Problem Identification and Resolution Plan for:

Subject:

Clear Channel FEMA Backup Generator

Prepared by:

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Background:

A review of the Clear Channel FEMA Backup generator (fig. 1) and fuel supply tank (fig. 2) in question yielded a substantial amount of visible contamination. This contamination is evident even though this generator incorporates an “on tank” fuel polishing system (fig. 3, 4) intended to keep the fuel in the supply tank free of contamination. We know that visible contamination is the manifestation of a much larger problem, particularly in areas that are not visible. We also know that the rather expensive process of using “on tank” fuel polishing is not alleviating the contamination issue.

B3C Fuel Solutions was tasked to assess the contamination, perform further testing, and recommend a plan of action to alleviate the contamination issues for this, and other, Clear Channel generators. This Resolution Plan will assess the contamination and its causes, including our explanation of why it is occurring. More importantly, we will offer a tangible and proactive plan of action that will not only resolve these issues, but keep them from occurring again. Additionally, our Resolution Plan is neither complicated or expensive.

fig.1

fig.2

fig.3

fig.4

Problem Identification:

Visible Fuel Contamination:

Fuel extracted from the generator and fuel supply tank (fig. 5) demonstrated excessive rust, biofilms, sludge and fungal / microbial growth. This contamination has settled to the bottom of the test fuel container and is present throughout the fuel. This small container provides an excellent representation of the larger fuel tanks which most likely contain similar or even worse contamination.

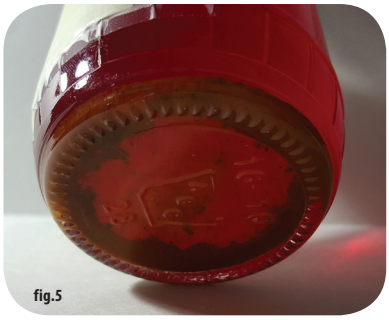
fig.5

Visible Valve Contamination:

Contamination is also clearly present in the generator check valves (fig. 6, 7). The same forms of contamination visible in the fuel is also visible in the valve (e.g. rust, biofilms, sludge and fungal / microbial growth). Contamination present in the tank and fuel supply (fig. 5), means contamination is present throughout the entire generator fuel system. As such, the contamination has to be eliminated at the fuel source, then prevented from happening again.

fig.6

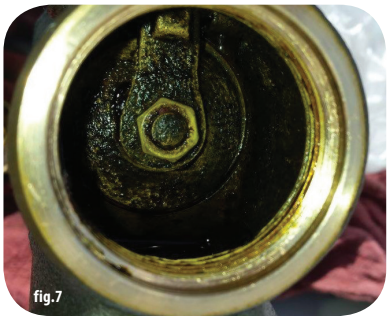
fig.7

Fuel Testing:

ISO Certified Lab Results:

In order to validate the visual analysis, we performed a Third Party lab test of the sample fuel through WearCheck. The results support the visual review. WearCheck recommends “a filter service, and use of off-line filtration to improve the cleanliness of the system fluid”. As indicated in the report, the following are noted:

* The fuel is classified as “contaminated” and contains a “high degree of visible dirt / debris”.
* Rust is abundant as indicated by the abnormal iron level (26 parts per million).
* Water contamination is an issue as indicated by the abnormal amount of iron / rust and particulate contamination (microbial contamination is visible; microbial culture results are pending incubation). Additionally, diesel fuel and biodiesel inherently contain water (this fuel is 3.7% biodiesel).

MOB I WEAR CHECK
MOBILE OIL ANALYSIS REPORT

CONTAMINATION	ABNORMAL
WEAR	ABNORMAL
OIL CONDITION	NORMAL

CLEAR CHANNEL - Diesel Fuel

Unit Make	: {n/a}				
Unit Model	: {n/a}	Serial No	: {n/a}	Date Rec'd	: Oct 6, 2015
Comp Make	: {n/a}	Cust. Ref No.	: {n/a}	Sample Date	: Oct 5, 2015
Comp Model	: {n/a}	Stub No.	: WC-03837341	Diagnostician	: Doug Bogart

RECOMMENDATION

We advise that you perform a filter service, and use off-line filtration to improve the cleanliness of the system fluid. Mibrobial culture results pending incubation.

Sample Date	Current	UOM
Time on Unit	0	mls
Time on Oil	0	mls
Time on Fltr	0	mls
Oil Maint.	n/a	---
Filter Maint.	n/a	---

CONTAMINATION

High concentration of visible dirt/debris present in the fuel. The water content is negligible.

Sample Date	Current	Abn
Silicon	0.7	10
Potassium	2.4	20
Sodium	0.5	80
Fuel (%)	3.7	<2.0
Glycol	---	0.06
Water (%)	0.007	0.05
Soot (%)	---	---
Sulfation (%)	---	100
Nitration (%)	---	100

OIL CONDITION

3.7% Biodiesel.

Sample Date	Current	Base
Boron	0.0	---
Barium	0.0	---
Calcium	0.0	---
Magnesium	0.0	---
Molybdenum	0.0	---
Sodium	0.5	---
Phosphorus	0.0	---
Sulfur	10	---
Zinc	0.0	---
Visc 40°C (cSt)	2.7	---
Visc 100°C (cSt)	---	---
VI	---	---
Oxidation (%)	---	---
AN (mg/KOH/g)	---	---
BN (mg/KOH/g)	---	---

WEAR

The iron level is abnormal.

Sample Date	Current	Abn
*White Metal	NONE	---
*Babbitt	NONE	---
PQ	---	---
Iron	26	2
Nickel	0.0	2
Chromium	0.0	2
Titanium	0.0	2
Copper	0.1	2
Aluminum	0.3	2
Tin	0.0	2
Lead	0.0	2

ReportID:B3CCON-03837341 pg.1 of (©2015-WearCheck)

NOTE: all elemental values reported in parts per million (ppm).

Problem Assessment and Explanation:

Problems evident in your fuel system include fuel contamination, particularly water, and fuel aging. As indicated, visible review of the fuel and valves from the fuel system in question demonstrated excessive rust, biofilms, sludge and fungal / microbial growth. The ISO Certified Lab Results from WearCheck confirmed the visible assessment. We also know, based on extensive experience, the visible contamination is only the "tip of the iceberg". Visible contamination is the manifestation of a much larger problem with the entire fuel supply, starting with the fuel and including the fuel tank, supply lines, filtration system, and the ultimate piece of equipment (in this case, the Clear Channel FEMA Backup Generator). In your case, we know the "on tank" fuel polishing system is not alleviating the problems.

Today's diesel fuel (e.g. biodiesel and low sulfur diesel) contain many types of contaminants; all of them harmful to fuel or engine systems. We know that diesel fuel and biodiesel inherently contain water. In addition to being inherent in diesel and biodiesel, water is caused by such things as condensation from temperature fluctuations / high humidity, biodiesel blends, and low sulfur diesel. As an example, biofuels are hygroscopic, absorbing water from the atmosphere. Water will separate out of the fuel, sit on the bottom of a fuel tank, and provide a breeding ground for microbial growth (bacteria, mold, yeast) above and below the fuel line.

Biodiesel and ULSD (Ultra Low Sulfur Diesel) also have a solvent effect, releasing particles, which plug filters and fuel systems. Additionally, another issue that affects ULSD is the formation of wax crystals. A number of other detrimental contaminants exist, including rust, asphaltenes (solid particles in crude oil / diesel fuels that are not soluble in fuel), gums, and sludge. Biodiesel may even be mixed in with diesel fuel without disclosure. When combined, particularly over time as the fuel ages, these issues are compounded.

Recommendation (for any and all standby generators):

A healthy fuel system is free of water, particulate matter, and microbial contamination (i.e. good "fuel hygiene"). We can help you build a healthy fuel system by eliminating and preventing the fuel contamination we have seen. As indicated, our recommended plan of action is proactive, preventative, and achievable at relatively low cost:

1. *Eliminate Microbial Contamination:* We recommend a Diesel Fuel Biocide. We recommend 1 Gallon to 5,000 Gallons of diesel fuel. Note that once we implement our recommended action plan, biocide is not necessary because we will prevent these issues from reoccurring.

2. *Treat and Stabilize the Fuel with Diesel Mechanic In A Bottle All-In-One Additive (see Product Info Page):* Initially treat the fuel in the fuel tank with 500 ounces of DMIB (1 ounce per 10 gallons). DMIB fixes and protects the entire diesel fuel system from problems caused by diesel and biodiesel blended fuels. It removes water, stabilizes the fuel, keeps the fuel system clean above and below the fuel line (with Vapor Corrosion Inhibitors) and extends the life of pumps and other components. Continue treating the fuel at 1 ounce per 10 gallons.

3. *Install Heavy Duty Diesel Tank Snake with Extra Neodymium Magnets (see Product Info Page):* Keep a Diesel Tank Snake Water Absorber in your equipment or bulk tank at all times for continuous water removal and prevention of sludge, bacteria, algae. The extra strong neodymium magnets will pick up free floating rust and metal particles.

4. *Perform Ongoing Testing and Document Results:* Monitor your fuel systems and document the results in order to maintain proper fuel and fuel system quality. B3C Fuel Solutions welcomes the opportunity to work with you on developing an ongoing Fuel Quality Monitoring Program.

DIESEL Mechanic In A Bottle™

NEW STANDARD OF

Antioxidants & Anticorrosives

CONFORMING TO MILITARY GRADE SPECS!

Introducing NEW Diesel Mechanic In A Bottle

Engineered to the Highest Standard

Conforms to Military Specifications (Mil-Spec) for Antioxidants and Anticorrosives...This Level of Protection Has Never Been Available To The General Public Until Now

Fuel Stabilization (Antioxidant Package): Conforms to military specifications (Mil-T-5624P and ASTM D 1655). DMIB controls gum and peroxide formation in all diesel fuels, stopping the formation of oxidation and asphaltenes. This is the highest standard of protection for any diesel fuel in storage (i.e. generators).

Anticorrosive Package: This technology prevents corrosion in fuel tanks and storage tanks above and below the fuel with the only *Diesel Vapor Corrosive Inhibitor (VCI)* available. DMIB protects all metals as tested by ASTM D130 (received an A-1 rating) and by NACE (received an A rating).

Improved Fuel Efficiency: DMIB has additive components that contain a fuel catalyst that allows the diesel fuel to burn more efficiently, therefore reducing fuel consumption. The BTU's are also increased resulting in improved fuel efficiency and horsepower.

Smoke Opacity and Emission Reductions: Due to more efficient combustion, tests have indicated a significant reduction of exhaust smoke during acceleration and gear changing. As a result, particulate filters stay cleaner longer which means longer intervals between filter regeneration. In addition, EGR valves will have longer service life.

High Temperature Detergent: DMIB promotes better volumetric efficiency allowing for continuously clean spray patterns. This detergent guards against gum and varnish build up to free up "sticky" injectors. DMIB restores the fuel system back to the manufacturer's original specifications.

Pour-Point Depressant: Adding DMIB into No.2 Ultra Low Sulfur Diesel (ULSD) fuel effectively lowered the pour-point by -18°F (from the base pour-point).

Upper Cylinder Lubricity: The new ULSD blends reduce the amount of lubricity in the fuel. DMIB has an additive that restores lost lubrication, which significantly improves the condition of the cylinder liner, piston, and piston ring (as tested by ASTM D7688).

24/7 PROTECTION

Water Protection: DMIB disperses water molecules allowing them to pass harmlessly through the fuel system and burn during combustion. DMIB prevents the bound water in the diesel/bio-diesel blends from settling on the bottom of the tank. This prevents microbial growth as well as stops asphaltenes from forming sludge which plugs and damages most filters (as tested by ASTM E1064).

Cetane Improvement: DMIB increased cetane ratings by 2 points based on ASTM D976. This increase will assure better cold starting, reduced smoke opacity, faster warm-ups, and improve engine performance.

Protection From Biodiesel Blends: DMIB is 100% synthetic and will protect and revitalize seals and rubber components as well as protect the fuel system.

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DIESEL Mechanic In A Bottle™

NEW STANDARD OF

Antioxidants & Anticorrosives

CONFORMING TO MILITARY GRADE SPECS!

Third Party Lab Test Results

Oxidation Stability (Storage) (ASTM TEST D2274)

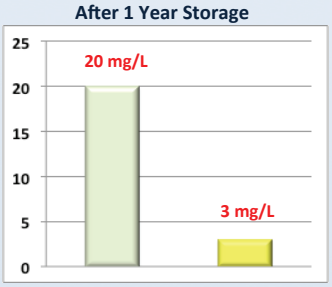
Expected life of diesel fuel is indicated by oxidation stability test ASTM D2274.

This test measures how much gum and sediment will be deposited after keeping the fuel at 95°C in the presence of oxygen for 16 hours *(corresponds to approx. 1 Year **Storage** at 25°C).*

A result of less than 20 mg/L of sediment and gum after the test is considered acceptable to normal diesel.

RESULT: Treating with DMIB resulted in 85% less gum and sediment after 1 year of storage.

Sediment and Gum Left After 1 Year Storage



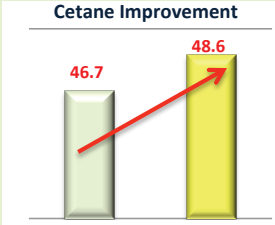
Cetane Number (ASTM TEST D976)

Cetane Number (CN) is a measurement of the combustion quality of diesel fuel during compression ignition.

The higher the CN, the more easily fuel will combust in a compression setting (such as a diesel engine). The characteristic diesel "knock" occurs when the first portion of fuel that has been injected into the cylinder suddenly ignites after an initial delay. Minimizing this delay results in less unburned fuel in the cylinder at the beginning and less intense knock. Therefore higher-cetane fuel usually causes an engine to run more smoothly and quietly.

RESULT: Cetane improved nearly 2 points by adding DMIB.

Cetane Improvement



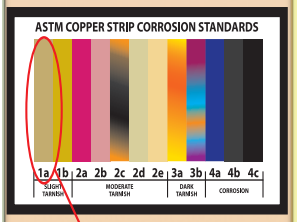
Corrosion Protection (ASTM TEST D130)

Evaluates the degree to which a lubricant will **corrode** copper-containing materials (i.e. bronze, brass)

- Rates oils by immersing a prepared copper strip in the lubricant at 2 temperatures in typical range of operation.
- Ratings range from "1a" with slight discoloration, but barely noticeable *(similar to a freshly polished strip)*, to "4c"or severely corroded, blackened and pitted.

RESULT: Diesel Mechanic In A Bottle received the highest rating of "1a".

ASTM Copper Strip Corrosion Standards



Diesel Mechanic In A Bottle received a "1a" rating in the ASTM D130 test.

Corrosion Rating (NACE Standards)

TEST for ferrous metals

Shows the rating from E (poor: 75 – 100% coated with rust) to A (excellent: 0% rust) of the ability to resist corrosion, per NACE standards.

NACE International is the world's leading professional organization for the corrosion control industry.

RESULT: DMIB has the highest rating for corrosion resistance, vastly improving fuel's corrosion resistance beyond those without DMIB.

Untreated Fuel vs Treated Fuel

Bottom Sample (where rust occurs)

Pour Point (ASTM TEST D6371)

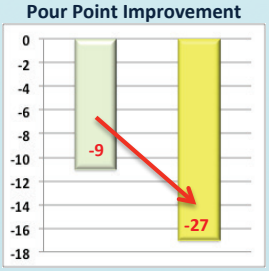
Diesel engine power loss during winter is often traced back to Paraffin crystal formation restricting flow through fuel filters.

Freezing temperatures can also cause emulsified water to form a fuel / ice slush.

Pour Point is the temperature at which the Paraffin in fuel crystallizes to the point where fuel gels and resists flow.

RESULT: Pour Point improved (reduced) by 18°F when DMIB was added to #2 Diesel.

Pour Point Improvement



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DIESEL 10X USE
TANK SNAKE
PATENT PENDING
Water Extractor

DIESEL TANK WATER ABSORBER

XD EXTREME DUTY

CONTINUOUSLY REMOVES WATER FROM DIESEL TANKS TO PREVENT FORMATION OF SLUDGE, BACTERIA AND FUNGUS

SUPERIOR ONGOING PROTECTION

B3C's breakthrough TANK SNAKE Water Extractor technology protects the entire diesel fuel system by continuously removing water, preventing algae, sludge buildup, bacteria, and fungus in diesel fuel. This technologically advanced device is designed to be placed into the fuel tank for the whole season making protection from bio-fuels easy.

PROTECTS FROM THE MOST DAMAGING CONTAMINANT - WATER

Water will separate out of the fuel, sit on the bottom of the tank and provide a breeding ground for microbial growth. These contaminates clog the fuel system and can cause acids to build up in the fuel leading to damaged components of the fuel tank. TANK SNAKE Water Extractor is placed in the tank bottom, where it can contact and absorb the free water without harming any fuel system components.

WHERE DOES WATER COME FROM?

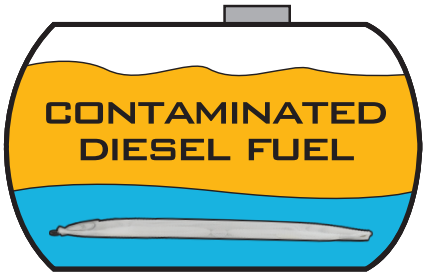
- Condensation through the fuel system vents
- External leaks in the tank
- Heating and cooling from temperature variations
- Attraction from bio-diesel

EASY TO USE

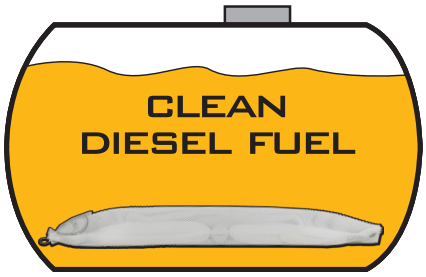
Simply place into level and stationary fuel tank. Make sure there is free and clear access to bottom of tank. For mobile applications, make sure device does not get tangled in tanks with baffles and sending units if used during operation. Requires tank opening of 2.5 inches or greater.

ENVIRONMENTALLY FRIENDLY

Always dispose of in accordance with federal, state and local laws.



Empty Water Absorber



Full Water Absorber

- 10X REUSABLE
- NEODYMIUM MAGNET PICKS UP METALLIC FLOATING PIECES LIKE RUST!
- CUSTOM SIZES
- EXTRA ABSORPTION CAPACITY
- STAINLESS STEEL TETHER FOR EASY INSTALL & RETRIEVAL

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