster low emitting distributed generation technologies and limit the growth of high emitting sources. This could ease permit requirements for clean technologies while ensuring that high emitting diesel engines are given careful review. Generally, permits would not be needed for low emitting sources, except when the units exceed a given size threshold. Permits would be needed for more polluting technologies even at fairly small generation capacities. States could use the following draft language in their permitting rules or procedures.

DRAFT MODEL PERMIT APPLICABILITY LANGUAGE FOR DISTRIBUTED GENERATION EQUIPMENT

- Permits are required for all existing, modified, and new electric generating equipment that emit air contaminants with the following exceptions:

  - Fuel cells of any generating capacity size fueled by hydrogen;
  - Fuel cells with less than 5,000 kW generating capacity fueled by methane;
  - Fuel cells with less than 500 kW generating capacity fueled by fuels other than hydrogen and methane;
  - Microturbines with less than 500 kW generating capacity fueled by natural gas, verified to emit less than 0.4 lbs/MWhr NOx;
  - Diesel engines with less than 37 kW generating capacity[1];
  - Diesel engines equal to or greater than 37 kW generating capacity (50 horsepower (HP)) but less than 200 HP that are not located at a major stationary source of NOx emissions;
  - Other electric generating equipment with less than 500 kW generating capacity, which is verified to emit less than:

    1. 0.4 lbs/MWhr NOx;
    2. 0.25 lbs/MWhr CO;
    3. 0.1 lbs/MWhr PM;
    4. 0.01lbs/MWhr SO2.

- Verifications must adhere to established regional verification agreements and protocols.

- Mobile generators, less than a certain size (to be determined), do not require pre-construction permits.

- Permits are required for all generating units, including emergency generators, unless exempted above. Emergency generators, as defined in the March 6, 2001, OTC Model Rule for Additional NOx Control Measures, are not required to achieve the emission rates specified for non-emergency generators.

- The permitting agency will modify the size and emissions thresholds for pre-construction permits periodically with the first review occurring within three years. Technology improvements that generate fewer emissions would tend to increase permit thresholds. The need for additional emission reductions to improve or maintain air quality would tend to decrease thresholds.

RELATIONSHIP TO THE OTC MODEL RULE FOR ADDITIONAL NOx CONTROL MEASURES

This paper delineates an exemption from permits for diesel engines less than 37 kW, while the March 6, 2001, OTC Model Rule for Additional NOx Control Measures (Model Rule) proposes NOx emission rate limits for stationary reciprocating engines 200 HP or

[1] Non-road diesel engines smaller than about 37 kW (50 HP) are regulated by the U.S. Environmental Protection Agency's Compression-Ignition Engine Emission Regulations.

larger. This leaves a question of how to handle stationary internal combustion engines greater than 50 HP.

Proposed solutions include:

- Require a permit for any existing, modified, or new stationary reciprocating engine with a maximum output equal to or greater than 50 HP located at a major stationary source of NOx emissions. States may use general permits or permits-by-rule to ease the potential implementation burden;

- Require existing stationary reciprocating engines (located at a major stationary source) of NOx emissions to meet the NOx emission limits specified in the Model Rule for each engine size (i.e., 200 HP to 2000 HP) and each engine type (i.e., spark-ignited rich burn engine);

- Require existing stationary reciprocating engines used as emergency generators or load shaving units, as defined in the Model Rule, to meet the emission limit requirements of the Model Rule;

- Require that any existing group of 50 HP stationary internal combustion engines located at a major stationary source of NOx emissions where the total power output from the group of engines is 200 HP or greater to meet the emission limits specified in the Model Rule for the 200 to 2000 HP engines and each engine type;

- Require any new or modified stationary reciprocating engine 200 HP or greater located at a major stationary source of NOx emissions to meet a NOx emission limit of 0.7 grams per brake horsepower hour (bhp-hr);

- Require any new or modified group of 50 HP stationary reciprocating engines located at a major stationary source where the total power output from the group of engines is 200 HP or greater to meet a NOx emission limit of 0.7 grams per bhp-hr.

IMPLEMENTATION AND INTERSTATE COORDINATION

This draft air permitting approach would result in regionally consistent requirements for distributed generation technologies. To ensure the growth of low emitting distributed generation, States should take the following actions:

- States should evaluate their policies and procedures and possibly amend their regulations to ensure:

    - Lower emitting technologies can be successful in the small power market;
    - There is not an increase in emissions due to proliferation of higher emitting technologies.

- In order to reduce the impact of the anticipated influx of permit applications from distributed generation emission sources, States may use a "verification program" approach for general permits or permits-by-rule.

    - If the verification approach is taken, consistent emission verification programs and standards should be developed and implemented within the Region to the extent possible.

- In general, State air officials should actively collaborate with their State utility commissions and energy offices to explore cross agency issues, such as:

    - The distribution of funds from System Benefit Charges for clean or renewable distributed generation technologies;
    - Net metering;
    - Incentives that promote the installation of clean or renewable distributed generation equipment.

- States could encourage research in emission control technologies for clean or renewable distributed generation technologies.

- States could consider incentives to encourage combined heat and power configurations where distributed generation technologies are sited.