



Pall Corporation

Contamination Control for the Power Generation Industry

Filtration. Separation. Solution.SM

PGCAPABENa

Introduction to Pall Power Generation

Pall - Your integrated partner in Power Generation

Pall Corporation is a global company solving complex contamination, separation and purification problems.

Pall's Power Generation Group is part of Pall Energy Division and as such serves the power generation market around the world. With a broad line of products and services, Pall can help you improve fluid quality and increase profitability by optimizing the performance of plant equipment.

The power generation industry trusts Pall as a solution provider

Pall is a worldwide leader in fluid purification technologies for the power generation industry. Pall advanced separation science and high quality manufacturing are applied on all fluids throughout the power plant to ensure cleaner, safer, more reliable power with higher profitability.

Pall can solve your purification challenges in any size of application, from small flows and simple installations to large flows and complex systems, from the supply of filter elements to fully-integrated turnkey systems.

Benefit from Pall's expertise and customized services

Pall is much more than a filter company. Pall specializes in fluid management, leveraging our unmatched capabilities to make your operation more successful. Our expertise has enabled us to build a large library of proprietary core materials, which we can modify to separate, remove, or selectively capture the most elusive contaminants.

Total Fluid Management_{SM}

Pall has the ability to design, manufacture, and install economical, integrated systems as well as service them. Pall's **Total Fluid Management (TFM)** program for power generation plants help plant operators and engineers manage, control and monitor plant water, fuels and oil resources. This approach results in a reduction in total operating costs associated with fluids, operation and maintenance on critical components. Combining products with consulting services, commissioning and flushing assistance, Pall is the ideal partner for the power generation industry.



**‘Pall can help
you improve
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Contamination Control

Why is it so important to take care of fluid cleanliness?

Solid, liquid and dissolved contaminants present in liquids and gases will cause operating and maintenance problems on power production assets like boilers, turbines or transformers.

Left unchecked, these contaminants increase O&M costs, decrease thermal efficiency and output, and threaten environmental compliance of power plants.

Such issues can be solved by the use of highly effective, reliable and correctly applied filtration and separations technologies.

Applications:

Fossil Generation

Power plants around the world choose Pall to ensure the quality of their condensate water, the purity of their lubrication oil and the reliability of turbine control system operation. Pall products reduce downtime with unsurpassed flushing and oil treatment capabilities, technologies and on-site assistance. Pall water treatment systems also control and maintain make-up water and waste stream purity.

Nuclear Generation

Pall filtration systems help nuclear plants of all reactor types to maintain low levels of radioactive contamination throughout the water cycle. Pall filters reduce costs and maximize output by protecting the NSSS system, filtering the reactor pool and polishing condensate water:

- Less downtime
- Lower chemical usage
- Improved safety
- Optimal operating efficiency

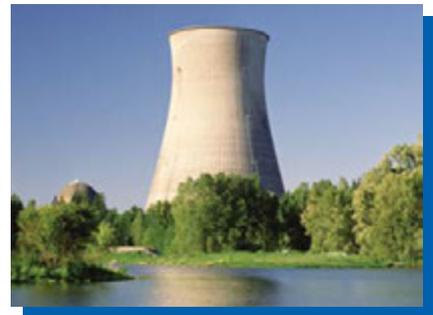
Renewable Energy

Pall technology takes part in the development of renewable energy sources. From the filtration of hydroelectric turbine control and lubrication oil to the protection of windmill gearboxes or the purification of biomass gases, Pall employs state-of-the-art technology to ensure that greener is always cleaner.

Transmission and Distribution

Energy availability also depends on a reliable and efficient grid. Pall products protect the critical purity of insulating oils. Pall online purifiers allow the online/onload treatment of transformer oil and insulation, dramatically reducing maintenance and downtime costs. By controlling water and fine particulate matter, Pall Ultipor® WG filters protect LTC contacts, prevent OCB oil degradation and extend maintenance intervals.

‘Let Pall help you optimize the performance of your generating equipment by improving fluids contamination control!’



Fossil Fuel Generation

Fuel Treatment Systems

With unmatched experience in the oil and gas industry worldwide, Pall brings complete solutions to the treatment of liquid and gas fuel for power plants. Combination of particulate filtration and high efficiency coalescence provide a fuel quality that meets the most stringent specifications of new generation combustion systems. The efficiency of Pall liquid/liquid and liquid/gas coalescers is only matched by their ease of use, low maintenance and long life.

Process Water Management

Boiler Feed Water Systems

Pall filters and membrane systems combine into a complete water treatment chain to ensure consistent, uninterrupted process water with minimal chemical usage, optimum quality and an unmatched ease of use and service. With microfiltration, ultrafiltration, reverse osmosis or filter cartridges, Pall offers the widest range of water filtration products.

Condensate Water Systems

Boilers and turbines are protected by Pall condensate filtration systems, either in backwash or disposable configuration. For any system pressure or flowrate, Pall combines media science and system engineering expertise to offer the best protection against corrosion transport.

Pall HGCoLD-R and HGPPB backwash systems offer:

- Engineering expertise to ensure long, economical operation, in demin-precoat or straight filtration mode
- Variety of media ranges and materials to adapt to any condensate flow conditions

Pall Ultipleat® High Flow disposable filters offer:

- Small footprint even for full flow installation
- Proprietary crescent shaped pleat geometry
- High efficiency, high flux filtration at ratings from 100 to 1 micron
- Simple element replacement

'high efficiency filtration, purer fuel, reduced pollutant emissions, low energy consumption, protection from erosive and corrosive wear, with minimal maintenance.'

Hot Gas Filtration

Pall has the full complement of fluid management products for hot gas filtration for the latest combustion technologies including ceramics for biomass and coal gasification, plus products that reduce pollutant emissions driving the movement towards efficient, clean and low cost energy.

Steam Turbines

Lubrication

Pall's full range of oil filtration and oil purification products combine to provide the best possible protection of the bearings and shaft against wear and corrosion. By efficiently and economically removing moisture, particles and gases from lubricating oils, Pall products ensure that critical machinery is protected and that the oil remains in pristine condition.

Hydrogen Seal Oil

The task of protecting seals from abrasive wear, and preventing water from ingressing into the generator falls on the turbine lubrication oil control system. The solid and moisture protection from the Pall TLC (Turbine Lube Conditioner) helps maintain hydrogen purity and minimize maintenance on the seals.

Control

The hydraulic systems controlling the steam valves are some of the most sensitive and critical components around the steam turbine. Pall products combine filtration, dehydration and ion exchange to protect and even reclaim hydraulic fluids, whether mineral or synthetic. With proper filtration and fluid treatment, critical valves are protected against stiction and erosive wear, and hydraulic fluids are protected against thermal degradation or acid formation.



Nuclear Power

State-of-the-art media design, application experience and unsurpassed removal efficiencies have made Pall the world standard in nuclear safety, control, radioactive waste treatment and fuel pool clean-up. Pall products shorten outages, increase operating efficiency and minimize exposure with the backing of expert customer support worldwide.

Fine Ratings Programs

For many years, Pall filtration systems have been used in the most sensitive nuclear applications of PWR coolant systems. Today, the cleanest plants use Pall nuclear grade filters to reduce the out of core radiation levels and reduce overall personnel exposure. The fine ratings program is a step by step reduction of filtration level down to 0.1 micron in order to decontaminate the coolant systems progressively, ensuring better operation, easier maintenance and reduced exposure.

Media

Pall provides innovative disposable and back-washable media in a wide range of micron removal ratings, developed, designed and manufactured under the strictest quality controls for exceptional performance, reliability, and consistency.

Elements

Pall's disposable nuclear cartridges are designed with exceptional structural integrity and perform well in environments with high radioactivity and varied pH. They have long service life, which means less radioactive waste, fewer change outs and added protection for equipment and personnel.

'Pall offers filtration solutions that enable you to meet regulatory requirements and minimize radioactive exposure while reducing your total cost of ownership.'

CVCS and Coolant Pump Seals

Pall Ultipor GF Plus media is positively charged and rated down to 0.1 micron. These rapidly remove radioactive material and provide the highest level of safety in the primary loop.

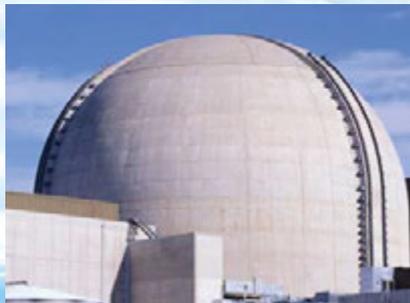
Ultipor GF Plus cartridges filter the cooling water, protecting against seal wear and plant exposure with unsurpassed integrity, efficiency and durability. Pall filters provide the best way to reduce out of core radiation, personnel exposure and costs.

By removing minute solid particles, Ultipor GF Plus filters are also used to protect the seals of the main coolant pumps. Reduction in abrasive wear of the seal, shown by a drastic reduction in leak rates, ensure longer life and lower seal replacement costs.

Nuclear Condensate Systems

Pall backwashable condensate filtration systems are an industry standard for BWR protection. In pre-coatable or straight filtration mode, Pall elements combine very high efficiency with strong integrity and durability. Backed by unmatched system design and operation expertise, Pall filters are the most effective way to maintain feed water purity, reduce ion resin consumption and protect the steam generators.

Pall traps and laterals protection feature an all-metallic porous media combining a very high void volume with high mechanical and thermal resistance up to 315 °C (600 °F). With removal levels from 400 down to 18 micron, the Pall Rigimesh® line offers the best protection against resin leakage and fouling.



Renewable Energy

Hydroelectric Power

Clean hydroelectric generation depends greatly on the reliability, availability and response of the turbine control mechanisms and lubrication systems. By ensuring that the lubricating and hydraulic oils are maintained in pristine condition, Pall filters and purifiers improve system response, shorten ramp-up times and lower maintenance costs. Combined with Pall analysis capability and monitoring equipment, they form the ultimate protection against component related outages, high oil replacement costs and sluggish system response.

The combination of fine particle control and efficient moisture removal protects the oil films and the components. By consistently maintaining oil cleanliness lower than a ISO 16/14/12 life of roller or journal bearings can be drastically extended.

Filtration and Moisture Control - A Total Fluid Management solution

Pall Ultipleat SRT filters are especially designed to remove clearance size particles known to cause fatigue wear of the bearings, abrasive wear of the governor control valves and fluid degradation. With superior resistance to cyclic flows and no electrostatic discharge, the Ultipleat SRT filter performs at its peak under the toughest of conditions.

When moisture is kept well under the saturation level of the oil, the process of oil oxidation can be stopped and with it, corrosion in the lube and control system. In hydroelectric plants, Pall purifiers and air desiccant breathers maintain moisture levels under 30 %RH, and protect lubrication and hydraulic fluids against water ingress.

‘Pall filters and purifiers improve system response, shorten ramp-up times and lower maintenance costs.’

Wind Power

Gearbox Protection

When the gearbox faces variable loads, and operates in vibrating and extreme environments, it needs to be protected by a filtration system able to deliver specified cleanliness under stress conditions, at all times, consistently, and reliably. Pall wind turbine lube filtration systems combine design simplicity, ease of service, light weight with the performance of Ultipleat SRT technology.

To ensure total cleanliness control, oil is protected against water or dirt ingress by Pall breathers, and its quality can be remotely monitored with Pall moisture and particle sensors.

Remote Monitoring of Oil Condition

The ability to detect oil quality problems early is a critical step in ensuring viability of remote windfarms. Oil contamination can be a strong indicator of component wear, its detection is the key for switching from reactive to predictive maintenance practices. With Pall capability for remote particle and moisture sensing equipment, wind turbines are never left alone, as far as they may be.

Biomass

Pall ceramics and metallic filter technologies are used to purify combustible gas in hot and chemically challenging environments such as in gasification processes and protect burners and turbines downstream. With advanced design capabilities for large blowback gas filter systems, Pall participates actively in the development of renewable combustible sources.



Pall Technology Services



What is Total Fluid Management?

Total Fluid Management (TFM) is the integration of properly selected filtration and separation technologies and services into a production process to yield the highest efficiency at the lowest cost. The Pall TFM program covers a wide range of filtration products, advanced technologies and services to improve system operation and increase productivity.

Our global team of scientists and engineers support TFM

Pall offers a variety of services to help you maximize productivity within your plant. We deliver TFM to you with the support of our global teams of Scientific and Laboratory Services (SLS). Located in more than 30 countries, our scientists and engineers provide these services locally, with broad-based assistance from Pall's worldwide technical support network. Our experts work directly with you to determine how Pall products and technologies can benefit your process.

Our customized system services include:

Commissioning and Flushing

Pall has the most extensive network of distributors and customer service centers in the world. Pall provides flushing, monitoring and consulting during plant overhaul, turbine start-up or system flushes worldwide. With Pall products, monitoring equipment and field expertise, our start-up assistance programs enable users to get back on-line faster, cheaper and more efficiently to maximize output, flexibility and operating profits.

Cleanliness Audit

A cleanliness audit can uncover contamination problems and their detrimental effects. Our laboratory staff and field engineers have at your disposal lab-scale and analytical equipment and field pilot-scale units. By sampling at various locations throughout the process, we collect, quantify and identify solid and liquid contaminants to determine their origin and provide you with recommendations for corrective action. Our recommendations are designed to help you optimize your processes and increase the reliability of your equipment at the lowest possible cost.

Process Audits / Consultancy

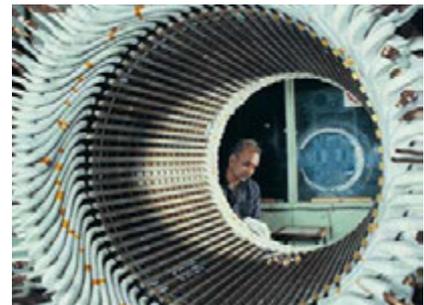
Pall offers troubleshooting, audit and consulting services to identify opportunities for process improvements that lead to increased productivity. Improvements are defined, for instance, as the reduction of operating costs or maintenance operations. An audit involves data collection and proposal review, followed by a technical report documenting the findings and suggestions for improvement.

Filtration Equipment Rental

When you need to rent filtration and purification equipment to conduct spot depollution of system fluids, to conduct large-scale pilot testing or to use while permanent equipment is being manufactured, contact Pall. Our rental services can provide equipment on the spot, so that you can handle upsets promptly.



Consultancy



Servicing



Flushing Services



Filtration Equipment Hire

Combustion Turbines and Combined Cycle



In all aspects of the operation of a combined cycle plant, Pall employs state-of-the-art technology to ensure a consistently high quality supply of water, fuels and lubricating oil to the machines. With gas treatment solutions to reduce emissions and environmental impact, Pall is the complete partner for CCGP operators looking to improve operation, save on fuel and water costs and improve system reliability and availability.

Fuels

Pall's expertise in liquid and gas fuel treatment ensures that combustion turbines are constantly protected from the mechanical and chemical attacks due to fuel impurities. Pall fuel treatment solution combines very efficient particulate filtration with coalescence to remove moisture or aerosols in the fuels. The result is a drastic reduction in the presence of solids, gels, water and salts in the fuels entering the combustion chamber.

Pall is also an expert in the treatment of alternative fuels and is an industry standard for coal and biomass gasification systems, with a range of ceramic and metallic filtration systems. With unmatched experience in materials and system designs, Pall hot gas filtration systems are at the core of some of the newest and most promising power generation designs.



Liquid / Liquid and Liquid / Gas Coalescers

Machine Protection

Whether industrial or aeroderivatives, combustion turbines are protected by Pall oil filters in the lubrication and control systems. By stopping the chain reaction of wear in rolling or journal bearings of the turbine, Pall filters protect the machine against downtime, repairs and bearing wear.

Pall oil mist eliminators reduce emissions of oil vapour to the atmosphere using Pall liquid / gas coalescers. Their efficiency and low resistance to flow means that the system reservoirs can breathe without restriction and with no detectable oil emissions into the plant.



Oil Mist Eliminator

Water Systems

In combined cycle plants, the availability and quality of water is critical for both the heat recovery boilers and the combustion turbine itself. Pall membrane systems ensure consistently pristine water meeting the most stringent purity requirements of new generation combustion turbines and high pressure boilers. With a wide range of ultra and microfiltration membranes, reverse osmosis, cartridge filtration and polishing systems, Pall brings the complete water management solution to combined cycle plants. The result is a cleaner combustion, better operation of Nox control systems, protection of the boiler against corrosion and FAC and reduced water usage overall.



Pall Aria™ Filtration System

Ultraleaf High Flow Particulate Filters

Technologies For Contamination Control And Monitoring



Pall filtration and separation technology

Pall designs and supplies a wide range of media, filters, and systems to remove contaminants from liquids and gases.

These products, along with our service capabilities and technical expertise, enable us to fulfill diverse fluid purification requirements throughout all power generation processes.

Particulate Filtration for Liquids and Gases

Pall designs, manufactures and markets the widest range of solid contamination control products anywhere. Pall filters can remove minute solid particles from liquid or gas streams, across a wide range of temperature, pressure, and chemical conditions. These particulate filters can be made of glass fibres, polymers, metals or ceramics. With various shapes, sizes and micron ratings, they offer economic, efficient and durable contamination control in some of the most critical applications in power plants.



Ultipleat High Flow/Coreless Filter Elements

Coalescence and Dehydration

Removal of moisture and aerosols from oils or fuels is paramount in order to protect machines like combustors or bearings. Moisture and aerosols carry chemical and solid contaminants responsible for deposits, chemical attacks or fluid degradation. Results can be devastating outages and high maintenance costs. Pall coalescers and oil purifiers have what it takes to remove unwanted contaminants from hydrocarbons, down to their solubility levels, and even beyond. Combustion chambers, injectors, bearings or seals all benefit from complete removal of moisture contaminants from fuels and oils.

Membrane Technologies

Membrane Technologies are by far the most effective methods for water processing applications. The Pall range of membrane systems includes microfiltration, ultrafiltration and reverse osmosis membrane technology. Pall Aria water treatment systems for example use hollow fiber microfiltration membranes to produce pure water from any water source. They remove bacteria, iron, manganese, arsenic, and other solid particulate to deliver water that consistently measures up to the toughest cleanliness and quality standards. Pall membranes are used for production of make-up water, recycling of blowdowns and wastewater, as well as water fed protection for combustion turbines.



HNP006 Oil Purifier

Contamination Monitoring

Solid Contamination Monitors

Obtaining accurate and reliable fluid cleanliness data quickly in order to detect abnormal contamination is a key factor in ensuring the efficiency of industrial processes and reducing downtime.

Reliable monitoring solutions

...whatever the conditions

...whatever the fluid

Pall have portable devices that resolve detection problems by giving plant operators the ability to measure the cleanliness of even the most troublesome fluids reliably, simply, and quickly, and prevent unnecessary and costly machinery downtime.

The Pall PCM400W Cleanliness Monitor can confirm cleanliness of almost every kind of system fluid.

The Pall PCM400W uses multiple mesh blockage technology to address the common problem of inaccurate or unreliable results when monitoring fluids that are dark, cloudy, or contaminated by water or air. Additionally it can read fluid temperature and saturated water content (when appropriate).

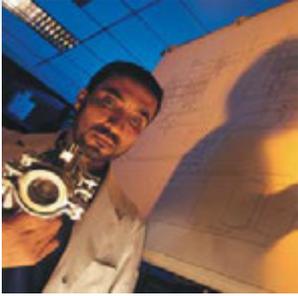


PCM400W Cleanliness Monitor

Pall Water Sensors

Wherever possible, oils should be operated without the presence of free or emulsified water.

Pall Water Sensors detect water in solution within the fluid, displayed as a percentage saturation or expressed as a parts per million (PPM) reading. Options include the handheld unit for a 'point-in-time' reading or the permanent unit which can provide continuous or timed monitoring.



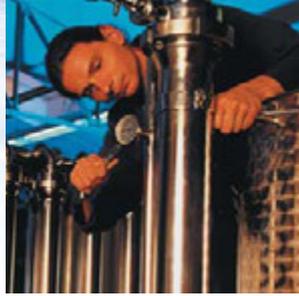
Research and Development

Working with equipment and component manufacturers in these markets, Pall custom designs products and purification systems that are fully integrated into oil and gas industry applications. These products extend component service life, enhance safety and improve the operating reliability of all processing systems.



Scientific and Laboratory Services

A principal element in Pall's customer support operations is our Scientific and Laboratory Services (SLS) Department. Filtration problems arising in the field can be assessed and simulated in the laboratory. Close monitoring by Pall scientists can determine the engineered solution to your contamination and separation problems and advise accordingly.



Sales and Support

The sales and support team comprises a group of experienced specialists located in Europe, the USA and across Asia with distributors and representatives worldwide. We offer a comprehensive sales and service support to all customers around the world.



Quality

The policy of Pall is to design and manufacture products to the highest and most current standards of quality, safety and reliability. To implement this policy, the organisational structure and the procedures by which Pall operates are fully defined in quality management systems, approved to ISO 9001:2000



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