The Effects of Ultra Low Sulfur Diesel On Generator Set Engines In Data Center Emergency System Applications

Effects on the environment are a consideration for all industries, and companies running data centers are no exception. To help data centers meet current and projected environmental regulations, manufacturers of generator sets must meet stringent design and testing requirements to reduce the effects of fossil fuel emissions from their engines. One step in this process is a federal mandate from the U.S. government to use Ultra Low Sulfur Diesel fuel (ULSD).

Overall, Ultra Low Sulfur Diesel is less harmful to the environment, but it can be quite harmful if used in older diesel engines, where the negative effects can include fuel system leaks, clogged fuel injection systems, and incompatibility with lubrication oil. Most significantly, Ultra Low Sulfur Diesel contains less energy content, so generators running ULSD may be less capable of adapting to rapid load changes.

Specifically, some diesel generator sets may have previously been loaded below their rating, but now are loaded to full (or nearly full) nameplate rating for testing purposes (because additional load is being carried by the generator set). In these cases, the generator sets may not perform as expected. For example, if an older 1,000kW generator set was previously loaded to 650 kW (and was operated and tested to this value with success), it may not meet the specified rating or the transient loading performance requirement when load is added or when testing is performed to the nameplate rating of 1,000kW.

CONCERNS ABOUT USING ULTRA LOW SULFUR DIESEL

Use of Ultra Low Sulfur Diesel does not necessarily mean that your emergency generator set will not perform according to your needs. There are some considerations, however, that should be taken into account.

Reduced Energy Content

The refinement process for Ultra Low Sulfur Diesel reduces the energy content of the fuel (typically expressed as BTU/gallon) by 1.2% or more. This lower energy content can have the following effects on your generator set’s engine:

- The generator set may be less capable of accepting block load, or sudden transient changes in load.
In some cases, the generator set may be rendered inoperable if it operates at or near rated nameplate capacity. The generator set may be unable to start, come up to speed, and stabilize at rated frequency and voltage within the required time. Because the fuel contains less energy, more fuel is needed to provide the same electrical output. For example, if a fuel storage system is rated for a run time of 24 hours at full load, the system may have inadequate fuel capacity when using ULSD.

**Fuel System Leaks**
A possible effect of the new refining process for Ultra Low Sulfur Diesel can contribute to fuel system leaks. These typically occur at seal points where o-rings are used to seal fuel lines near fuel pumps and injectors. Seals that are designed for long service and higher temperatures, such as nitrile rubber seals, seem to be the most susceptible to leaks when using ULSD.

**Lubricating Oil Incompatibility**
Typically, engine lubricants include additives that are designed to prevent internal engine components from corroding. A reduction in fuel sulfur may result in more un-reacted additives in the oil, which can cause additional deposits to form on engine components when some of the oil is burned. These deposits can build up behind piston rings, causing accelerated cylinder wear in the engine.

Here are some additional considerations that should be taken into account when using Ultra Low Sulfur Diesel in your generator set’s engine:

- Increased microbial growth in the main fuel storage tank will contaminate the fuel supply, so special care should be taken to monitor the condition of the fuel.
- Engine components made of copper and zinc are not compatible with Ultra Low Sulfur Diesel, so using ULSD in these engines can result in the accelerated formation of sediments, gels, and soaps. Therefore, oil sampling intervals should be shortened.
- Changing to ULSD requires that the storage tanks be marked accordingly, and fuel suppliers should be made aware of the change.
- Replacing older, high-sulfur diesel in the main storage tank may loosen sediments in the tank, so be sure to test the tank when replacing fuels.
- ULSD has a lower conductivity than high sulfur diesel, so care should be taken to avoid the possibility of a static discharge.
RECOMMENDATIONS

Here are two key recommendations for making the transition to Ultra Low Sulfur Diesel in your generator set engines:

**Proper Monitoring**
Monitor for fuel system leaks and fuel filter plugging during the changeover to ULSD, and establish a program to check regularly for these problems.

**Loading the Generator Set (Electrically)**
After the transition to ULSD, test the system fully to determine how it accepts block load (moving from no load to full load and transient loading). This can be done using a portable load bank that is rated for the full rated capacity on the nameplate of the generator set. Since the greatest concern is transient loading, review the load test to see how the generator set responds to transient loading. If the generator set shows deficiencies during the test, step the loads onto the generator set in a different order, remove some non-critical loads from the emergency system, or upsize the generator set.

The Service Department at Stowers Machinery Corporation can provide support for your generator sets during the transition to Ultra Low Sulfur Diesel. Stowers has the load bank testing capability to fully test your system in order to determine what steps should be taken to ensure that your generator sets are operating according to their specifications. After an initial test, we can also make recommendations for the maintenance of your emergency power system.

This material was adapted from the article “How Low Sulfur Diesel Mandate Impacts Data Center Generators” that first appeared in the Spring 2008 issue of *Disaster Recovery Journal*. 