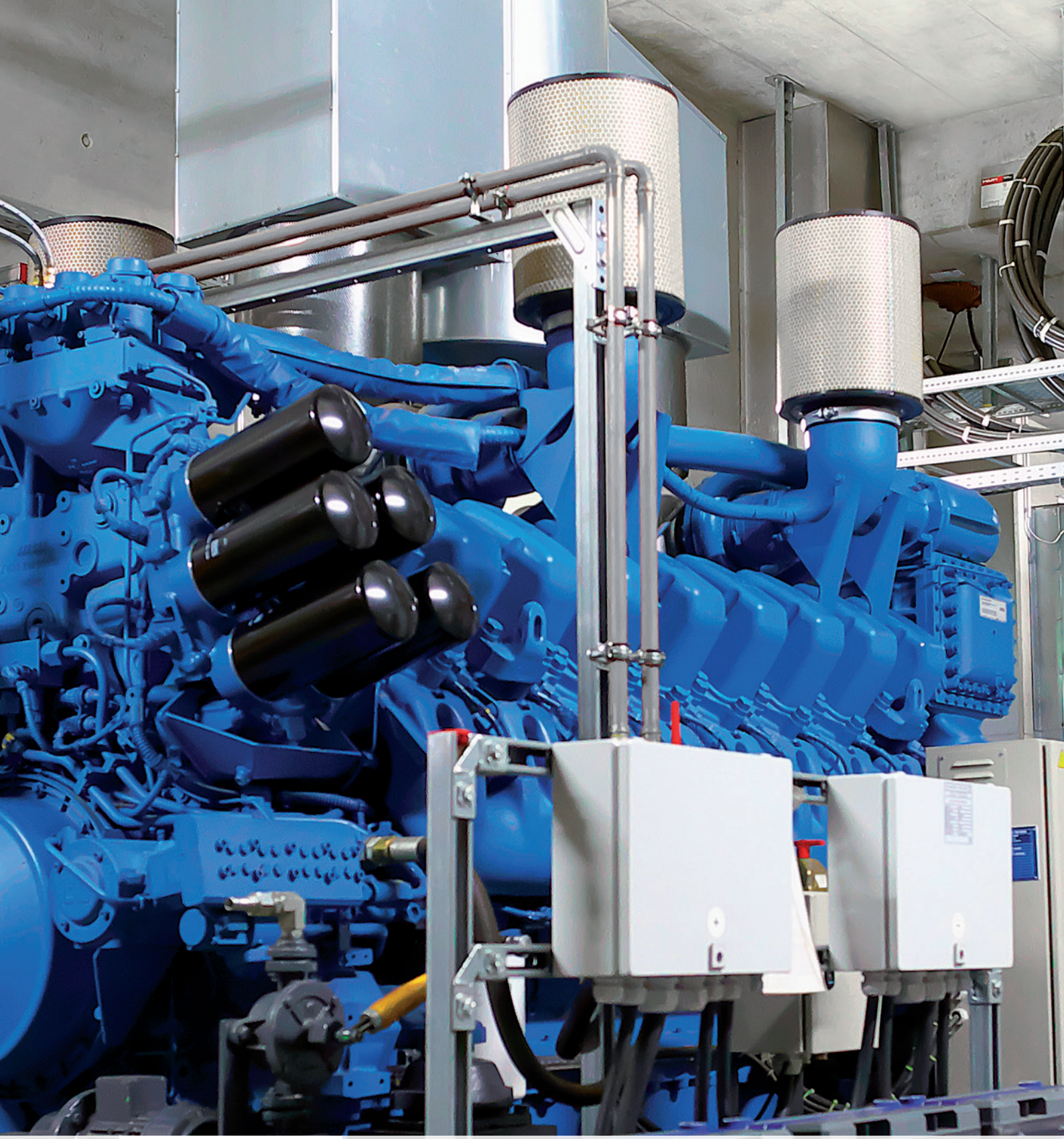


Fuel Check for emergency power systems

Fuel Check: Just to be sure
Increased reliability – lower costs

Indispensable: reliable fuels for emergency power supply

Many companies, health- and social facilities and organizations of domestic security and of civil- and emergency services operate emergency power systems to ensure the required supply of electrical power in cases of power failure. Electricity is especially indispensable for the use of modern information- and communication technologies.

Regular maintenance and test runs of motors and generators shall guarantee the emergency power system's operational safety. However, experience has shown that the quality control of fuel supply in storage tanks is not the focus of attention for operators. Due to increasing malfunctions, the former Institute for Heat and Mobility (IWO) (today: en2x – the Association of Fuels and Energy) together with the Federal Ministry of the Interior initiated a study in 2014 regarding this topic. The fuels of a representative number of emergency power systems were analysed and their func-tional efficiency valued. The result was alarming, as the reliable operational readiness of the emergency power systems mostly was not given for fuel-related reasons.

New study concerning fuel storage for emergency power supply shows risks

For the due reliability of emergency power systems IWO conducted a study to assess the quality reliability of the fuel supplies. In practice, the following fields of problems occurred:

Operators monitor the filling level but not the fuel quality

Even today, regular quality analyses of fuel stocks are not always carried out. Even today, this is not generally implemented despite the recommendations in the Federal Office of Civil Protection and Disaster Assistance's Guide to Emergency Power Supply in Companies and Authorities (Volume 13). Fuel quality analysis of fuels is currently not carried out on a regular basis. A long storage time over a couple of years of a fuel with a limited shelf life is usually the result.
A fuel related problem is often identified not before the occurrence of malfunctions or even cases of damage the engine respectively engine failures.

The complete study "Fuel quality in emergency power systems" with background information and findings about the long term storage of fuel supplies can be requested via email: fuel-check@tec4fuels.com

Note: The study is only available in German.

Installations with copper piping accelerate fuel ageing

Copper piping is often used for fuel feed between tank and engine. The catalytic influence of non-ferrous metal leads to a faster fuel ageing with negative consequences for its operational fitness.

Critical long-term stability of standard market diesel with biodiesel content

Engine manufacturers usually demand the use of diesel fuel according to DIN EN 590, which contains up to 7 % of biodiesel for the fulfilment of the Biofuel Quota Act. This diesel is designed for the transport sector with an average use within 90 days, but not for long-term storage. In the case of biogenic admixtures, the risk of fuel-related malfunctions of the emergency power system due to degradation and microbiological infestation increases with longer storage periods of diesel stocks.

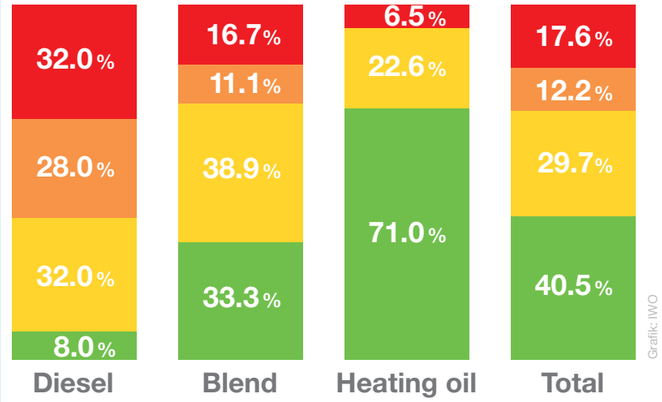
The study "Fuel quality in emergency power systems" shows critical conditions of a variety of the analysed fuel supplies:

- In nearly one third of the analysed cases (29.8 %) the **fuel** was rated as **unusable** (no more usable, 17.6 %) **or at least very critical** (strongly aged, 12.1 %).
- Particularly critical were the fuel supplies with biodiesel content: **60 % of all diesel fuels** were stated as **immediately** (no more usable, 32.0 %) **or imminently** (strongly aged, 28.0 %) **unusable**. A major cause for the reductions in quality of standard market diesel and its blends was the share of up to 7 % biodiesel that has been proven to be critical in long term storage.
- In systems **operated with heating oil only 6.5 % of the analysed fuel supply** was no more usable.

Note: According to the German Fuel Standard DIN 51603-1, low sulfur heating oil may not be blended with biodiesel.

Assessment of the analysed fuel supplies

Results according to fuels



- **No more usable:** to be exchanged immediately
- **Strongly aged:** further use possible subject to exchange within next 3 months
- **Ageing endangered, but usable:** observe, to be analysed again at the latest in 6 months
- **Compliant with the norm and usable without any restriction:** next analysis at the latest in 12 months

More security for the fuel tank: Quality control and prevention is necessary

The Federal Office for Citizen Protection and Disaster Support (“Bundesamt für Bevölkerungsschutz und Katastrophenhilfe”, BBK) and the Federal Office for Information Security (“Bundesamt für Sicherheit in der Informationstechnik”, BSI) have revised their guidelines and recommendations for planning, establishment and operation of an emergency power system in companies and authorities to ensure quality and operation readiness of stored fuels.*

To guarantee the permanent functionality of an emergency power system and to recognise critical changes in fuel quality early, the guidelines now include urgent advises on regular quality controls of the stored fuel supply. Equally, there are strong recommendations for the choice of fuel and the installation of the fuel supply system.

BBK and BSI´s important recommendations of fuel supply

During maintenance and tests of emergency power supplies particular attention should be paid on the quality of the stored fuel in the future:

- Let check the fuel quality at least once a year preventively, to recognise changes and to act as soon as possible.
- The day tank’s fuel quality is the critical size and should therefore be monitored with priority.
- Withdrawal equipment has to be installed at the day tank at a suitable place for sampling under observance of water-protection law as well as technical rules.

Following recommendations concerning fuel and installation help to avoid fuel-related disturbances and malfunctions of the emergency power supply:

- Use low-sulphur heating oil according to DIN 51603-1, because this fuel does not contain any biodiesel.
- Condition the low-sulphur heating oil with help of an additive package, which has been designed for the special long term ageing as well as the improvement of motor performance (increase of the cetane number).
- Copper pipes have to be avoided, because of accelerated catalytic ageing of the fuel. It is recommended to use stainless steel and also aluminium.

*** BBK and BSI recommendations can be viewed at**
www.tec4fuels.com/kraftstoff-check-gegen-dieselpest-in-netzersatzanlagen/bundesbehoerden-empfehlen/

Engine manufacturers’ authorization for the use of low-sulphur heating oil

So far, for the operation of engines has been requested diesel fuel according to DIN EN 590 by the manufacturers of emergency power systems. Until now this results in a substantial problem for operators and service companies. On the one hand, the warranty of engine manufacturers is linked to DIN EN 590, on the other hand, the fuel’s long-term storage cannot be guaranteed due to the admixture of biodiesel with respect to the Biofuel Quota Act.

Up-to-date: Leading manufacturers have authorized the use of low-sulphur heating oil according to DIN 51603-1 for their engines or even recommend it explicitly. An overview and further information on heating oil approvals of the individual manufacturers can be found at:
www.tec4fuels.com/qualitywatch/hersteller-empfehlen/
Unless the manufacturers’ requirements allow the usage of heating oil according to DIN 51603 part 1 as a fuel, it is essential that you obtain approval from the manufacturer.

Special additives for emergency power systems

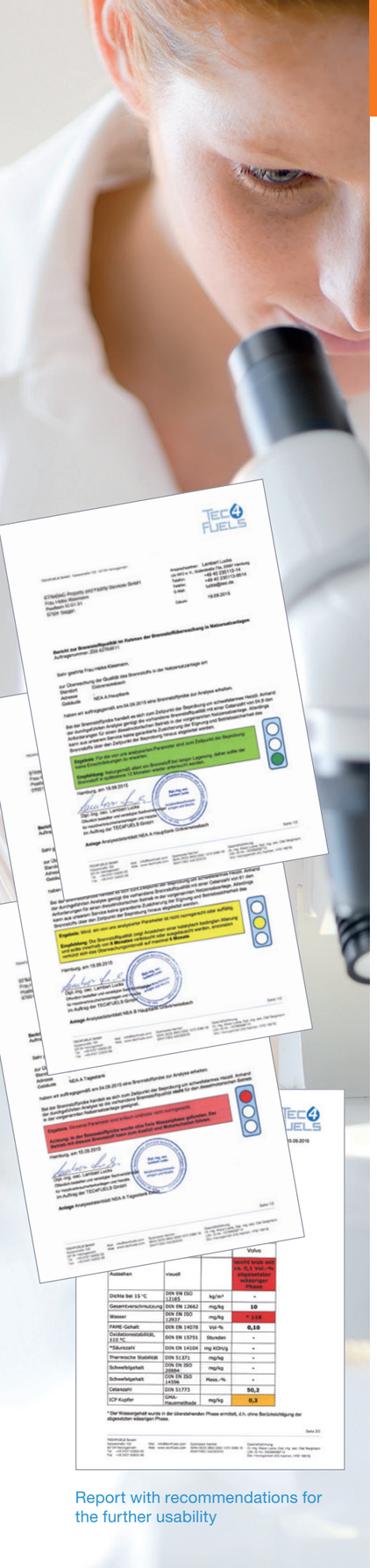
Special additives are recommended for the use of low-sulfur heating oil in diesel-engine driven emergency power systems to optimize the performance of the engine, the operational safety and longevity. The special ingredient combination should fulfil the following functions:

- Increase of the cetane number over the minimum value requested by the producers, also in heating oil operation
- Protection against corrosion and deposits
- Cleaning of the fuel system and keep clean of the injection nozzles
- Improvement of lubricity
- Increase of long term storage capability by stabilizers
- Prevention of bacterial growth by biocides
- Good miscibility with the fuel storage, even for subsequent blending

Further information about producers and supply:
Currently only one special additive for the use of low-sulfur heating oil in emergency power systems is known. It is offered by the ERC Additiv GmbH under the name „NEA protect PLUS“.

Contact:

ERC Additiv GmbH
Bäckerstraße 13
21244 Buchholz
Tel.: +49 4181 216 500
E-Mail: office@erc-additiv.de



Report with recommendations for the further usability

Benefit from our service offering

Basic service

“Play it save!”

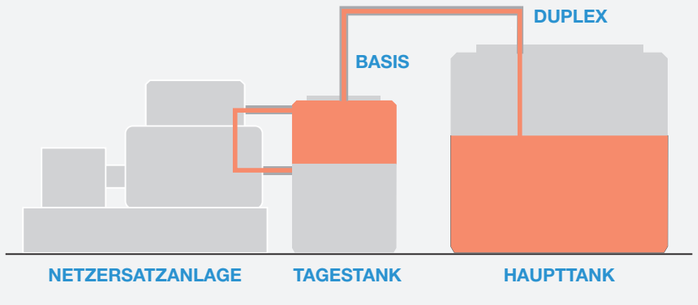
Fuel-Check

Quality control of an emergency power system’s fuel supplies with single tank: Analytics and evaluation of the fuel sample

The sampling at the single tank is carried out by the operator or a service technician on their own responsibility. TEC4FUELS may provide the necessary sampling-kit and organizes its shipping according to current hazardous goods regulations. Your request will be processed in a fast, efficiently and reliable way.

What is the result?

- We offer the testing and advice on the quality of the fuel supply at the time of sampling in a transparent and clear report based on selected standard and other characteristic values. Our analyses and assessments correspond to the methodology of the study and are based on the current state of science and research.
- The analytics of the fuel samples are performed in cooperation with an accredited laboratory for the testing of fuels according to checked and accepted rules of the German accreditation body. They offer a sound basis for the quality and significance of the results and for our recommendations.
- We offer you clear recommendations for action and for the further use of the fuel supplies and we inform you about possibly operation-critical quality – certified by a public appointed and sworn expert for fuel oil consumer installations and heating oils or an instructed and authorized representative.*
- We will be pleased to advise you about the selection of a suitable fuel and additives for long-term storage. And support you with our fuel service-partner network in a possibly necessary exchange of the stock.



*The recommended action based on the interpretation of the results, which follows the relevant standards and the findings of appropriate research projects on the ageing behavior and on the operational safety of middle distillates. However, no guaranteed assurance of the fuel’s suitability and operational safety beyond the time of sampling can be derived from our service.

Additional services

“You can combine the following services!”

Smart Analytic

In the case of emergency power systems with a day tank and a main tank, we analyse the fuel level in the day tank and only if there are any abnormalities do we analyse the fuel level in the main tank.

The fuel quality in the day- and main tank may differ because of different storage conditions. Therefore, we take one sample per tank. At Smart Analytic, we decide on the need for analysis and evaluation of the main tank sample depending on the quality in the day tank. By that, we avoid unnecessary costs, without dispensing safety.

If you wish to analyse the fuel quality in both tanks regardless of the day tanks‘s analysis we can gladly arrange this as well.

OnSiteService

Sampling at the tank system by TEC4FUELS by appointment:

With pleasure we take handle the sampling for you. You only take care of the access to the tank system, we will take care for the rest. This is how you save time and training effort and have the security of a correct sampling for sound analysis results.

By the way: If needed, we make an offer for the assessment and examination of the tank system’s professional equipment by an expert according to Water Resources Law (WHG).

PremiumContract

Agreement on a regular quality control of the fuel storage:

We offer maximum security. Within a 5-year contract on easy terms, we regularly take care of the next appointment in accordance with the recommended test cycle. You can benefit from a complete time series of fuel and analysis data of your system. We also provide proof of a safety- conscious and responsible quality monitoring.

Our know-how for your security

You can profit from our know-how and long-term practical experience in the areas of liquid fuels that are based on scientific research projects. Your advantages:

Increased security

- Reliable operational readiness of the emergency power supply for important functions
- Avoidance of incalculable consequential damages caused by malfunctions and liability risks

Lower costs

- Use of the most cost-effective fuels with long durability
- Prevention of expensive repairs by exchange of fuel supplies in time

Our recommendation: Reduce your fuel costs and optimize your operational safety by the use of special additives to low-sulfur heating oil.

About TEC4FUELS

TEC4FUELS is a competence centre for conventional and alternative fuels and lubricants and their application in existing and new technologies. As a research service provider, TEC4FUELS is active in the research and development of technical components and products, systems and energy sources as well as their application in the energy market for fuels. This includes the development and implementation of application-oriented hardware-in-the-loop test procedures to determine the functionality and performance of application technologies and fuels. The aim of the investigations is usually to optimise the operational safety and service life of technical components and systems. In addition to test procedures and fuel checks, TEC4FUELS also offers R&D-related consulting and other services. This also includes testing and certification, procurement as well as manufacturing and sales of the products.

TEC4FUELS supports its customers in the following areas:

- Testing – Development of special hardware-in-the-loop (HiL) systems and implementation of test methods for quality assurance of technical components as well as conventional and alternative fuels and lubricants.
- Fuel check for emergency power supply systems – Monitoring the quality of fuel stocks in emergency power supply systems (emergency power generators) to maintain availability and operational safety.
- Technical Consulting – Advice on fundamental questions of innovation management, pre-development, concept development, series development and after-sales service.

As an experienced and reliable partner, TEC4FUELS meets the highest quality standards and accompanies product development from the initial idea to quality assurance and the production of prototypes.

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