

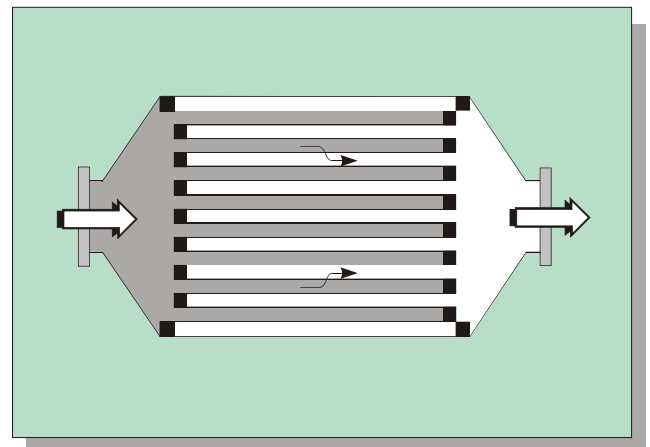
# DIESEL PARTICULATE FILTER SYSTEMS (DPF) for Emergency Power Systems

The diesel particulate filter systems "CRP" were developed primarily for emergency power applications but can also be employed for continuously operating applications. Due to the ever more restrictive environmental regulations, it became necessary to provide an inexpensive filter system for emergency power applications. Although the German regulation "TA-Luft" is somewhat voluntary ("...the application of diesel particulate filters is desired"), some German states have required the use of DPFs for years. The particulate filters of the "CRP" series exceed the requirements of German environmental regulatory agencies and the working reliability of the emergency power system. The feared trail of black soot observed during diesel engine startup is a relict of the past.

## 1. Component Description

For larger power installations the filtering takes place with ceramic monoliths, which are connected in parallel (modular structure). Depending upon design, the collection efficiency ranges from 95 to 98 percent. For further emission reduction, an oxidation catalyst can be installed downstream of the DPF, which converts hydrocarbons and carbon monoxide, compounds found in the exhausts. In particular, the unburned hydrocarbons carry the odor-causing components of the exhaust gas. In addition, the DPF acts as a silencer, with a sound reduction capability of about 20 dB(A).

The modular structure of the filters makes it possible for one filter system to handle the entire power range from less than 100 kW to several Megawatts. Finely tuned adjustments to the individual power requirements for each system allows for an economic design.



*Schematic of a filter monolith*

The use of DPFs ensure the ability to meet current and future emission standards for particulate matter. With the filtering units, both new and in-use diesel-fueled power generation systems can be retrofitted. This meets the diesel particulate matter emission standard of 5 mg/m<sup>3</sup> as required by Berlin's environmental regulatory agencies.

## 2. Operational Principle

The exhaust gases of the diesel engine pass through the porous ceramic filter and deposit soot particulates and associated hydrocarbons on the filter walls. The purified exhaust leaves the filter and flows into the exhaust system downstream (heat exchanger, muffler, etc.). In order to ensure a trouble-free operation, the built-up particulate matter has to be removed, either continuously or in regular intervals. This procedure is called regeneration. Different filter systems and regeneration procedures are available, depending upon the application.

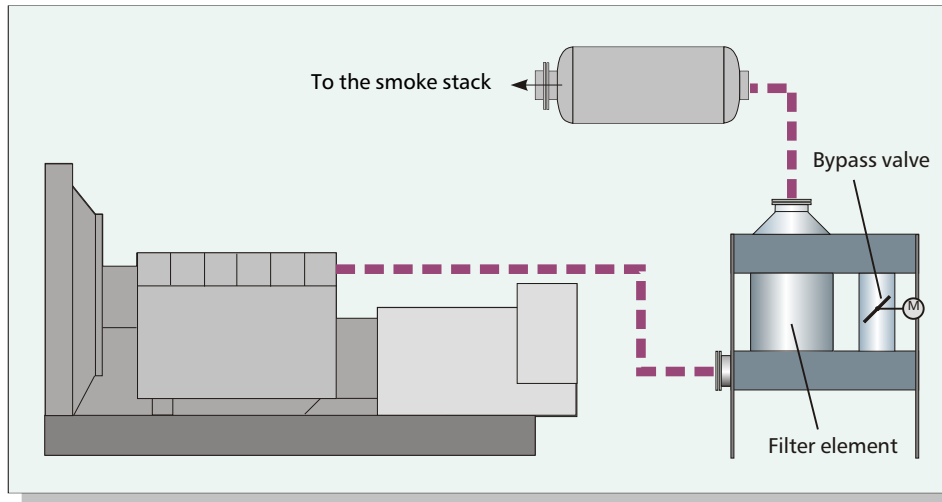
# CRP-N

## The Universal Filter System for Emergency Power Systems

The emergency power operation represents the most difficult operational condition for a diesel particulate filter in regards to regeneration. The required regeneration temperature of 600 °C is not achieved. The typical power range of emergency generators is between 20 and 80% of their rated output, and is subject to strong fluctuations. The exhaust gas temperature seldom reaches 400 °C.

emergency power operation. After that, an external regeneration is required.

Since the filter design is based on the maximum allowable exhaust backpressure of the diesel engine, as well as the small load to be expected in the event of average power outages, a filter service time of more than 12 hours can be expected under continuous operating conditions. Practical experiences have demonstrated that regeneration is only necessary after 2 years.



*Schematic of the filter system CRP-N*

### Assembly

The filter can be installed at any desired place in the exhaust gas system. The only requirement is that the filter must be positioned upstream of the muffler.

The filter system “CRP-N” therefore does not rely upon continuous regeneration. The DPFs are loaded, the exhaust backpressure is monitored, and once the maximum backpressure allowance for the engine is reached, the filters are exchanged and regenerated externally.

The filter system is equipped with an automatic bypass. The bypass valve opens automatically, if the allowable exhaust backpressure is exceeded for any reason. Through this system, the emergency power operation is ensured in all cases. The status is monitored by the control system.

### Design

Contrary to continuously operating diesel engine applications, a continuous regeneration of the filter is not required for emergency power applications. The running time accrues primarily through frequent maintenance and testing, and to a lesser degree through operations during actual power outages. The standard DIN/VDE0108 prescribes monthly test runs of 1 hour, with at least 50% load. Actual power outages usually last just a few minutes, with only few power outages lasting several hours. Therefore, the design is based on a service life of about 1 year actual



*Soot particulate filter CRP-N2, for power systems up to 300 kVA with bypass, pressure monitoring, and control panel*

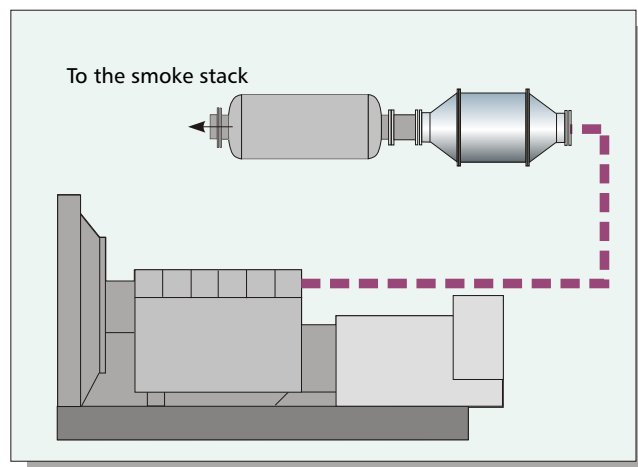
# CRP-S

## The Self-Regenerating Systems

Thanks to its modular design, the "CRP-N" system can theoretically cover any power range desired. However, the interchangeable filter system becomes impractical for power generation systems ranging above 1,000 kVA (assumed power). Therefore the following self-regenerating DPF systems are made available for diesel-fueled high performance power generation equipment.

However, sufficient conditions for regeneration are required. Depending upon the filter system, a minimum exhaust gas temperature of 320 °C or perhaps 420 °C is required. This assumes either a reliable high emergency power performance, or the operation for testing and maintenance under grid parallel conditions.

Unlike the "CRP-N" system, there is no need to have the diesel particulate filters positioned on the ground. They can be installed either above the power generation system or on the ceiling.



*Schematic of the filter system "CRP-S"*

### CRP-S Filter Operation With Additive

The regeneration temperature can be lowered to approx. 320 °C if additives can be used to ignite the collected particulates. The filter regenerates independently, as long as this exhaust gas temperature is reached constantly, or in intervals. The filter is equipped with a pressure-monitoring device that sends a signal to the control system.

This temperature is reached with approximately 30 to 40% of the engine's rated power output. The additive is added to the fuel in a 1:1000 ratio. The fuel price is thereby increased by approx. 2%.

### CRP-SB

An additional safety bypass is recommended with emergency/standby power generation systems. If for any reason the allowable back-pressure is exceeded, the bypass valve opens and ensures the emergency power operation.

### CRP-SK Catalytic Coating

The regeneration temperature can be lowered to 400 °C if a catalytic coating is incorporated on the ceramic filter. The filter regenerates independently, as long as this exhaust gas temperature is reached constantly, or in intervals. The filter is equipped with a pressure-monitoring device that sends a signal to the control system.

This temperature is reached with approximately 80 to 90% of the engine's rated power output.

### CRP-SKB

With emergency power generation systems, an additional safety bypass is recommended. If the allowable back-pressure is exceeded for any reason, the bypass valve opens and ensures the emergency power operation.

*Soot particulate filter "CRP-SB" for power systems up to 2,000 kVA with bypass, pressure monitoring*



## Scope of Services

### 1. Planning and design

- Selection of suitable filter and regeneration technology
- Selection of components and obtaining release statements from engine manufacturers
- Generation of technical drawings for design and layout
- Design of the control system concept
- Size optimization

### 2. Implementation

- Project development
- Installation, supervision of installation supervision
- Startup

### 3. Service

- Service support of the systems and customer service for all components
- Regeneration of the particulate filter elements

