

# OIL MIST SEPARATORS

## DELIVERING CLEAN AIR SOLUTIONS

at gas and steam turbines, hydro turbines,  
gas and diesel engines, vacuum pumps,  
compressors, gears, etc.



## CLEAN AIR CREATES ATMOSPHERE

- Introduction of **FRANKE FILTER**
- Product information
- Filter process
- Application



## WELCOME TO *FRANKE FILTER*

The growing concern for environmental protection and the introduction of strict pollution standards for exhaust air were the basis for developing a filtration system which efficiently eliminates oil mist from the exhaust air of the lube oil system of rotating machines.

Back in 1989, the company was founded in Holle as *FRANKE Mess- und Filtersysteme* focussing on the manufacture of customised, high quality oil mist separators for power plants and turbine manufacturers in Germany and its neighbouring countries. With its relocation to Bad Salzdetfurth in 1996 - a brand new office and assembly hall were erected - and its change of name to *FRANKE FILTER GMBH* in January 2001, the clean solution could be offered to customers in Europe and all over the world.

Being both the designer and a specialised manufacturer of oil mist separators *FRANKE FILTER* has gained valuable experience for almost 20 years through personal customer contact for all conceivable applications concerning separation of oil mist.

We look forward to having a share in the growing importance of environmental protection.

# YOUR BENEFITS

by using our oil mist separators

## An environmentally-friendly solution

A compact and individual design of our filter systems allows assembly in the narrowest space at gas and steam turbines, hydro turbines, gas and diesel engines, turbo compressors, generators, gears and other rotating machines.

**FRANKE FILTER** systems achieve results far below the stipulated permissible values and due to their compact design allow unproblematic assembly. Our colleagues manufacture and assemble all oil mist separators in our own workshop - individually for your application. Even the flange is prepared in such a way that no extra welding or additional backfitting is required after delivery. Recover valuable oil and comply with environmental regulations.



At **FRANKE FILTER** we are committed at providing you with active environmental protection. In order to achieve the best possible results we manufacture according to the most up-to-date quality standards. The diameter of the filtered oil particles is within 0.1  $\mu\text{m}$  and below.

The necessary precision of all individual parts and the complete systems undergo extensive quality controls in compliance with DIN EN ISO 9001:2008. Since 2007 **FRANKE FILTER** manufactures according to ATEX which means, that our filter systems comply with the norm for installation in explosion hazardous environments.

## EXACT ADJUSTMENT

of vacuum in the lube oil system

**30,000 HOURS**

and more of continuous operation

**EFFICIENCY OF 99.99%**

at 0.1  $\mu\text{m}$  particles and droplets.

## QUALITY OF LUBE OIL

is maintained or even improved

Recover up to **2,000 LITRES ANNUALLY**  
depending on size of a turbine

Up to **1  $\text{MG}/\text{M}^3$**  and less residual oil  
content in exhaust air is possible

# OIL MIST SEPARATOR

special design & additional equipment

## INTERNAL/EXTERNAL ADMIXED AIR

for manual adjustment of the required vacuum in the lube oil system. The internal admixed air no longer requires an air filter, thus reducing maintenance.

## DIFFERENTIAL PRESSURE GAUGES

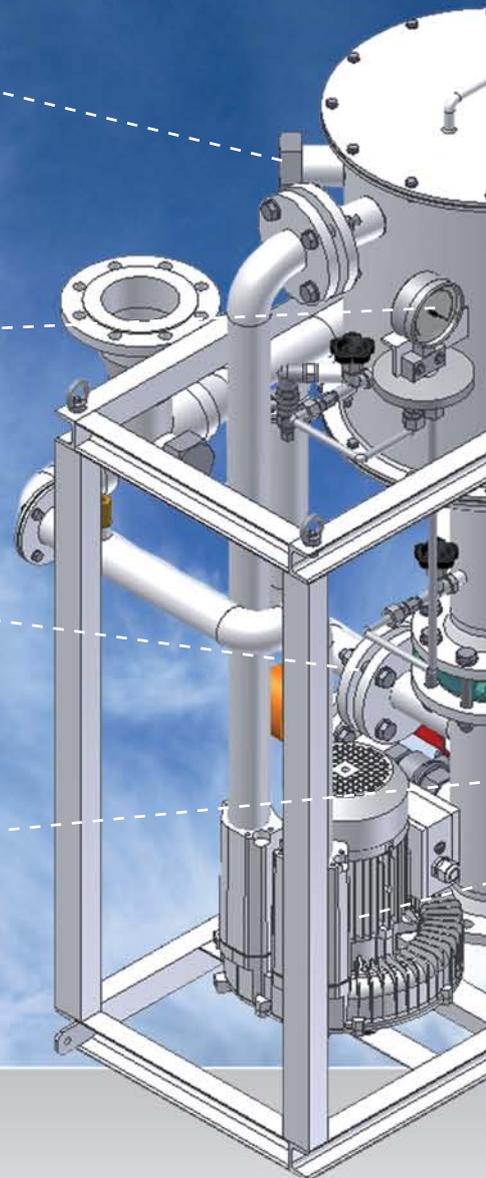
are used for surveillance of the differential pressure. An optional pressure switch reports condition to the control room.

## ACTIVE/PASSIVE BYPASS LINE

protects the whole lube oil system against overpressure and allows simple replacement e.g. of filter cartridges during operation of a turbine.

## STANDPIPE & INTEGRATED OIL RETURN LINE

saves installation of a separate, external oil return line and fulfils the required geodetic height. Standpipe application does not need an additional siphon.



## MODE OF OPERATION

Oil mist separators from **FRANKE FILTER** guarantee a high separation efficiency of oil mist suction from turbines in power stations.

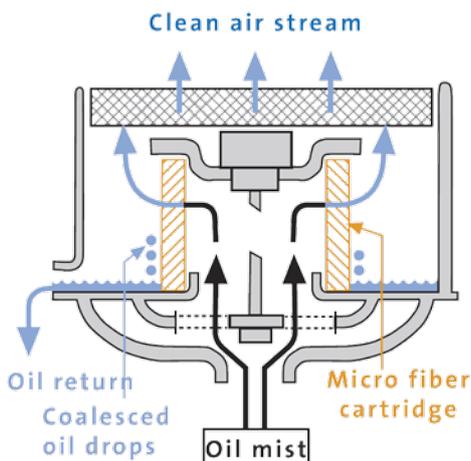
### Vacuum

The integrated side channel pump leads the oil-saturated air via a suction pipe into the filter system. The required vacuum can be adjusted individually via the admixed air valve which is included into delivery.

### Coalescence effect

Within the filter housing the sucked air is led through numerous highly-

efficient micro fibre filter elements. They ensure that the tiniest oil particles on the micro fibre run together and flow down by gravity.

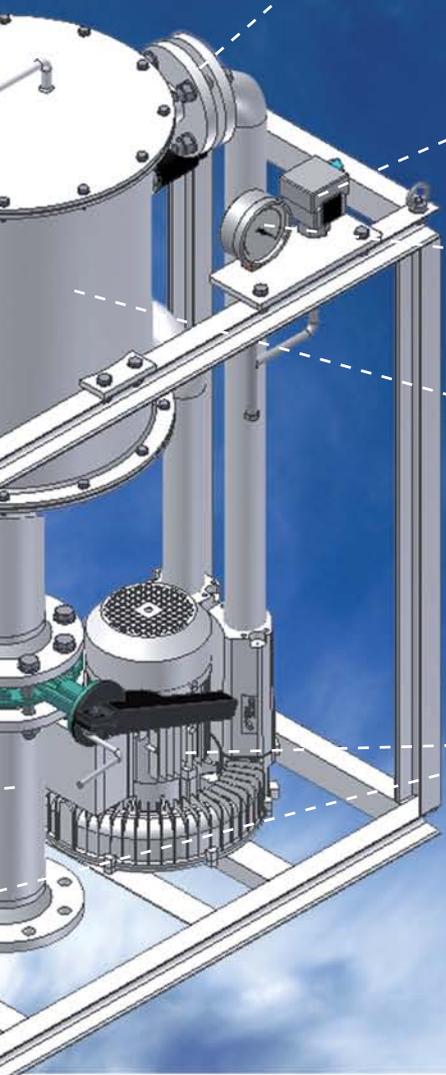


### Oil return

Oil, collected at the bottom of the filter is continuously led back to the lube oil tank via a return pipe.

### Result

This filter process saves expensive oil and ensures clean atmosphere. Our experience shows that over 30,000 hours of uninterrupted operation is possible. During this period the efficiency of the filter is 99.9% (particle size  $0.1 \mu$ ). Independent tests have shown that the quality of the lube oil remains constant.



## SHUT-OFF-VALVES

are used in combination with the stand-by vacuum pump and save adjustment work when switching on the second vacuum pump.

## PRESSURE SWITCH

controls vacuum in the lube oil system and reports any emergencies to the control room.

## VACUUM GAUGES

show vacuum in the lube oil system.

## MICRO FIBRE FILTER CARTRIDGES

function according to the coalescence principle and filter the sucked oil mist with the separation efficiency of 99.9% at a particle size of  $0.1\mu$ . The residual oil is far below the officially stipulated values.

## SIDE CHANNEL VACUUM PUMP

produces necessary vacuum in the whole lube oil system.

- application possibility in the explosion hazardous area (zone 2, zone 1 according to ATEX)
- applications with 50 Hz/60 Hz, all voltages
- delivery with separate motor possible
- failsafe operation thanks to a stand-by vacuum pump

Oil mist separators from **FRANKE FILTER** fulfil several requirements in order to ensure safe operation of your turbine.

### At a glance

1. constant vacuum is created in the whole lube oil system
2. emerging oil mist is fully filtered mechanically
3. chemical constitution of lube oil remains preserved
4. filtered oil is led back into the tank
5. legal environmental regulations can be complied with
6. the result is the clean air

### Individual manufacture

In dialogue with our customers beginning with planning, construction and through to production we develop a tailor-made oil mist separator. Thanks to this close cooperation we are able to offer an optimum solution for each application.

The compact and individual design of the systems allows assembly in the most confined spaces on gas and steam turbines, gas and diesel engines, turbo compressors, generators, gears, etc. Our team manufactures and assembles all oil mist separators in our own factory.

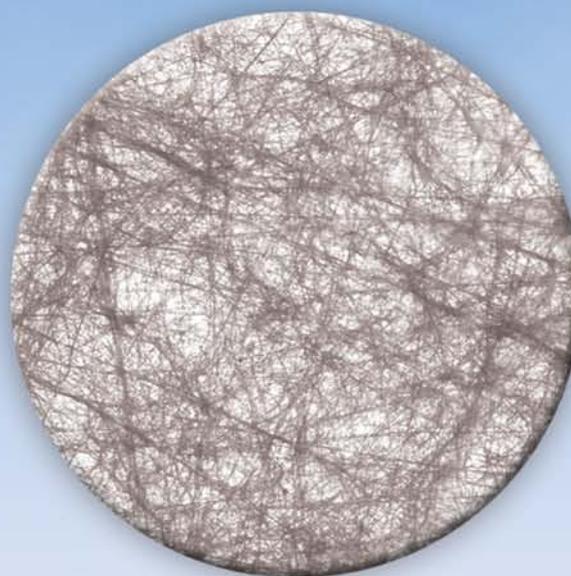
Each unit is manufactured for a specific, individual application.

### Optional equipment

**FRANKE FILTER** provides an extra range of equipment for further possibilities of adjustment and extension. For instance, execution of distribution which allows filtering up to four bearings with one oil mist separator. You can find further extras on pages 8/9 as well as application examples on pages 12/13.

# THE COALESCENCE EFFECT

The most important process for mechanical oil mist separation. It describes consolidation of oil particles into oil drops



## COMPLETE SOLUTION FROM ONE SUPPLIER

Being a specialist in the separation of oil mist **FRANKE FILTER** possesses 20 years worth of experience and can profit from numerous projects worldwide.

### Well consulted

The gained knowledge and experience from various projects are the basis for each consultation.

### Mutually planned

In continuous dialogue we closely cooperate with customers in order

to find an optimum solution for each application.

Our project managers can offer special equipment to meet specific problems like explosion protection or systems in stainless steel.

### Individually manufactured

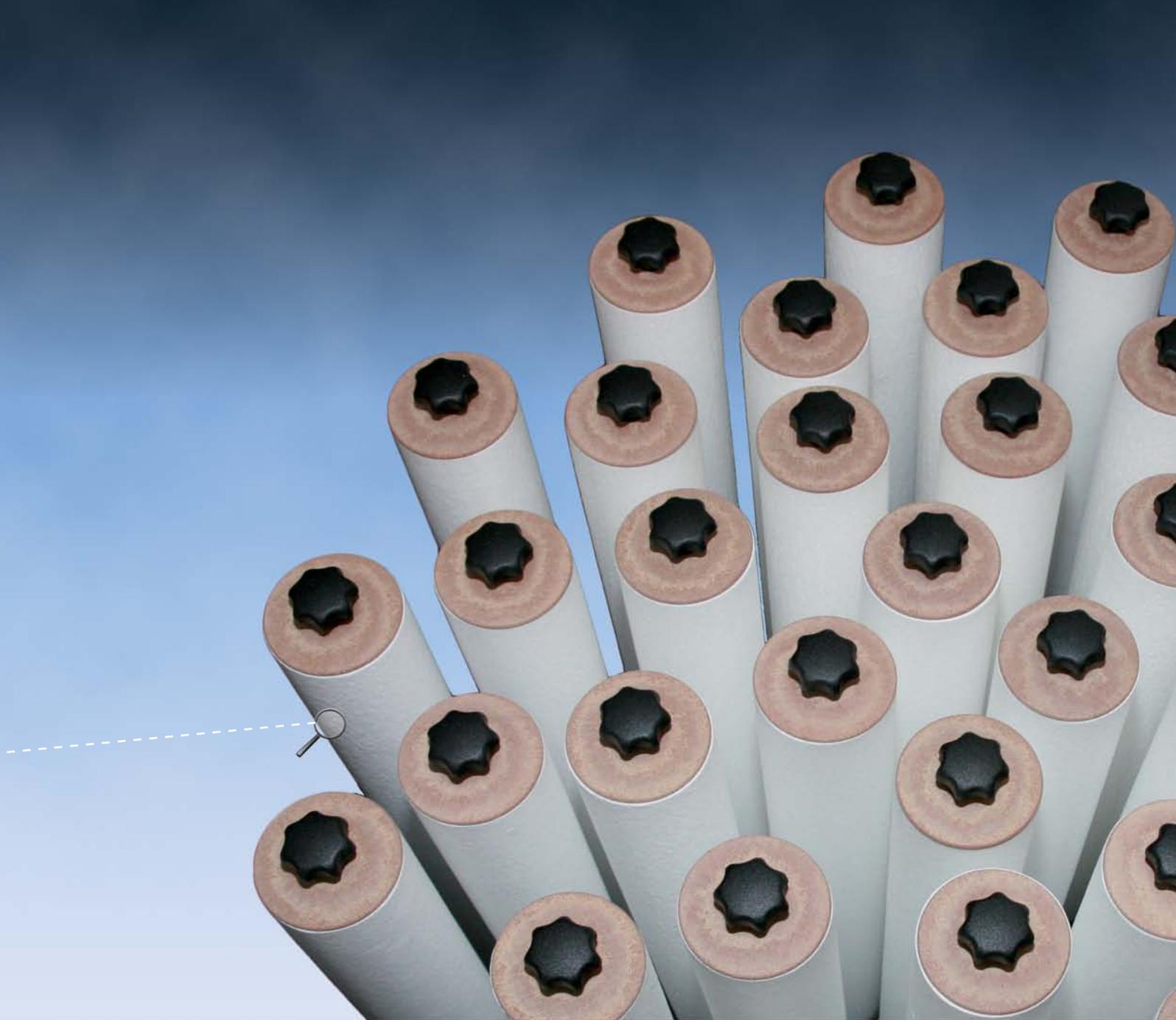
Our own CAD-department considers all details of the project during the quotation stage and integrates them into production. 3D models at each stage show the smallest amendments.

### Quality-assured manufactured

In the adjacent workshop the specially trained **FRANKE FILTER** team manufactures each part and the whole filter system individually in accordance with the current quality standards. Continued internal and external controls ensure a high level of quality.

### Simply assembled

All the connections of the oil mist separator are prepared, so that assembly on site can be carried out without complex welding works.



## MAINTENANCE & SERVICE

### Long time no maintenance

After being commissioned the filter system can operate up to 30,000 hours maintenance-free.

The special composition of the micro fibre cartridge guarantees continuous high efficiency during a long period. The vacuum gauges show when the filter cartridges should be replaced.

These and other spare parts can be ordered from **FRANKE FILTER**.

After 15,000 operating hours the initial differential pressure of the filter cartridges is still available, which means

less maintenance and lower costs!

We would be glad to carry out maintenance for you.

Contact our project managers and make an appointment when our experienced service technicians can carry out installation and commissioning e.g. replacement of filter cartridges, gauges or compressor or carry out a complete system check. All can be done on prior consultation.

Our aim is to constantly improve our service. The growing network of service partners is at your disposal as contact persons directly at your site.



# THE NECESSARY SIZE

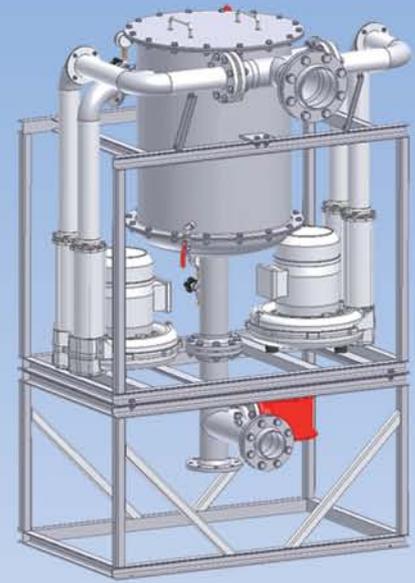
for each application



FF2-011 with internal  
admixed air for small turbines



FF2-011 with internal  
admixed air for small turbines



FF2-366 with double compressor  
for heavy-duty turbines



## THE CORRECT TYPE OF FILTER

**FRANKE FILTER** is pioneer in innovative filtration technology for tiniest oil mists of turbines in power stations all around the world. In a way we are proud that our competitors try to integrate our technology and innovations into their own products.

Our advanced know-how in combination with quality of production and customised manufacture - this is what distinguishes us from our competitors.

### Valuable ideas and experiences

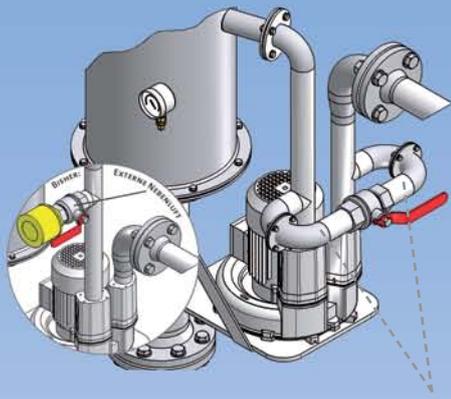
Valuable experiences from several thousand successful projects can be applied in each consultation and product.

A decisive factor for the best interplay of a turbine and filter system is the selection of the correct size of separator. This, as a rule, depends on the tank size of your turbine.

At most projects we can consider standard values, some applications, however, require special adjustments.

Crucial for the smooth procedure from first contact to the trouble-free commissioning is the continuous dialogue with the customer.

## INTERNAL ADMIXED AIR

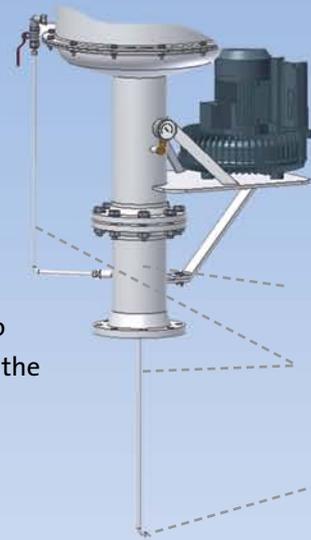


Internal admixed air

Each separator is equipped with a side channel pump which creates vacuum in the lube oil system and overcomes differential pressure of the micro fibre cartridges in the filter system. Vacuum can be adjusted via the so called admixed air, led from atmosphere. The internal admixed air- compared to the external one- has an advantage that no contaminating particles can be sucked from the atmosphere. This is extensively applied in the off-shore-sector or in deserts. The external admixed air filter and its maintenance are not longer needed.

## INTEGRATED RETURN LINE

For the cost- and time-saving maintenance **FRANKE FILTER** offers a standpipe as additional module with integrated return line. The latter ensures that the necessary geodetic height (required min. height to the oil level) is maintained. The return line is submerged into the oil and ensures continuous circulation into the lube oil tank. The manifold at its end prevents air bubbles from coming into the line and from interrupting vacuum.

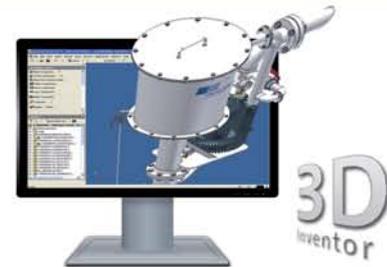


Stand pipe

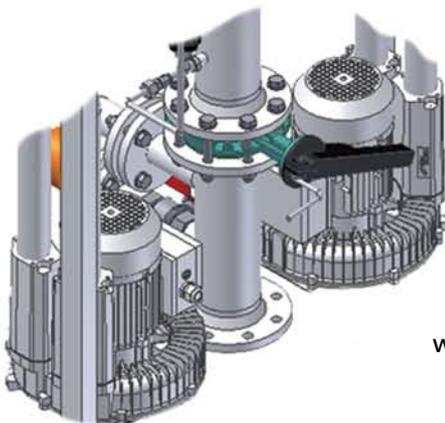
Integrated return pipe

Bent pipe

**WPAR**  
CERTIFIED



## STAND-BY VACUUM PUMP



An additional second side channel vacuum pump provides a reserve and at the same time increases failure safety, ensuring further, continuous operation. In case one compressor breaks down, the stand-by compressor ensures continuous operation.

The installed, shut-off-valve saves further adjustments at switchover of the oil mist separator. Replacement of the defective compressor is possible without interruption of the filtration process.

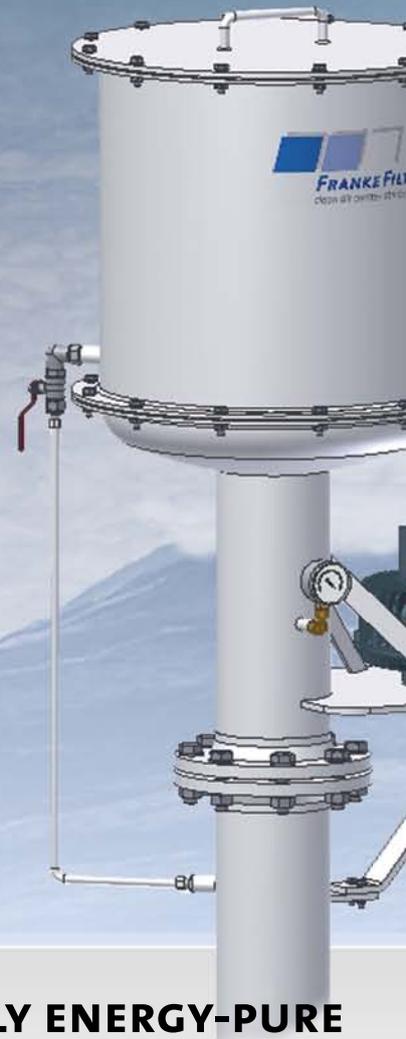
## TUBE COUPLING

A tube coupling provides fast, safe axial connection of metal pipes at assembly of the oil mist separator on the connecting piece of the oil tank or bearing. It compensates length tolerance of the pipes and reduces welding works on site.



# OIL MIST SEPARATORS FOR HYDRO TURBINES

in hydro and pump-storage power stations



## ENVIRONMENTALLY-FRIENDLY ENERGY-PURE

### Special execution

The structure of a hydro turbine in a hydro or pump-storage power station differs fundamentally from a gas or steam turbine in a conventional power station.

**FRANKE FILTER** has developed special components for this application. With their help up to four bearings can be filtered. Vacuum gauges with an appropriate regulator per branch pipe allow exact separate adjustment of vacuum for each bearing.

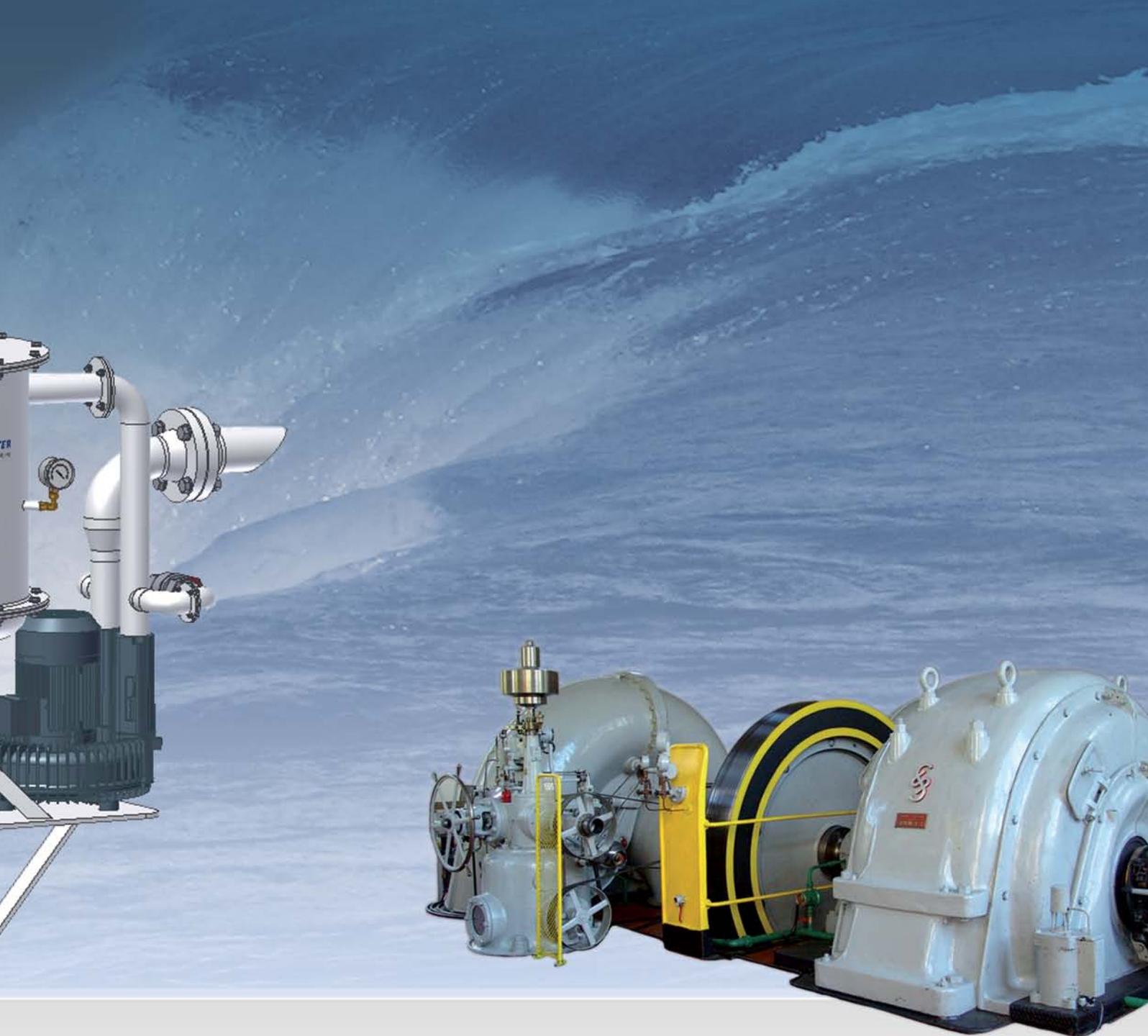
Similar to gas and steam turbines the further most oil mist separator filters

the emerging oil mist from the lube oil tank.

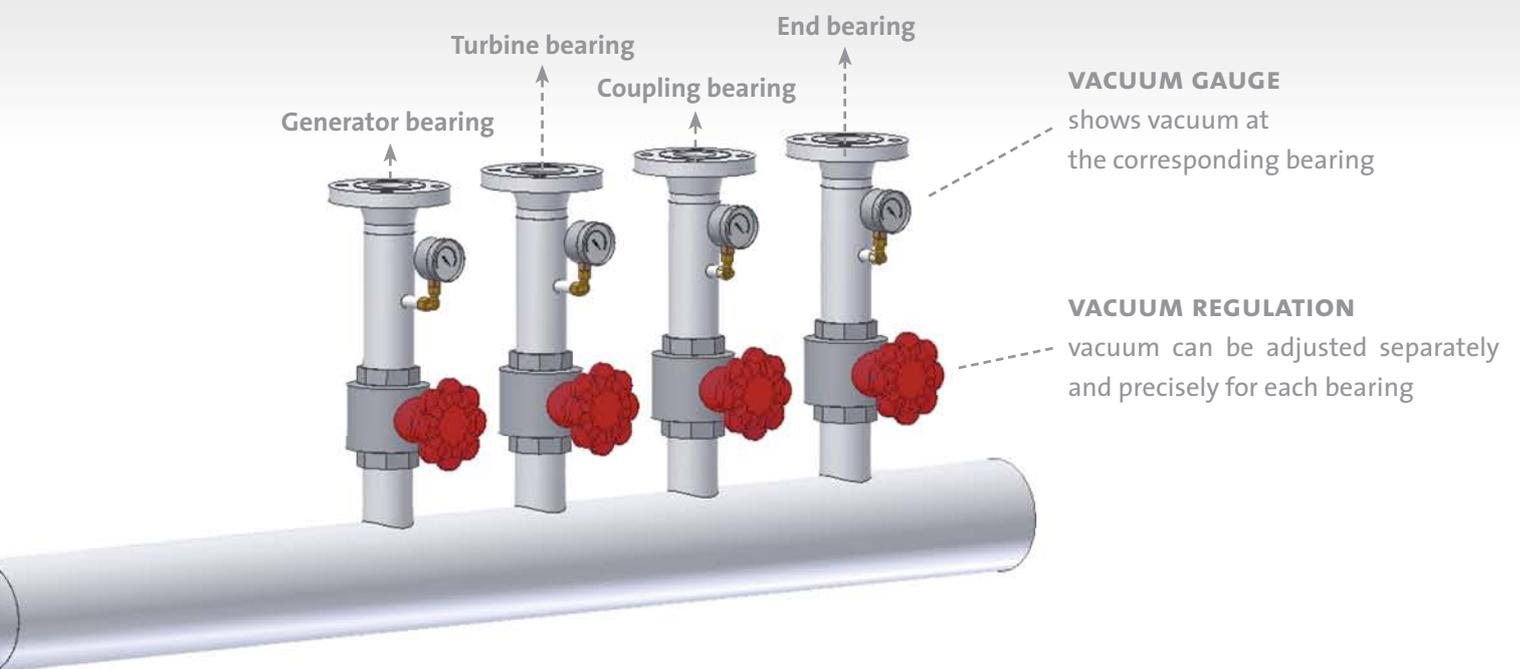
### The result

30,000 hours and more of maintenance-free clean air for an environmentally-friendly energy generation.





## VACUUM AT UP TO FOUR BEARINGS



# IN USE

a solution for each application

## PUMP-STORAGE POWER STATION, LUXEMBURG

### Precondition

In autumn 1959 the attractive location in Ourtal led the Société Électrique de l'our (SEO) in cooperation with many European countries to construct a pump-storage power station in Vianden. This power station is currently still one of the most efficient of its type and is known worldwide for its structural and technological systems.

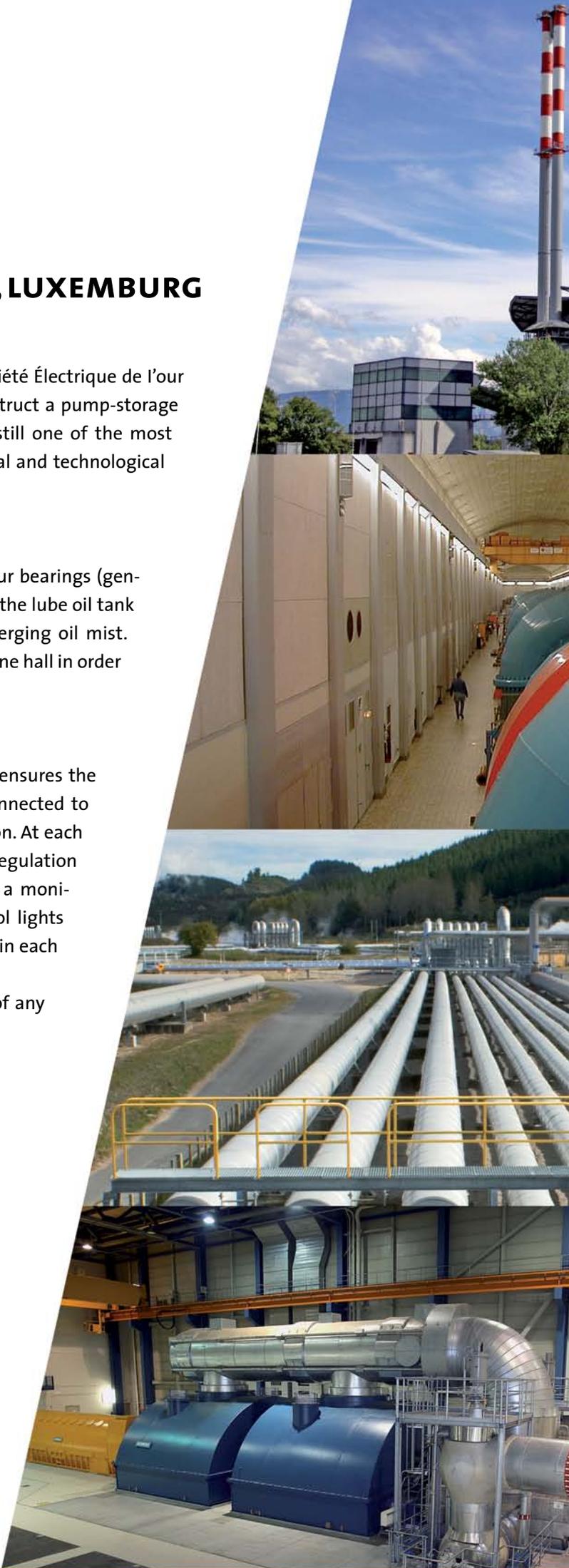
### Task

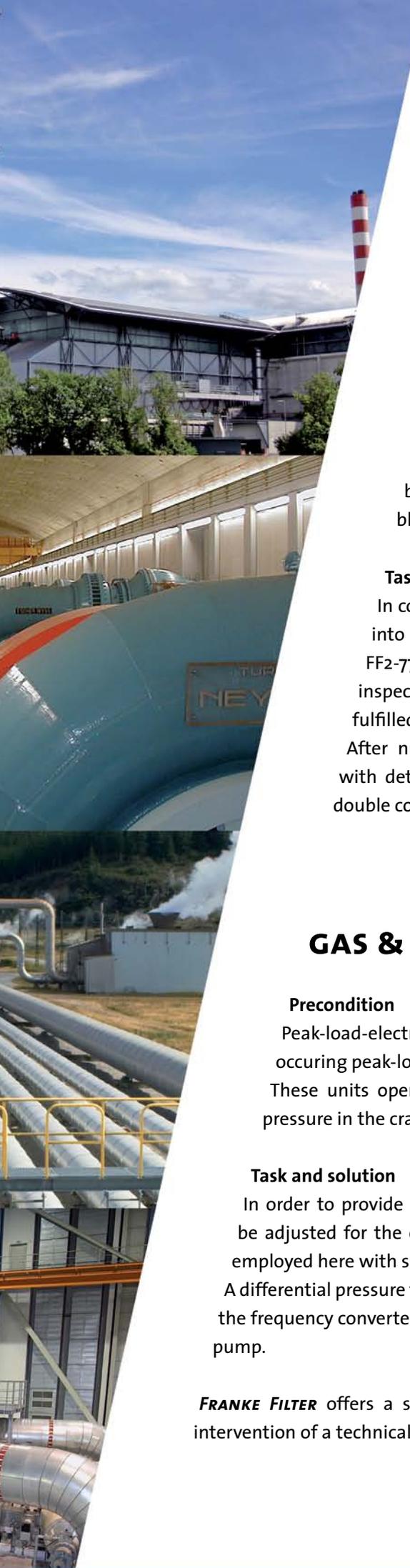
At nine of the ten existing machine units on each of the four bearings (generator, turbine, coupling and end bearing) and in addition at the lube oil tank constant vacuum should be created for suction of the emerging oil mist. A further task was to lead the clean exhaust air into the turbine hall in order to save the expensive and time-consuming pipe laying.

### Solution

Two separators are used for each of the nine turbines. One ensures the required vacuum in the lube oil tank; the second one is connected to the four bearings via a fourfold distributor for oil mist suction. At each of these bearings vacuum can be adjusted individually. For regulation and monitoring of the filtration process per machine unit, a monitoring system consisting of a switching cabinet and control lights provides information at all times as to the status of vacuum in each individual part of the system.

Connection to the control room informs on site personnel of any impending breakdown .





## NUCLEAR POWER STATION

### Precondition

The nuclear power station Olkiluoto, located on the peninsular Olkiluoto, has been in operation since 1982 with two reactors, 840 MW capacity each.

In 2003 a tender was launched for a third reactor. The construction began in 2005 under strict safety precautions. Completion of the block is planned for the year 2012.

### Task and solution

In cooperation with the company Siemens, **FRANKE FILTER** was involved into the project since 2004 having quoted an oil mist separator type FF2-777. Due to the very strict requirements of the Finnish nuclear inspection authority only our oil mist separator could be considered which fulfilled the highest safety regulations.

After numerous preliminary inspections and extensive documentation with detailed construction drawings the quoted oil mist separator with double compressor was supplied to Olkiluoto in October 2007.

## GAS & DIESEL ENGINES

### Precondition

Peak-load-electricity generation plants which are there for the short-term supply of occurring peak-loads in the power grid frequently use gas and diesel engines.

These units operate with variations of load which leads to constant change of pressure in the crankcase.

### Task and solution

In order to provide reliable filtration the operation of the side channel pump has to be adjusted for the continually changing pressure conditions. Oil mist separators are employed here with side channel pumps, fitted with frequency converters.

A differential pressure transmitter takes the nominal comparison and sends an impulse to the frequency converter, which in its turn regulates the rotation speed of the side channel pump.

**FRANKE FILTER** offers a solution which functions completely automatically and without intervention of a technical on site.

# IN YOUR OWN WORDS

letters of reference of our customers

## Project in Sweden

Dear Mr Franke,  
we have installed the oil mist separator and taken it into operation. The filter functions very well and until now we have had not problems with it. We are very satisfied with your product.

Sincerely  
Olaf Johansson  
Senior Engineer

## Projects in Europe

For approximately 8 years we have been cooperating with the company **FRANKE FILTER** in Bad Salzdetfurth. We use their oil mist separator at gas turbines type frame 5, 6 and 9. During this time we have installed more than 35 oil mist separators from **FRANKE FILTER** at various gas turbines. Quality of the filter systems is excellent. The functioning principle is based on the coalescence effect and ensures residual oil of less than  $20\text{mg}/\text{m}^3$ . The exhaust air is clean and dry.



GE ENERGY

THOMASSEN

ABB INTERNATIONAL

VATENFALL

HITACHI

ATLAS COPCO

ALSTOM

RWE

ENBW

E.ON

SIEMENS

OLKILUOTO

CRYOSTAR

MAN-TURBO

ALLWEILER

The required vacuum in the lube oil system can be exactly adjusted.

A further advantage of **FRANKE FILTER** systems is that they can be used in explosion hazardous environments. The filtered oil can be recovered and led back to the lube oil tank.

Kind regards,  
M. Hartmann  
Senior Engineer

#### **Project in Scandinavia**

We use **FRANKE FILTER** oil mist separators which operate according to the coalescence principle, i.e. oil droplets from the sucked oil mist are mechanically filtered.

The filtered oil is led continuously back into the lube oil tank. The tests in our own research laboratory have shown that the quality of the filtered lube oil is in no way affected. Viscosity and TAN-levels remain during the whole circulation process at the same, constantly low level.

We are fully satisfied with the solution from **FRANKE FILTER** and can fully recommend their oil mist separators.

Sincerely,  
Timo Häkkinen  
Operations manager

#### **Nuclear power station in Germany**

Dear Mr Franke,

I would like to once again thank you for good cooperation.

Especially that the very short-term delivery date has been maintained.

Since three weeks the filter system is in test operation and has currently vacuum of 30 mbar.

The oil mist is completely filtered.

Best regards,  
Martin Viersen  
Kraftwerksleiter



