Buckeye Power Sales
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The digital data-drive world we now live in has made a society that has to be interconnected 24/7 and significantly increased our reliance on electrical power. As this reliance has increased, power consumers' tolerance for power interruptions has decreased. However, the macro utility grid that supplies most of the power within the US has not developed as fast as the technology driving the increased power demand. In North America, there is a large installed megawatt base of engine-driven generator backup power systems in a multitude of applications that usually stand idle. Utility companies are seeing this installed power base as an additional power source when the macrogrid cannot meet peak demand. This information sheet discusses how standby power systems can be a source of power for the macrogrid, the pros and cons, types of regulation, and emission criteria when using engine-driven systems rated for standby power applications.

1.0 STATE OF THE CURRENT US ELECTRICAL GRID:

The US electrical grid, which in many areas is connected between States (but not Texas), is a network of millions of miles of transmission and distribution lines. This network strategically connects many large power stations nationwide to bring power, where needed, to most parts of the nation. However, up to 70% of the lines are over 25 years old and need repair and upgrade. The American Society of Civil Engineers gave America's power grid a rating of D+. The US need to invest considerably in upgrading transmission upgrades to meet the accelerating demand for electricity and alternative renewable energy inputs.

Emission Regulations Covering Generators When Paralleling with the Grid

Figure 1

Title 40, Part 63, Subpart ZZZZ (63.6580) of the Code of Federal Regulations (CFR) covers the National Emission Standards for Hazardous Air Pollutants (NESHAP) for Reciprocating Internal Combustion Engines (RICE).

Entities with 100 horsepower (HP) or larger engines that operate or commit to operating for more than 15 hours and up to 100 hours per year as part of blackout and brownout prevention will need to collect and submit an annual report, including location, dates, and operation times.

- Reporting requirements ensure compliance with the regulations and provide information about the air pollution impacts of the engines.

A combined total of 100 hours per year may be used to prevent blackouts and brownouts without meeting emission limits for the following purposes.

- Maintenance and testing.
- Emergency demand response for Energy Emergency Alert Level 2 situations.
- Responding to situations when there is at least 5 percent or more change in voltage.
- Operating for up to 50 hours to head off potential voltage collapse, or line overloads, that could result in local or regional power disruption.

The rules restate that in an emergency, such as a hurricane or ice storm, any emergency engine of any size can operate without meeting federal control requirements for emission limits.

Emergency engines that commit to running less than 15 hours a year as part of blackout and brownout prevention can operate without meeting federal control requirements or emission limits.

Figure 2

2023 Emission Levels Stationary Non-Emergency Engines		
Engine Generator		g/kW-hr
kWm	kWe	CO/NMHC/NOx/PM
8<19	10-15	6.6/7.5*/0.40
19<56	15-40	5.5/4.7*/0.03
56<130	80-100	5.0/0.19/0.40/0.02
130<560	125-450	3.5/0.19/0.40/0.02
560<900	500-800	
>900	900-2000	3.5/0.19/0.67/0.03
>2200	>2000	

Tier 2
Tier 3
Tier 4
* NMHC+NOx

Figure 3

2023 Emission Levels Stationary Emergency Engines		
Engine Generator		g/kW-hr
kWm	kWe	CO/NMHC+NOx/PM
8<37	10-20	6.6/7.5/0.40
37<75	20-60	5.0/4.7/0.40
75<130	80-100	5.0/4.0/0.30
130<560	125-450	3.5/4.0/0.20
560<900	500-800	
>900	900-2000	3.5/6.4/0.20
>2200	>2000	

Tier 2
Tier 3
Tier 4

2.0 EXAMPLES OF ELECTRIC UTILITIES USING STANDBY GENERATOR POWER:

Using an engine-driven generator to take over power from the utility company is not new. As covered below, Peak Shave installations enabling customers to generate their own power during peak power demand periods have been used for decades. However, Peak Shaving is usually for the benefit of the utility customer, not necessarily the utility. This paper covers applications when the utility company has one of their customers start up their standby generator to feed the generator power produced into the Macrogrid.

Examples of utility using other sources of power:

2.1 PARALLELING STANDBY GENERATOR SYSTEMS WITH GRID:

The installed base of standby generator systems in the US can be measured in gigawatts and, most of the time sits idle. In some areas of the US, particularly on the West and East Coast, where the high technology sector has greatly increased electrical demand, electrical utilities ask their customers to parallel their standby generator systems with the grid during peak demand periods.

2.2 CUSTOMERS SWITCHING FROM THE GRID TO THEIR STANDBY POWER SYSTEMS:

Alternatively, instead of paralleling with the grid, when grid demand is very high, utilities can ask their customers to switch from the grid to their standby generator systems and ensure enough power for other customers.

2.3 MACROGRID CONNECTING TO MICROGRIDS:

Across the nation, originally in remote areas but now also renewable energy microgrid sites, are separate microgrids operating in island mode separate from the Macrogrid. Utility companies have arranged for microgrids to feed into the macrogrid when demand exceeds supply.

3.0 PEAK SHAVING:

Some utility consumers have a much lower base level of power requirement but may have a process/machine that requires a power level many times the base level. To avoid the cost of provisioning, for example, 200kW, when the base load is 30kW, the customer generates their own power for the peak period their process requires power. Usually, the additional load is powered through a separate circuit, and it is not necessary to parallel with the grid.

4.0 MECHANISM TO FEED THE GRID:

The grid supplies AC power; as such, any power fed into the grid has to be synced to the AC sine wave of the grid to avoid any short-circuiting or back feed that could damage the generator. Most consumer solar systems are grid-tied, feeding through an inverter that is synced to the grid voltages (see information sheet When Solar Arrays Require Standby Power). An AC generator system to be connected to the grid has to feed power through paralleling switchgear. Typical types of Grid connection.

4.1 UTILITY CONTROLS THE CUSTOMER'S GENERATORS:

Some utilities offer to supply the on-site paralleling switchgear at the electrical company's cost. PGE in Oregon has a Dispatchable Standby Generator (DSG) program. In exchange for lending their standby generators to PGE for up to 200 hours per year, PGE pays for enhanced generator controls, power quality monitoring systems, and upgrades from automatic transfer switches to new paralleling electrically operated draw-out breakers. The customer is not paid for the electricity produced, but the utility covers all the standby generator's annual testing and maintenance costs.

In this arrangement, the utility can control the starting and stopping of the generators remotely as and when required.

4.2 CUSTOMER PARALLEL GENERATORS WHEN ASKED TO:

The same controls and safety features are applied as described above. However, in this case, the customer still retains the generator maintenance and testing cost. But the power output fed into the grid reverses the direction of the electrical meter, and the utility pays for the power fed into the grid.

In either of the above cases, customers can make their generators unavailable by notifying the utility or switching their control system out of remote mode, especially when the grid goes offline.

5.0 EXHAUST EMISSION CONSIDERATIONS:

The Environmental Protection Agency (EPA) has set certain exhaust emission levels for Reciprocating Internal Combustion Engines (RICE), i.e. spark and compression ignition (diesel) engines used to power generator systems are split into two levels.

- Engines used for Prime continuous power
- Engines used for Standby power, see ***Figure 1***.

5.1 TIER 4 FINAL FOR PRIME POWER:

Generator sets that run continuously, non-emergency power and with no hours limitation have to perform to the most rigid emissions, that is TIER 4 final; see ***Figure 2***. Generators of this type can be paralleled to the grid with no limitations, provided they meet Title 40, Part 63, Subpart ZZZZ (63.6580) of the Code of Federal Regulations (CFR) covers the National Emission Standards for Hazardous Air Pollutants (NESHAP) and any local regulations such as CARB.

5.2 TIER 1, 2 AND 3 FOR STATIONARY EMERGENCY ENGINES:

Stationary generator sets rated for emergency standby that are paralleled with the grid are subject to less stringent emission regulations but are restricted in the number of hours they can run, see ***Figure 3***. While under an emergency, such as a hurricane or ice storm, they can operate without meeting federal control requirements or emission limits; usually when paralleling with the grid they would be limited to the hours run per year.

To fulfill our commitment to be the leading supplier in the power generation industry, the Buckeye Power Sales team ensures they are always up-to-date with the current power industry standards as well as industry trends. As a service, our Information Sheets are circulated on a regular basis to existing and potential power customers to maintain their awareness of changes and developments in standards, codes and technology within the power industry.