

Conversion of Diesel Generators To Dual Fuel (Diesel and Gas)



Dual Fuel Power Systems and is a pioneer in the field of conversion of diesel engines to run on a mixture of gas and diesel fuel. We are the ONLY company in the world offering an electronic dual fuel kit with a dedicated, modular, microprocessor based electronic controller incorporating continuously variable servo actuated gas flow valve as a standard fit. We also offer options of remote flow monitoring and control. Our kit is now acknowledged as the most efficient and cost effective on the market today.

As world oil prices continue to rise, and environmental issues continue to be a concern, converting your diesel engine to run on a dual fuel mixture with the gas of your choice (Natural Gas, LPG, Biogas, etc.) continues to be an operationally sound decision, enabling flexibility and better management of fuel supply, substantial financial benefits and reduced emissions. Not only does dual fuel operation provide economic benefits but it also enables earning carbon credits where available.

WHY GO DUAL FUEL?

DIESEL ENGINES ARE THE WORKHORSES OF INDUSTRY. LOW COST OF ACQUISITION AND MAINTENANCE MAKE THEM IDEALLY SUITED ALTHOUGH DIESEL FUEL IS A POLLUTANT AND CONSIDERED A 'DIRTY' FUEL.

CONVERTING DIESEL ENGINES TO OPERATE USING A MIXTURE OF DIESEL AND GAS INCREASES EFFICIENCIES WHILE SIMULTANEOUSLY REDUCING EMISSIONS AS WELL AS COST.



How much Diesel is substituted?

Targeted substitution of diesel fuel is 80% and, in practice, the highest ratio achieved has been 92:08. Actual rate of substitution is affected by a variety of factors such as condition of generator, ambient pressures and temperatures, load, engine speed, BMEP and fuel injection timing. Under light load, or in applications requiring excessive idle time, there will be a substitution rate penalty. On generators operating with a high cyclical loading, the ratio shall reduce whereas generators operating on a steady state load shall exhibit a much higher ratio of diesel replacement. For planning purposes however, it is recommended that all calculations be based on a conservative ratio of 70:30.

How can this help the environment?

Utilizing dual fuel technology, base diesel emission levels for NOx and particulates are reduced. The stack exhaust is made cleaner and there is visible reduction of smoke from the exhaust. Internally, the engine oil runs cleaner, the filters last longer and the oil change interval can be revised upwards.

Additionally, we can customize kits to burn nearly ANY type of gaseous fuel in your engine, even fuels with low BTU ratings, we can help you use biogas, digester gas or other specialized gas fuels.

Do you alter my engine completely?

It must be understood that the finished product is still a diesel cycle (compression ignition) engine. **There is no modification to the original diesel engine and our kit does not require changing the compression ratio. There is also no change required to the cooling and exhaust systems.**

The Dual Fuel Kit does not alter the diesel engine in any manner whatsoever and the generator can operate on full diesel fuel if required, even with the kit installed.

How about the economics?

In countries where piped gas is cheap compared to diesel fuel, the financial benefits of substituting diesel fuel with natural gas provide a very attractive option. When there is considerable cost difference between natural gas and diesel, it provides for a short payback period.

Gas engine generators cost considerably more than a diesel engine fitted with a dual fuel kit. Once again, the dual fuel generator enables greater operational freedom because, if, for some reason, the gas supply is affected, a dual fuel engine can still be operated on diesel fuel without loss of production.

January 2013

Afghanistan

CNG Diesel-DualFuel Conversion

In Support of Task Force for Business & Stability Operations

United States Department of Defense

Exclaim was selected as a vendor by TFBSO for a turnkey system which included providing equipment to transport large volume of Compressed Natural Gas to the generator site, a high output pressure reduction station, and a comprehensive Dual Fuel conversion system which included fuel flow monitoring and logging with capabilities of remote connections.



We were able to provide the complete solution in record time; provide a conversion team to work in a remote, complex, and challenging environment, and finish the job on budget and under a compressed schedule.

The generator site was able to replace up to 65% of their diesel fuel usage with an indigenous, cleaner resource: **Compressed Natural Gas**, and operate on approximately 40% NET fuel cost savings.

The mission of the TFBSO is economic stabilization in order to reduce violence, enhance stability, and restore economic normalcy. In Afghanistan, this project focused on building the country's energy infrastructure based on indigenous gas resources which had been neglected for nearly five decades.

We were able to showcase a sustainable model to leverage existing generation assets to provide stable and lower cost power to communities using the Exclaim DualFuel System.

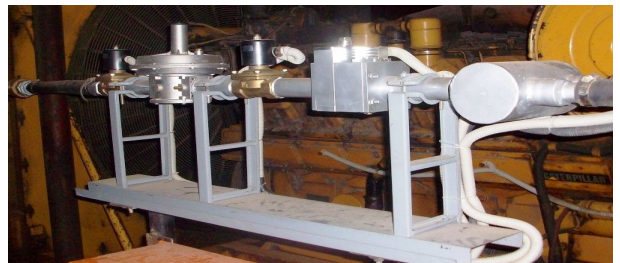
July 2011
8 Mega Watt Dual Fuel Conversion (6 x Caterpillar 3516)



Diesel Consumption = 1320 liters/hour (gross)

Dual Fuel – 60:40 Gas: Diesel (customer approved average)

SAVINGS: 800 liters of diesel / hour
approx. **40,000 USD / month / generator**



*Remote Monitoring of Dual Fuel operation AND
Electronic Fuel Metering with digital output.*



October 2013

Rig-Safe (Ex) Standard, 3 x Cummins KTA50-G3
for Coastal Energy (USA) Offshore Platform, Johor Baru, Malaysia



We worked on this project with some of our OEM partners to heavily modify a standard Cummins KTA50-G3 generator to meet Explosion Proof standards required for an operator on an Oil rig operating in Asia, while also being Diesel Dual Fuel capable.

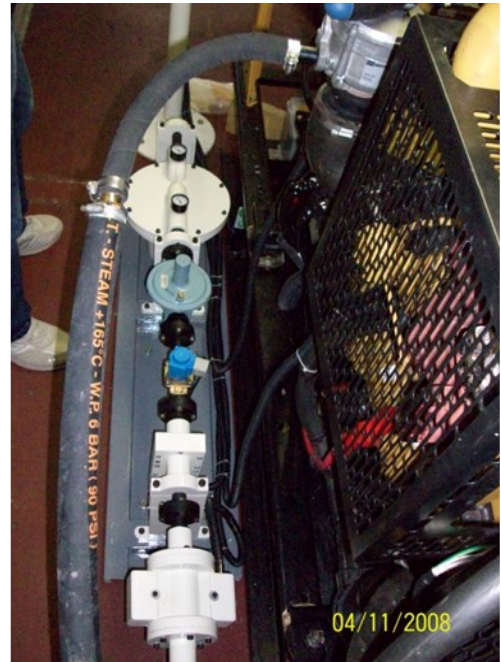
The conversion was carried out with full reporting capability and fuel monitoring of both diesel and gas.

November 2008

Nantes, France

Green Diesel-DualFuel Conversion

Diesel Generator burning valorfat and biogas



The DualFuel conversion was done on a diesel generator which was modified to run on valorized animal fat instead of diesel fuel. We then used the Exclaim DualFuel kit to run the engine on a DualFuel mixture of liquid (valorized) animal fat and Bio Gas – demonstrating the ability of Diesel engines to be CLEAN burning sources of power, with full fuel flexibility – especially in farming/animal processing communities. Additionally, the higher exhaust temperatures under DualFuel operation proved optimal for the heat recovery system.

A MODULAR, CUSTOM DESIGNED, OPTIMUM EFFICIENCY SYSTEM

The electronic controller is a major proprietary portion of the Dual Fuel Kit and the key distinguishing factor which provides the most efficient and safe operating dual fuel engine. It is a three part modular unit designed specifically to enable easy placement of the components around the generator. Segregation of electronic components also provides for substantially increased safety and conformance with EMI standards.

All power requirements of the conversion kit are channeled through a rugged, specially constructed power supply unit. This ruggedized power supply is specially designed for continuous operation in the harsh environment of power houses and open areas from the tropics to the arctic region. The intelligent power supply module ensures that it activates itself only when the generator is on line and producing power.



Powerful logic circuits and algorithms are used in the microprocessors that constitute the heart of the solid state controller. The proprietary firmware utilizes multiple sensor inputs and processes them for real time, continuous and precise gas flow control. The circuits have extensive fault detection and autonomous fault correction subroutines.



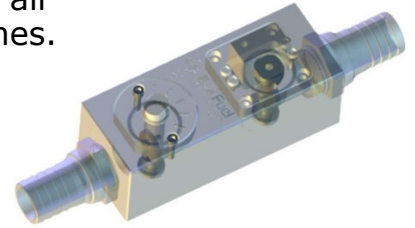
A simple, user friendly operator control terminal provides display of all pertinent data on either an alphanumeric display panel or an LCD screen. The control terminal incorporates switches and lights for various user inputs and information.



The proprietary dual fuel algorithms uploaded in the onboard firmware are designed to operate the engine at the **maximum possible gas substitution** based upon dynamic, real-time engine performance data being constantly correlated with threshold values and safety parameters and customized to engine make, model, output, etc.

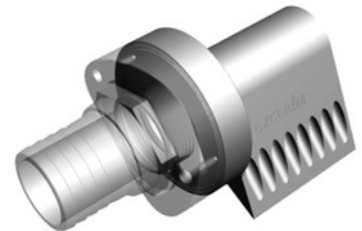
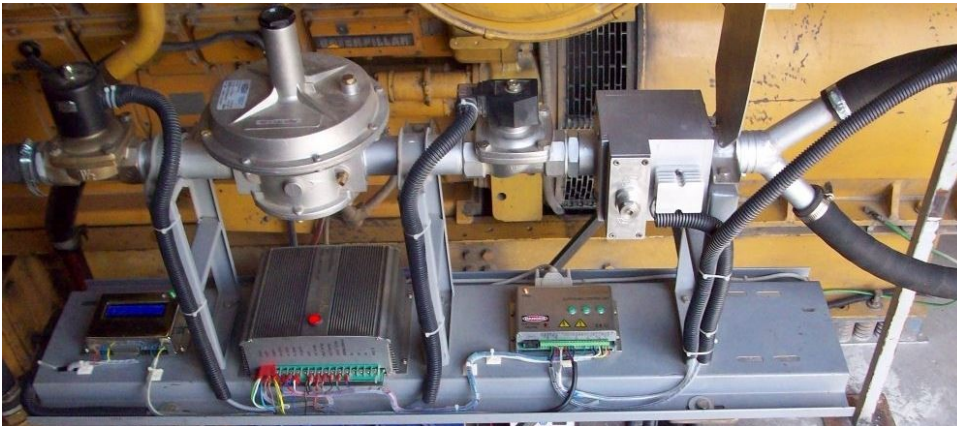
Gas Flow Control Assembly and Actuator:

The heart of our proprietary designed and precision engineered unit is an extremely precise gas flow controller which dynamically regulates the flow of gas to ensure perfect air fuel ratios at all engine loads throughout the operating envelope of all engines. An electrically actuated solenoid valve is used to ensure maximum safety.



Air-Gas Diffuser:

A NASA biconvex aerofoil section is used as the interface which mixes gas with the air stream. This proprietary designed component ensures precise blending of gas with air within the generator air intake. The aerofoil design also obviates blowback. The air-gas mixer profile is specifically tailored to ensure that adequate air-flow is available to the engine throughout its operating range either on pure diesel fuel or dual fuel.



ALL COMPONENTS ARE DESIGNED WITH NO USER REPLACEABLE PARTS AND DO NOT REQUIRE ROUTINE MAINTENANCE OR SERVICE AFTER INSTALLATION.

LOAD SENSING

Specially constructed load sensing current transformer units with split-cores for easier installation



VIBRATION AND KNOCK SENSORS

Proprietary piezo-electric sensing units for monitoring engine noise, vibration and acoustic parameters



EXHAUST TEMPERATURE SENSING

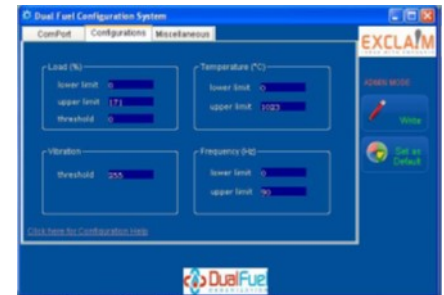
Custom-designed surface mountable probe type thermocouples for precise measurement of engine and stack temperatures



SOFTWARE, and ADDITIONAL MODULES

ENHANCED FUNCTIONALITY

Our standard kit ships with an easy to use, intuitive, Windows-based software for kit administration and settings adjustment. This allows for administrators/trained technicians to connect a laptop/tablet to the kit via an industrial standard serial port connection and alter kit operating parameters – However, under normal circumstances this only needs to be done once when the kit is tuned initially, or after certain major changes in operating parameters.



Remote Reporting Module: For more active reporting, logging, and real-time monitoring applications, especially, in centralized control rooms of power houses or where the generators are physically separated from the operators, we offer an *optional* remote connection module where all engine operating data, and more importantly, any fault codes can be displayed on a distant PC. This 'module' consists of firmware update of the main controller, dedicated remote monitoring software, and can be augmented with hardware which can allow for multiple engine, longer distances, and even GPRS based remote



Fuel Metering Modules: Can be purchased for either or both fuel options (diesel and gas). We install specially calibrated and selected fuel meters for the appropriate engine size and respected fuel flow rates. Using meters on either just the diesel input line with a proprietary return fuel flow mounting or (in special cases) diesel meters on both the input and return line, we take a digital output into the host PC via RS485/232 and display as well as log fuel flow in our integrated monitoring application. Similarly for gas we add a turbine gas flow meter calibrated for the particular gas and with intelligent outputs we are able to log and show the instantaneous and cumulative fuel flow.

Either of the modules can be added on to the basic DualFuel kit package. When purchased as a fully optioned solution the customers can have dashboard displays on their control PC which can show the full operating condition of the engine, as well as historical logs—which can be exported as delimited text documents into any analytical application the customer may have.

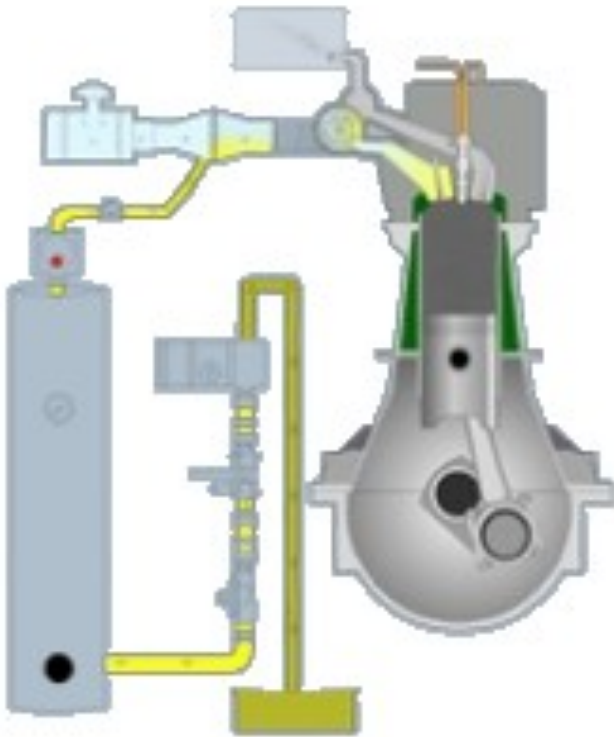
HOW DOES IT WORK?

FUMIGATION METHOD: Gas is mixed with air by a specially designed mixer installed before the turbocharger(s). Gas flow is controlled by our proprietary butterfly valve, which is electronically operated with state of the art microprocessors by our specifically designed electronic control system according to the required engine output and speed.

In order to avoid unsafe operation we install various safety and performance monitoring probes including heat sensors and detonation and knock sensors.

Salient Features:

- No reduction of engine power or efficiency
- Smooth transition between diesel and dual fuel operations at any time
- Gas and air are blended behind air filter before
- turbocharger by central mixer
- State of the art electronics maximizes the amount of injected gas while keeping all engine parameters within limits specified by the engine manufacturer
- No modifications of internal engine components are required



Summary of Advantages

- NO LOSS OF OUTPUT POWER
- Less Pollutants = Cleaner Environment
- Fuel cost reduction enables huge savings.
- Dual fuel ability enables great operational freedom.
- Whenever there is a natural gas shortage, the engine automatically reverts to diesel operation.
- Liquid fuel trucking, handling and storage problems are greatly reduced.
- Liquid Fuel Pilferage is prevented.
- Fuel filter change intervals are much longer.
- Oil change interval is increased.
- Oil filter changes are reduced.
- Safety is enhanced.



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