Diesel EPA Tier 4 Final Certified vs. Compliant Emissions

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INTRODUCTION

Stationary nonemergency generators operating in the U.S. require the use of diesel exhaust aftertreatment devices to reduce air pollutants to comply with U.S. EPA–mandated levels. Confusion often arises about how this can be accomplished, primarily because end users encounter stationary nonemergency generators infrequently. This white paper seeks to educate specifying engineers, contractors, and end users on the differences between compliant and certified aftertreatment systems for diesel generators operating in the U.S. and Canada.

TIER 4 EMISSIONS REGULATIONS

STATIONARY COMPRESSION IGNITION

Tier 4 emissions regulations for stationary combustion ignition (CI) engines were introduced in 2005 with the New Source Performance Standards (NSPS) for Reciprocating Internal Combustion Engines (RICE) and phased in completely by 2015. The ruling states all stationary nonemergency use diesel generators operating in the U.S. must be factory-certified to meet or exceed Tier 4 emissions levels, see Figure 1. As of 2020, Canada proposes to follow U.S. Environmental Protection Agency (EPA) Tier 4 in 2021. Diesel generators operating in emergency situations only are subject to less stringent emissions standards and are allowed limited runtime for nonemergency use.

DETERMINING EMERGENCY VS. NONEMERGENCY

When determining emergency versus nonemergency, be careful not to confuse the generator's duty rating, e.g., standby, prime, continuous, with the use type. While the two are often tied together, the EPA does not recognize or consider the generator rating when evaluating emissions. The use type, run hours, and location of the generator are used to determine the required emissions performance of the unit.

EXHAUST AFTERTREATMENT FOR TIER 4

Meeting Tier 4 emissions levels requires exhaust aftertreatment devices on most diesel engines, especially with an output exceeding 560 kWm.

Figure 1

<table>
<tr><th colspan="12">U.S. EPA NSPS Stationary Nonemergency Diesel</th></tr>
<tr><th colspan="12">Engine generator</th></tr>
<tr><th>kWm</th><th>kWe</th><th>2007</th><th>2008</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th></tr>
<tr><td>8– <19</td><td>10–15</td><td></td><td colspan="9">6.6/7.5/0.40</td></tr>
<tr><td>19– <37</td><td>15–20</td><td></td><td colspan="5">5.5/7.5/0.30</td><td colspan="4">5.5/4.7/0.03</td></tr>
<tr><td>37– <56</td><td>20–40</td><td></td><td colspan="5">5.0/4.7/0.30</td><td colspan="4">5.0/4.7/0.03</td></tr>
<tr><td>56– <75</td><td>40–60</td><td></td><td colspan="4">5.0/4.7/0.40</td><td colspan="3">5.0/2.3/0.02</td><td colspan="2">5.0/0.19/0.40/0.02</td></tr>
<tr><td>75– <130</td><td>80–100</td><td colspan="5">5.0/4.0/0.30</td><td colspan="3">5.0/2.3/0.02</td><td colspan="2">5.0/0.19/0.40/0.02</td></tr>
<tr><td>130– <560</td><td>125–450</td><td colspan="4">3.5/4.0/0.20</td><td colspan="4">3.5/2.0/0.02</td><td colspan="2">3.5/0.19/0.40/0.02</td></tr>
<tr><td>560– <900</td><td>500–800</td><td colspan="4">3.5/6.4/0.20</td><td colspan="4">3.5/0.40/0.67/0.10</td><td colspan="2">3.5/0.19/0.67/0.03</td></tr>
<tr><td>>900</td><td>900–2000</td><td colspan="4">3.5/6.4/0.20</td><td colspan="4">3.5/0.40/0.67/0.10</td><td colspan="2">3.5/0.19/0.67/0.03</td></tr>
<tr><td>>2500</td><td>>=2200</td><td colspan="4">11.4/1.3/9.2/0.54</td><td colspan="4">3.5/0.40/0.67/0.10</td><td colspan="2">3.5/0.19/0.67/0.03</td></tr>
</table>

CO/NMHC+NOx/PM (g/kW–hr)
CO/NMHC/NOx/PM (g/kW–hr)

TIER 1 EFFECTIVE
TIER 2 EFFECTIVE
TIER 3 EFFECTIVE
TIER 4 INTERIM EFFECTIVE
TIER 4 EFFECTIVE

U.S. EPA CI ENGINE EMISSIONS

TERMINOLOGY AND DEFINITIONS

Application determines the use of a factory-certified Tier 4 generator versus an emissions-compliant generator that uses third-party equipment to meet a given emission level. See *Figure 2*. They serve different needs in the marketplace. One is not better than the other—rather, there is a better choice between the two, depending on the customer need.

A Tier 4 factory-certified generator, including EPA emissions labels, is required for any nonemergency use. A compliant solution is preferred when meeting local air regulations or if a user wishes to have a "green" solution for their emergency-use generator.

Figure 2

U.S. EPA Emissions Terminology & Definitions		
Compliance Level	Certified	Testing completed at engine manufacturer and certified by the U.S. EPA. Diesel engines must be EPA-certified to ship within the U.S.
	Compliant	EPA-certified stationary emergency engine with third-party aftertreatment equipment to lower emissions
Use Type	Emergency	Operation is limited to emergency situations including testing and maintenance up to 100 hours
	Nonemergency	Any intended operation outside of an emergency or preparedness for it
Location	Stationary	Remains in one location for >12 months
	Mobile	Generator is portable or transferable
Note:	Emissions standards apply differently to mobile, stationary emergency, and stationary nonemergency diesel generators.	

TIER 4 FINAL CERTIFICATION BY USAGE

NONEMERGENCY DIESEL GENERATOR APPLICATIONS

Stationary nonemergency diesel generators in the U.S. and Canada serve as either a primary source of power or as supplementary capacity to the power utility. See *Figure 3*.

Utilizing a generator as a primary source of power is common in remote locations, such as an oil field, island, or mountainous region, where grid power is not available. In addition, generating power to be sold, often incentivized by a utility company, is considered use as a primary source of power. Providing supplementary capacity for electric grid is a more common use of diesel generator in North America.

Figure 3

Nonemergency Diesel Generator Applications	
Primary Source of Power	Generating power to be sold
	Off-grid use
Supplementary Capacity for Power Utility	Curtailment/ Interruptible Rate Program
	Peak shaving

The benefit of these programs is that they use an on-site asset, a standby generator, to reduce the overall electrical bill for the facility. Therefore, generators utilized in these programs are often the backup for the facility as well, often providing critical life-safety power during an emergency event. These generators must meet nonemergency emission requirements.

The two methods are curtailment/interruptible rate programs and peak shaving. Both give the end user a financial benefit, but how the benefit is realized differs.

CURTAILMENT/INTERRUPTIBLE RATE PROGRAMS

Arranged between the local utility and the end customer, the financial benefit of curtailment/interruptible rate programs to the end user is a decreased energy rate by allowing the utility to drop their facility from grid power when the local utility is nearing the total capacity. The utility provider benefits by not needing to purchase supplementary power from neighboring utility companies to meet demand. It can be used as an interim solution to meet maximum utility grid demands without investing in additional capacity. Utility companies often target large consumers of power: water utilities, hospitals, factories, public buildings, etc.

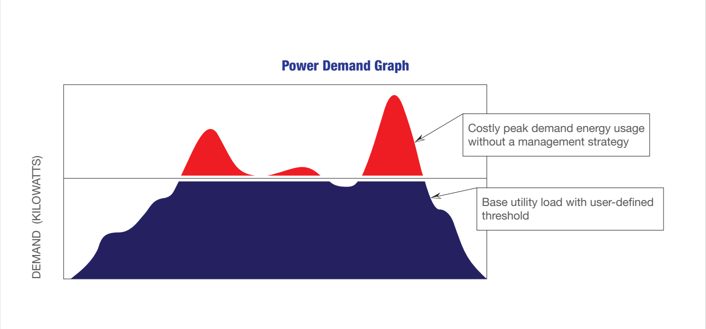
Program availability and conditions are dependent on the local power utility and needs to be discussed on a case-by-case basis to determine feasibility.

PEAK SHAVING

Commercial facilities typically pay for electrical usage as follows:

Power Consumption (kWh)
+
Demand Charge
(Peak kW observed)
= Total Bill

Figure 4



DEFINITION OF DEMAND CHARGE

The demand charge is a measure of the highest (peak) power consumption in the given billing period, usually measured in a 15-minute window.

The demand charge allows the utility company to share the burden for the infrastructure required to meet the peak requirements. While the peak demand is only realized over a short window, it can become a large portion of the total bill.

The financial benefit to the customer comes from utilizing on-site power generation to supplement the utility power during the limited peaks.

The financial return from a peak-shaving diesel generator will depend on the utility rate structure, frequency, and magnitude of peak events, as well as initial purchase price and maintenance cost of the Tier 4-certified equipment. Figure 4 depicts a power demand curve.

COMPLIANT EMISSIONS SOLUTIONS

LOCAL EMISSIONS REGULATIONS

Situations requiring compliant emissions solutions can be categorized as local emissions regulations, Title V limits, or green initiatives.

Local regulations are requirements imposed by a state or local agency that are beyond EPA guidelines. To clarify, the EPA sets federal/national limits for emissions standards of all engines. Generator set engines can only run in the U.S. based on their certification level. However, the EPA does not prohibit local agencies from mandating emissions standards beyond EPA regulation. In the case of a stationary emergency generator, it leads to using third-party aftertreatment equipment to lower specific criteria pollutants. Title V was introduced as part of the Clean Air Act. It requires sites emitting large amounts of pollution to gain permits, adhere to a testing schedule, and pay fees. Avoiding these limits is often sought by customers with a large installed base on a single site, such as a data center. Green initiatives are often driven by customer desire to reduce their carbon footprint.

LOCAL REGULATIONS

NONATTAINMENT AREAS

Local regulations generally occur around a nonattainment area. The EPA designates a nonattainment area as an area having air quality worse than the National Ambient Air Quality Standards (NAAQS) defined by the Clean Air Act (CAA). NAAQS sets limits on six criteria for air pollutants emitted by diesel engines. Particulate matter (PM), carbon monoxide (CO), and nitrogen oxide (NOx) are the pollutants we will focus on in this paper.

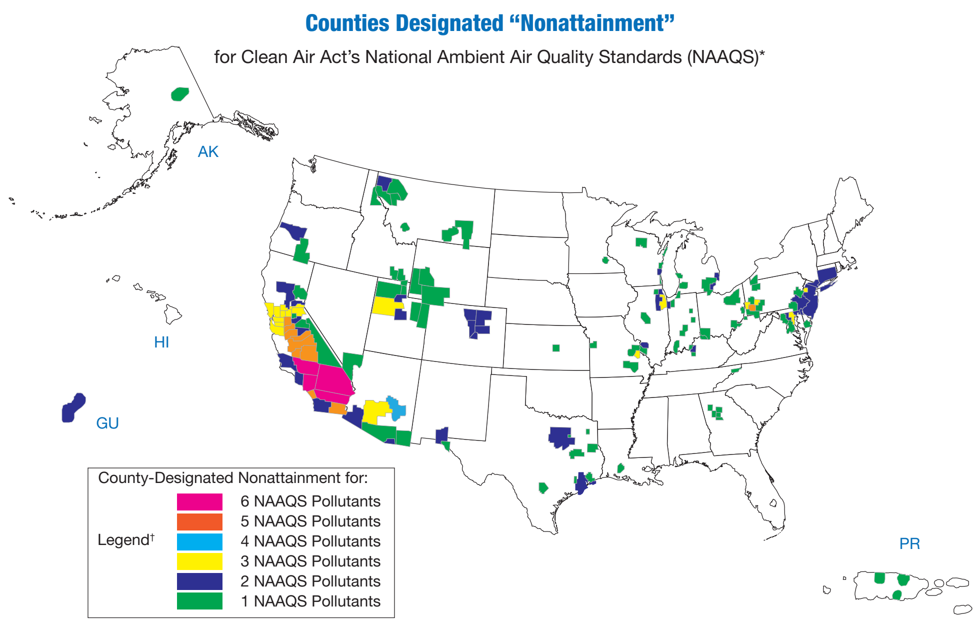
Figure 5 shows counties that are considered nonattainment areas for one or more air pollutant. It is important to understand which air pollutants are of concern for a given area and the corresponding designation.

Often local agencies have been established to monitor and permit equipment being used in these areas. For instance, the South Coast Air Quality Management District (SCAQMD) manages local regulations for the Los Angeles area. The area is affected by many air pollutants, however PM is often the most crucial for a diesel generator being installed in the region. Often adding a diesel particulate filter to be added to a unit will be required to reduce the PM levels below the local limits set by the SCAQMD.

Another example is the Northern Virginia and Washington, D.C., area that is in a nonattainment area. Operating limits for generators are managed in Northern Virginia by the Virginia Department of Environmental Quality (VDEQ). Generators operating in this region are held to strict not-to-exceed limits for ozone levels. A precursor to ozone is NOx, which is the engine air pollutant managed.

Using a selective catalytic reduction (SCR) system or special low-NOx engine calibration will allow for use of stationary emergency generators in these areas.

Figure 5



* The National Ambient Air Quality Standards (NAAQS) are health standards for carbon monoxide. lead (1976 and 2008), nitrogen dioxide, eight-hour ozone (2008), particulate matter (PM-10 and PM-2.5 (1997, 2006 and 2012), and Sulfur Dioxide (1971 and 2010)

†Included in the counts are counties designated for NAAQS are revised NAAQS pollutants. Revoked one-hour (1979) and eight-hour ozone (1997) are excluded. Partial counties, those with part of the county designated nonattainment and part attainment, are shown as full counties on the map.

Image source: epa.gov/airquality/greenbook/mapnpoll.html

TITLE V

EXCEEDING 100-TON-PER-YEAR LIMIT

Sites with multiple large standby generators, such as a data center, can realize emissions output from the generators that exceed major source thresholds requiring Title V permitting.

The permitting process, testing schedule, and fees are often undesirable, but customers can look at adding aftertreatment devices to lower specific pollutant levels to avoid the requirement. Generally, NOx is the pollutant to first hit the threshold, as emergency generator emissions are dominated by NOx levels. Therefore, using a third-party SCR system can reduce NOx pollutants and ensure the levels are not met.

GREEN INITIATIVE

DEMAND RESPONSE

Certain end users will wish to reduce the emissions levels on a stationary emergency generator. Common reasons include reducing the emissions footprint to enable LEED certification or to comply with a corporate initiative.

A Tier 4-certified generator will meet the customer demands, however using a third-party system is often a better choice. Tier 4 certification requires inducement of the engine if the aftertreatment system has any failure. This means the generator must be shut down if the aftertreatment is unable to work, rendering the generator useless during an emergency event.

An example of a situation that could lead to inducement might be a clogged diesel particulate filter. Compliant systems for stationary emergency generators are not subject to this inducement by the EPA and, therefore, make them better suited for meeting a customer's green initiative. Helping a customer weigh the costs and benefits between a Tier 4-certified or -compliant system versus a nonemergency regulation is an important task for a specifying engineer. End users aren't always aware of the significant price increase related to the aftertreatment equipment. Ensuring they understand early in the process can avoid much rework later in the design process.

SUMMARY

Tier 4 certified versus compliant emissions solutions are not a matter of better or worse; rather it is about selecting the right solution for the application. Understanding use type, local regulations, and customer requirements is an important step to ensure the correct generator and, if needed, aftertreatment device, is selected. While it remains the responsibility of the specifying engineer to understand these requirements, your local Rehlko–authorized distributor is ready and willing to help with questions and provide explanations.

ABOUT THE AUTHOR

Justin Loritz joined Rehlko in 2007 and has held various roles within the organization. After graduating from Michigan Technological University with a B.S. in mechanical engineering, he began his career supporting the large diesel assembly team as a process engineer and progressed through a variety of roles, including lead design engineer for the diesel marine product line, production manager for large generator assembly, and principal engineer of manufacturing systems. Justin has extensive knowledge of the Rehlko KD Series™ products and the needs of customers within this product category.

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Power Systems, Rehlko's largest division, delivers worldwide energy solutions designed to ensure resilience for mission-critical applications of all sizes. Building on more than a century of expertise and dedication, the company offers complete power systems, including industrial backup generators (HVO, diesel, gaseous), enclosures, hydrogen fuel cells systems, automatic transfer switches, switchgear, monitoring controls, genuine parts and end-to-end services. As a global company with service partners in every country, Power Systems provides reliable, cutting-edge technology to keep industries and businesses running. www.powersystems.rehlko.com

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