

A history of excellence...

Innovation and quality keeps Flowserve on top



Flowserve Edward's manufacturing plant in Raleigh, North Carolina.

Flowserve Corporation's involvement in the nuclear power industry dates back to the dawn of commercial nuclear power generation. Today, the company operates six nuclear-accredited manufacturing facilities in the United States, one in the United Kingdom and one in France. Ongoing investments in its product development and manufacturing capacity across the globe ensure that it can continue to meet the increasing demands of the nuclear sector in the years to come.

By Joanne McIntyre

The expansion at Flowserve includes investments in internal and external sales personnel, application, design and manufacturing engineers, tool designers and quality assurance personnel. On the manufacturing side, the company is growing its Raleigh, N.C.(USA), and Vernon, Calif., facilities to accommodate larger, faster machining capabilities, resulting in significantly increased production capacity. The facility in Springville, Utah, is in the process of regaining ASME N-Stamp accreditation, and the company's facility in Haywards Heath (UK), which has supplied the nuclear industry for many years, is also planning to increase manufacturing capacity. The company has manufactured process control equipment such as pumps, valves and actuators for more than 150 years, with various heritage brands coming together to form Flowserve in 1997.

Several of these heritage companies began their participation in commercial nuclear power generation over 50 years ago and have continued uninterrupted in this work ever since with some of their early original nuclear system supply customers including: General Electric, Westinghouse, and AREVA. Flowserve supplied equipment in the first Chinese nuclear power plant at Daya Bay and continues today as a major supplier in this developing market. Today Flowserve supports their global nuclear power generation customers with multiple manufacturing and service facilities. "New reactor designs tend to require larger equipment, so our investments are targeting both increasing capacity and being better equipped to manufacture larger items," said John Chappell, General Manager at Raleigh., "We're updating and enhancing equipment and systems to meet the upcoming production volumes

and the latest requirements not just for ASME accreditation, but also for the requirements issued by Nuclear Steam System Supplier (NSSS) companies." The mainstay of Flowserve's nuclear business at its Raleigh plant is the supply of high-specification critical-application valves, including the gate, globe and check valves used to control the primary and secondary loops in the nuclear power plant (NPP). Main steam isolation valves (MSIVs), main feed water isolation valves (MFIVs) and motor-operated valves (equipped with the Flowserve-Limitorque motor operators produced in Lynchburg, Va.) are a few of the company's key products. "Power plants undergoing upgrades look for companies with a proven track record—and that's where Flowserve excels," explained Floyd Bensinger, Product Portfolio Manager, Nuclear at Raleigh. "Our internal design and





engineering capabilities allow us to custom-design products with short lead times and to build replacement parts for obsolete items.”

As nuclear power plants are being constructed around the world, Flowserve is currently supplying equipment for plants in Finland, France, South Korea, China and the United States.

“Generally, the engineers who assist in designing and selecting valves are involved from the first day we make contact with our customers, whether they are a utility, an architectural engineering firm or a reactor supplier,” said Bensinger. “The same team that provides quotations for a job will process the contracts as they come through and then complete the design work.”

For customers, this approach means they are able to work with the same team from start to finish, ensuring they develop the right product and design. While Flowserve does provide standard products, the company is also able to custom-engineer products and services that meet the specific requirements of a customer’s facility.

Nuclear remediation

Another significant portion of Flowserve’s nuclear business is equipment for nuclear remediation. Nuclear remediation technology essentially processes spent

fuel and other nuclear waste into a more stable form through vitrification or other processes. Vitrification is a process that fuses the radioactive materials into impermeable glass solids, which can then be stored safely as the isotopes decay and ultimately become harmless. Remediated material is stable, easy to handle and suitable for permanent storage.

Flowserve developed the Durco-extended bonnet cartridge plug valve and McCANNA top-entry cartridge ball valve specifically for nuclear remediation.

“An important advantage of these cartridge valves is that they are easily repairable; all internal components of the valve can be removed in a single subassembly, and a new one can easily be installed,” said Keith Walker, Engineering Manager at the company’s Cookeville, Tenn. (USA), facility. “These valves are installed at four different locations in the U.S. and U.K.”

Often, remediation applications require special extensions be added to the valves to enable remote operation from

outside a radiation-proof containment bunker. Most valve manufacturers lack the expertise or resources or both to undertake the design of such specialized components. While each remediation site has its own requirements, Flowserve starts with the basic, proven cartridge valve design and adapts the extensions, seat, seal, and other components, based on the customer’s unique application. The valve bodies and other structural components are typically constructed from stainless steel. Seats and seals can be manufactured from UHMWPE (an ultra-high molecular weight polyethylene), a modified ethylene-tetrafluoroethylene (ETFE) fluoropolymer, PEEK (PolyEtherEther-Ketone), or metal depending on radiation, temperatures or other application parameters. The valves used for nuclear remediation are typically class 150 or 300, with sizes ranging from 1 to 6 inches.

Specialty pumps

Flowserve centrifugal pumps are used in a wide variety of applications and serve a



Vertical circulating water pump large enough to walk through.



number of roles in nuclear power plants. For the nuclear island, Flowserve supplies Class 1, 2 and 3 pumps; Class 1 pumps are involved with recirculation inside the reactor, and Class 2 and 3 pumps are part of the safe-reactor-shutdown systems. Outside the nuclear island, the plant requires the same types of pumps as a fossil station, all of which Flowserve supplies.

All pumps within the reactor are made of 300-series stainless steel due to the high working temperatures and extreme purity of the water inside the reactor. Pumps



Flowserve Anchor-Darling Flex Wedge gate valve with Flowserve Limitorque SMB motor operator.

in the balance of plant (BOP) are usually made from 400-series stainless. One exception is cooling water pumps, where material selection depends on the water source. If seawater is pumped, then a higher grade stainless or duplex stainless steel is used.

The capacity of the pumps in a NPP vary widely, with reactor coolant pumps having a capacity of up to 21,590 cubic meters per hour (m³/h) (95,000 gallons per minute (gpm)). Reactor feed pumps typically pump 3,409 to 5681 m³/h (15,000 to 25,000 gpm) depending on the station size, reactor manufacturer and quantity of pumps used. However, the truly impressive items are the cooling water pumps, which are massive and can pump as much as 68,200 m³/h (300,000 gpm). These water pumps can be up to 10 feet in diameter, where one can literally walk through them.

Of the new reactor types being placed

in service in the industry, the most well known are the AREVA EPR and the Westinghouse AP1000. Flowserve has developed new models of pumps or modifications of existing designs to fit the specific duty conditions of these reactors. "The AP1000 presents different design conditions from previous reactors, requiring different pump sizes," said Fred Grondhuis, Strategic Marketing Manager for Flowserve Power Industries. "We also developed new pump models and sizes specific to the geometry that AREVA requires for its EPR reactor design." Last year, Flowserve was awarded the AREVA Certified Supplier award and seal of approval by meeting 25 criteria including quality, sustainable development values and competitiveness. Other decisive areas address investment in innovation and R&D, and the attention to nuclear/occupational safety and the environment. "Flowserve's relationship with Westinghouse dates back to the dawn of the nuclear era," said Grondhuis. "In the U.S., more than 80 percent of all pumps currently installed in commercial reactors were manufactured by Flowserve or one of the company's heritage brands."

Extensive qualifications

The nuclear industry is well known for its strict specification and accreditation demands, and Flowserve has attained the necessary qualifications for its product range including ASME Section 3 and RCC-M standards as well QME-1, NQA-1,



Flowserve Valtek's Mark One globe control valve is popular in the nuclear industry due to its maintenance-friendly top-entry design.



Flowserve Edward's Main Steam Isolation Valve fitted with gas / hydraulic actuator.

HAF-604 and IEEE specifications for the production and manufacture of pumps, valves and actuators used in the nuclear industry.

The NQA-1 standard focuses on the achievement of results, emphasizes the role of the individual and line management in the achievement of quality, and it fosters the application of these requirements in a manner consistent with the relative importance of the item or activity. It differs from an N-Stamp by focusing on the quality system and production management controls to guarantee manufacturing quality.

"Many of the specifications for remediation projects stipulate that a vendor's quality system comply with NQA-1 requirements, and the fact that we are able to manufacture and produce valves to this standard sets Flowserve apart," explains Walker. "Few companies in the world produce valves to NQA-1 quality levels."

There has been a slow evolution in code requirements when verifying the operability of equipment in support the continuous operation of nuclear power plants.

"While ASME accreditation is well known in the U.S. and Asia, there are various other specifications and quality assurance programs in Europe," said Wayne Naumann, Nuclear Program Manager, Control Valves at Flowserve's Springville facility. "Our aim is to have our products qualified for all major markets."



Upgrades and up-rates

New plants today are being built to run with a longer life span and, through life-extension programs, the industry is moving to a design life of 60 years. "Close to half the reactors in the U.S. and around the world have already been granted life-extension licenses," said Grondhuis. "Utilities approach us to conduct design and end-of-life calculations to validate that our pumps, valves and actuators are capable of operating for the life-extension period." Flowserve works with utilities and the engineering corporations to carry out these studies and to upgrade equipment, incorporating new designs and materials to ensure that equipment can operate trouble-free for the life-extension period. An important part of life extensions include up-rates, whereby the electricity output of a station is increased. Changing some of the components in the steam cycle increases the capacity compared to the original design; more steam equates to more electricity out of the plant. Plants are implementing up-rates of up to 20 percent. "Upgrades give us the opportunity to incorporate technological advances we've made over the last 40 years to increase the efficiency and output of the plant, making it more profitable for the end users," said Grondhuis.

Service capabilities for the life of the plant

Every day that a nuclear power plant is offline during a scheduled maintenance and refueling outage can cost the utility up to \$2 million USD in profit. Accordingly, rapid servicing is essential to the profitability of the facility. Equipment such as pump and valve components are typically repaired or replaced from a stock of spare assemblies or components maintained on site. In addition to selling new equipment, Flowserve operates a global network of quick response centers (QRCs) specifically geared to providing parts, repairs and services for existing installations. Nuclear equipment is manufactured at facilities that meet the nuclear quality standards, while the balance of plant parts can be sourced from the company's commercial part centers. Flowserve operates an N-Stamp certified repair facility in Charlotte, N.C.



A set of vertical, wet-pit cooling water pumps.

(USA), to repair non-contaminated safety-related equipment.

"Flowserve also has two facilities specifically geared toward repairs on radiologically contaminated equipment, located in Memphis, Tenn.(USA), and Pittsburgh, Pa. (USA)," said Grondhuis. "Users can send pumps and valves that have been in operation to these facilities, where Flowserve decontaminates the equipment and restores the critical components to original equipment manufacturer (OEM) standards."

Flowserve can provide performance tests to ensure that the pump meets the required hydraulic performance. For the balance of plant equipment, pumps can be shipped to a commercial QRC, where critical dimensions can be restored for OEM performance.

Flowserve also offers turnkey services, meaning they can bring in not only supervisory service engineering to overhaul pumps and valves on site, but also a team with craft labor to take over the whole task, thereby offloading maintenance tasks during these very busy outage seasons. Flowserve performs everything from scheduling and specialized tooling, to writing the maintenance reports and final inspections. This system is especially handy for pumps and valves that do not get overhauled frequently and where there is a low level of experience at the plant site; as the OEM, Flowserve has a tremendous amount of experience based on previous jobs for customers around the world.

Facts & Figures

Name:	Flowserve Corporation
Headquarters:	Irving, Texas, USA
Founded:	In 1997 the name Flowserve was created when BW/IP merged with Durco International. Flowserve then acquired the Flow Control Division of Invensys in 2002.
Core Business:	Flowserve Corp. is one of the world's leading providers of fluid motion and control products and services. Operating in more than 55 countries, the company produces engineered and industrial pumps, seals and valves, as well as a range of related flow management services for the global infrastructure markets.
Key markets:	Oil and gas; power generation; chemical and pharmaceuticals; water; distribution and OEM; building and construction; food and beverage; pulp and paper; mining and mineral processing
Employees:	More than 14,000 in 56 countries
Turnover:	\$4,370 million USD (2009)

