PALL

Power Generation

Filtration Products and Services for Nuclear Power Generation

Customized Total Fluid Management for the Nuclear Power Industry

*Filtration. Separation. Solution.*SM

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

We can provide a complete analysis of the systems in your plant and recommend the correct Pall filtration and separation technologies and products to improve efficiency. Pall offers real and lasting solutions, not just quick fixes. With today's sophisticated nuclear plants, a high level of technical proficiency is required to properly inspect, diagnose, and make recommendations for your systems. Pall Corporation can provide the expertise necessary to ensure that your plant operates at peak performance.

About Pall Corporation

Our company is committed to upholding the high standards we have set for product quality and service excellence for over 50 years.

Established more than a half-century ago, Pall Corporation has grown to be the largest and most diverse filtration, separations, and purification company in the world. Our global presence is far-reaching, and our product portfolio and technical expertise are extensive. Pall offers advanced filtration solutions for the removal of contaminants from water and hydraulic fluids in nuclear power plants. We have been a dependable source of filters and media designed to ensure outstanding reliability, long service life, and top efficiency. Our credentials include: ISO 9001-2000; ASME Section VIII, Div. 1; National Board of Boiler & Pressure Vessel Inspectors "R" Certificate of Authorization; American Society of Mechanical Engineers "U" Certificate of Authorization; NSF 53 and NSF 61 certification for water systems; and UL508A and CSA22.2 for electrical systems.

Pall offers a variety of services for all phases of system operation, from start-up to decommissioning. We design and install new systems including vessels, piping, valves, and controls, as well as retrofits into existing systems. These services are provided locally, with intensive, broad-based assistance from Pall's worldwide technical support network. Located in over 30 countries, our staff of engineers and scientists are technical experts who help determine how Pall products and technologies can best be applied to benefit you. As part of your customized Total Fluid Management solution, products, processes, and services are recommended to optimize your system and help you gain the edge in this increasingly competitive marketplace.

What is Total Fluid Management?

Total Fluid Management (TFM) is the integration of properly selected filtration and separation equipment and services to yield the highest process efficiency at the lowest cost. Pall's TFM program offers a wide range of filtration products, advanced technologies, and technical services. The Power Generation Group offers its customers an exclusive TFM program unique to Pall Corporation. This package provides filtration products and diagnostic, consulting, and on-site support services tailored specifically for customers in the nuclear power industry.

How can a Total Fluid Management approach benefit you?

- Reduces your operating costs and increases your process efficiency. Pall offers unsurpassed engineered products and services to help you cost effectively meet your purification goals.
- Gives you access to an extensive, multidisciplinary team of experts including engineers, physicists, chemists, biochemists, and microbiologists. Utilize the global technical support network of the world's leader in filtration, separation, and purification solutions.
- Offers you the benefits of Pall's advanced technology. Our teams of technical specialists are well versed in all areas of filtration, separations, and purification including microfiltration, ultrafiltration, nanofiltration, reverse osmosis, and phase separation.
- Enables you to redeploy your resources. With your system in the competent hands of Pall staff, you can put your resources where they are most needed.
- Introduces you to Pall's comprehensive services program. Our Total Fluid Management program offers a full range of services to help you meet your filtration, separations, and purification requirements.

Filters that meet your requirements

Select from a wide variety of disposable and backwashable filter products to meet all your filtration needs.

Pall filters are engineered and manufactured to meet stringent quality requirements and are rigorously tested before leaving our manufacturing plants. When you choose Pall, you can be assured that you are buying high-quality, dependable, and cost-effective filter products from the company that has set the standard for nuclear filtration for over 30 years.

Our products for nuclear applications include:

- Pall Aria™ filtration systems,
- Ultipor® III hydraulic filters,
- Pall Hydro-Guard® backwashable filters (HGPPB and HGPPB-R),
- Ultipleat® High Flow filters,
- PMM® and Rigimesh® sintered metal elements,
- Ultipor® GF Plus filters,
- over 160 different types of nuclear cartridges.

As part of our TFM program, we will conduct a detailed analysis of your filtration processes and recommend the correct Pall products for your system and application. This service provides you with a customized solution for optimizing the efficiency of your system and lowering operating costs.

There are many benefits to using Pall filtration products:

- absolute rating (ß 5000) for reliable, repeatable performance,
- long service life,
- high dirt-holding capacity,
- matrix bonding to prevent media migration,
- positive sealing to eliminate fluid bypass,
- direct replacements with no modification of equipment required,
- strict quality control.

** Microza is a trademark of Asahi Kasei Corporation.*

Media

Pall's varied selection of filter media makes your customized filtration solution possible. We provide innovative disposable and backwashable media in a wide range of micron removal ratings. These materials are developed, designed, and manufactured under the strictest quality controls and have proven their exceptional performance, reliability, and consistency.

Control Rod Drive filters using Pall's rigimesh media are used throughout the BWR fleet.

The following Pall media are most commonly used for nuclear applications:

- Microza* medium: mechanically strong, oxidant-resistant hollow fiber available in MF and UF grades,
- Ultipor III medium: inert, inorganic fibers securely bonded into a fixed, tapered pore structure,
- Rigimesh medium: extremely strong, highly permeable, sintered stainless steel woven wire mesh,
- PMM medium: thin, porous metal membrane constructed of very fine stainless steel, powder, and Rigimesh sintered together to produce an absolute-rated medium,
- Ultipor GF Plus medium: resin-bonded glass fibers supported by upstream and downstream polymeric substrates.

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 radwaste, fewer changeouts, and added protection for equipment and personnel.

Plant water treatment

You can rely on Pall water treatment technologies for successful purification and reuse of water within your plant.

Plant water treatment is the most recent addition to Pall's TFM program. We provide effective filtration products for the treatment of make-up water, drinking water, and wastewater within your plant.

Make-up water

The quality of your make-up water is critical to the operation and maintenance of your steam generator and condensate systems. Pall Aria water treatment systems consistently provide high-quality effluent, regardless of the water source.

Pall Aria systems offer the following advantages:

- fully automatic,
- self-regenerable,
- remotely monitored,
- use Microza hollow fiber microfiltration and ultrafiltration membranes,
- superior control of metallics, bacteria, and colloidal and particulate silica.

Pall Aria water treatment system is compact and flexible and produces high quality treated water

These advanced features can improve your reverse osmosis (RO) operation, reduce your chemical costs for precipitation, coagulation, and RO membrane regeneration, and lower your water treatment costs.

Drinking water

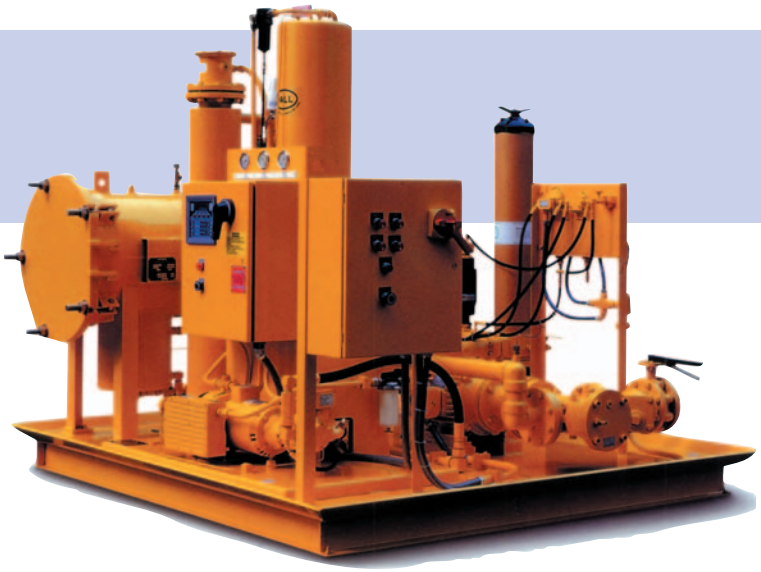
At power plants throughout the world, Pall Aria microfiltration systems have been preferred for drinking water treatment. Through the safe and cost-effective reduction of disease-causing organisms, Pall Aria systems can provide your plant with drinking water that meets strict quality standards.

Pall module cut-away reveals hollow fiber membrane

Wastewater

Successfully removing the undesirable constituents from wastewater streams is critical for conformance with stringent environmental regulations. Pall offers advanced wastewater management systems that are fully integrated, reliable, flexible, and easy to use. They are designed to optimize each step in the wastewater treatment process. Our Pall Aria microfiltration and ultrafiltration systems, backwash systems, and reverse osmosis systems successfully treat wastewater to meet your requirements, even when they are zero liquid discharge.

...for nuclear power plants



Pall's TLC unit protects steam turbine components and the generator seal oil system.

Steam turbine management

Pall offers the filters you need for efficient steam turbine management.

Through our TFM program, Pall provides products and services to improve the reliability, output, and efficiency of your steam turbine. Our total approach to turbine fluid systems optimizes turbine operation and reduces costs. We help ensure that all turbine fluids meet the most recent INPO requirements for steam turbine management.

For the smooth operation of your steam turbine, we recommend filters constructed of Pall's Ultipor and Ultipor SRT℠ medium. Both the Ultipor III filter and the Ultipor Dirt Fuse filter are outstanding products and are the most commonly used filters in steam turbine systems.

Ultipor III filters have numerous advantages, which include:

- maximum removal efficiency,
- long life,
- absolute rated down to 1 micron ($ß_1$>200),
- duplex configuration available for uninterrupted operation,
- fixed, tapered pore structure for superior dirt capacity,
- resistance to flow and pressure spikes,
- tested for integrity and efficiency.

Significant benefits of Ultipor Dirt Fuse filters include:

- 3,000 psid collapse rating,
- filtration down to 3 µm ($ß_3$ > 200),
- nonbypass design for maximum protection,
- superior flow resistance providing low differential pressure.

Steam turbine applications are crucial to reliable plant operations. Our TFM program provides products and services for applications including:

- turbine lube oil,
- electrohydraulic control (EHC),
- hydrogen seal oil.

Pall's Ultipor III cuts down on wear in turbines, reducing bearing wipes and improving start-up success.

EHC fluid treatment

The Pall HRP purifier enhances the operation of your EHC system. It combines anionic and cationic ion exchange with mass transfer dehydration and fine particulate filtration to control acid formation and maintain high volume resistivity. The HRP also reclaims degraded phosphate ester systems by removing metal salt deposits. If your EHC system uses GE or Siemens Westinghouse filters, you can convert to a Pall system by retrofitting your existing filters with our Ultipor III elements.

Hydrogen seal oil

Particulate and moisture in your hydrogen seal oil system can cause serious generator problems. Our hydrogen seal oil systems prevent these problems by protecting the seals from abrasive wear and preventing water from ingressing into the generator. Pall offers systems proven to maintain seal integrity, protect hydrogen purity, and minimize maintenance of the sealing system. We can convert your existing system by replacing your filter cartridges with Ultipor III elements.

Turbine lube oil

Your lube oil contamination problems can be resolved by implementing one of Pall's turnkey turbine lube oil systems. Our systems use high-efficiency filtration, coalescence, and mass transfer dehydration to combat contamination from water and solids.
Your benefit— consistently clean, dry oil.

...for nuclear power plants

Condensate filtration systems

Using a Pall condensate filtration system can improve the efficiency of your equipment.

Pall condensate filtration systems can lengthen the life of your equipment and prevent costly delays during start-up. Our backwashable and disposable systems effectively remove corrosion products while preventing resin bleedthrough.

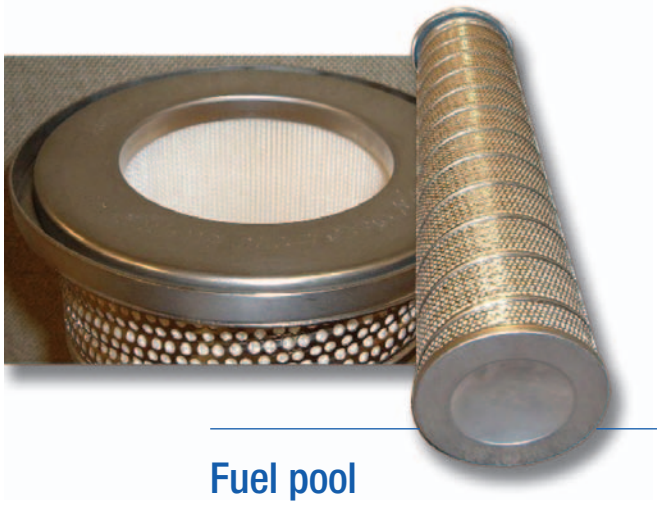
Backwashable systems

Pall backwashable elements are used around the world in small and large condensate systems to reduce particulate transport, protect steam generators and resin beds, and minimize worker exposure. Pall Hydro-Guard® PPB filters and Hydro-Guard® ColdR filters are designed for systems where filter integrity, element life, and efficiency are critical to maintaining the purity of water. Our backwashable systems can be used with and/or without precoat.

Disposable systems

Pall Ultipleat High Flow filters are frequently used in high-efficiency condensate filtration systems because they are available down to 1.0 µm absolute, are constructed of disposable media, and were designed specifically for the high flows encountered in these systems. The inside-to-outside flow configuration allows retention of particulate matter inside the element. The large diameter of the filter means that fewer filters are needed, and the small footprint lowers installation and filtration costs.

Photograph showing Ultipleat crescent pleat design.



Fuel pool

Minimize worker exposure and reduce operating costs with Pall Ultipor GF Plus® filters.

An optically clear and radiologically clean fuel pool can minimize delays resulting from crud bursts during refueling. Personnel exposure can also be decreased. Saving time and reducing radioactive exposure can cut your operating costs by millions of dollars.

Pall recommends Ultipor GF Plus filters to optimize the visual clarity of your fuel pool. These filters are used in the cleanest nuclear plants around the world to protect against radiation and to reduce waste volumes. They are strongly bonded, migration free, and capable of removing particles far smaller than the rated pore size. Our 140 series filter has the same attributes and is constructed of the same medium as the Ultipor GF Plus filter. This filter is designed to fit directly into existing Tri Nuclear Corp. underwater filter housings, without the need for rework, to keep your fuel pool clean and clear.

Radwaste

Pall filters are effective for the clarification of liquid radwaste having both high and low solids loading.

Radwaste filtration, like fuel pool clarification, can be accomplished using backwashable or disposable systems. Pall radwaste filtration systems provide highly effective decontamination of liquid radwaste. We offer complete backwashable systems that provide continuous, automated, long-term service for small- and large-flow applications. Our disposable systems are equipped with filter elements that are highly permeable and especially sturdy and efficient.

As part of our TFM program, Pall can evaluate your radwaste filtration system and upgrade it by retrofitting competitors' filters or filter assemblies with our products. If, for example, you currently have bag filter assemblies, we can retrofit them with our Marksman™ filter cartridges. Marksman elements have finer micron ratings and have been specifically designed to retrofit bag filter housings.

Reactor Water Cleanup (RWCU)

Replacing septa with Pall porous metal membranes prevents resin leakage and improves reactor water quality.

Spiral welded mesh, wedge wire, and coarse metal elements commonly found in RWCU systems allow significant resin leakage. Pall offers PMM septa and Rigimesh septa as alternatives. These filters prevent leakage without compromising filter efficiency and without the addition of cellulose fiber. In the absence of fiber, ion exchange capacity is improved, and waste costs are reduced. Converting to PMM membranes or Rigimesh membranes can substantially reduce the total time to precoat and to bring your system to full flow.

Laterals and traps

Our laterals and traps are constructed of extremely durable media to prolong the life of your demineralizer system.

Resin laterals and traps constructed of Pall's Rigimesh medium can lower differential pressure, improve resin fragment retention, and increase the service life of your demineralizer. This medium is an extremely strong, highly permeable, sintered stainless steel woven wire mesh available in a range of micron removal ratings. It forms a rigid barrier that withstands high pressure and temperature and is known for its exceptional dirt-holding capacity.

Nuclear Steam Supply System (NSSS)

Submicron absolute-rated filters can reduce radioactive exposure from your Nuclear Steam Supply System.

Exposure of plant personnel to radiation is a serious concern. Absolute-rated Pall Ultipor GF Plus filters effectively remove sources of radioactive exposure. They also reduce overall dose rates during refueling outages.

Our Ultipor GF Plus filters have additional advantages, such as:

- absolute-rated efficiency to ($ß_{0.1} > 5000$,
- effective removal of submicron particles (including Cobalt 58, Cobalt 60, and iron oxides),
- high dirt-holding capacity,
- high void volumes,
- decreased background radiation levels,
- reduced maintenance and refueling costs.

Chemical and Volume Control System (CVCS)

CVCS filter elements are expected to provide maximum removal of irradiated particulate and eliminate erosive wear of reactor coolant pump (RCP) seal surfaces. Filter elements with submicron ratings are needed to prevent seal surface corrosion. With a submicron removal rating of 0.1µm, the Ultipor GF Plus filter can significantly reduce resin fragments and corrosion products while protecting your deep bed demineralizer. This filter has also been demonstrated to reduce out-of-core radiation levels and prevent fouling of heat transfer equipment.

Our graduated filter replacement program (GFRP) is designed to maximize your cost savings by using coarser filters first, then gradually progressing through a series of continually finer filters as the inventory of particulate in your system is reduced and then maintained at the desired level.

Seal Water Injection (SWI)

Seal water injection (SWI) filters also prevent erosive wear of reactor coolant pump (RCP) seal surfaces. Ultipor GF Plus SWI filters and Seal Water Return (SWR) filters are industry proven to maintain seal leak-off rates by removing submicron particles. The removal of metal oxides and other particulate matter from your seal water ensures adequate cooling of the pump shaft and seal surface protection, thereby reducing the frequency of costly RCP seal replacement.

Quality service to optimize system performance

Pall provides quality service to ensure that your filtration, separation, and purification systems operate efficiently.

At Pall, we are dedicated to providing you with quality service to help maximize the efficiency of your system. Our engineers have a thorough knowledge of the components, design, operation, and maintenance requirements of Pall filtration and separation systems. They are expert troubleshooters who can quickly identify and resolve process inefficiencies. When additional resources are needed to diagnose and solve a problem, they call upon Pall's local and global teams of Scientific and Laboratory Services (SLS) engineers and scientists with their state-of-the-art equipment.

More than 430 SLS engineers and scientists.

Access to 41 SLS laboratories worldwide.

State-of-the-art equipment such as submicron filter test cells, scanning electron microscopes, and mass spectrometers.

High-tech communication tools – software and intranet communication tools for fast, efficient, 24/7 global information sharing.

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Pall Corporation has offices and plants throughout the world.

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