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Power Generation: Understanding Valve Options

The power industry, in the simplest of terms, provides energy in many forms. Electric power, nuclear power, and fossil fuel based power all offer various power and electricity benefits and the unique needs of each source directly dictate the types of equipment that should be utilized. Selecting the appropriate valve for any given project can be a challenge, but finding the right fluid handling solutions for critical fluid applications is essential for public safety.

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The available flow control solutions for the power generation industry are extensive – these represent solutions for a wide variety of power generation technologies, including sub-, super-, and ultra super-critical coal-fired power plants, nuclear power plants, simple cycle gas-fired or alternative fuel-fired power plants, combined cycle power plants, concentrated solar power plants, geothermal power plants and hydroelectric power plants. There are varying risks involved with the usage of all types of power generation; the media is often severe and, thus, the equipment within the plants must be carefully considered to ensure optimum safety. Specifically, the proper valve choice is essential to creating the safest possible facilities. The ideal valve type varies based on the power generation and the location within the plant that the valve will be used. Some examples of the ideal valve solutions for various power plant types are outlined below.

Valves used for critical, hazardous, and explosive processes require extreme safety precautions; whether you are involved in the construction of a new power plant, or in operations and maintenance of an existing power plant, it is important to find the right valve for each and every unique flow control need. Additional key valve features that should be evaluated for extreme applications include cost and ease of repair, reliability, meeting or exceeding standards and self-cleaning properties. Superior customer service, product quality, and technical expertise of the valve manufacturer should also be considered.

CENTER LINE® resilient seated butterfly valve

Compac-Noz high performance nozzle type non-slam check valve

Nuclear power plant

Nuclear power is one of the cleanest energy sources available, but it is also considered to be one of the most dangerous. Due to hazards involved with this type of power generation, as illustrated most recently by the Japanese Fukushima site following the earthquake and tsunami in March of 2011, selecting superior valve and valve testing products to help to ensure plant safety are essential.

Combined cycle power plant

A combined cycle plant is a high efficiency power source designed to maximize the exhaust of one heat engine to raise the temperature of a second engine. This improves efficiencies because heat engines generally use only approximately half of the generated energy; the rest of the energy essentially goes to waste. There are many areas within this type of power plant that valves are used. For example, valves are needed within the drum, superheater, reheater, steam turbine and condenser, cooling water circulation, water treatment, condensate pumps and more, all throughout the plant. Each of these areas represents varying media concerns and valve needs.

A variety of valves are utilized throughout the combined cycle power plant; specifically, check valves, isolation valves, non-return valves, vent & drain valves, metal seated ball valves, and butterfly valves to name a few.

Coal-fired power plant

A coal-fired plant relies on burning fossil fuels, in this case coal, to produce power. Many countries, the United States included, rely heavily on this type of electricity production. This type of power plant is among the major emitters of CO_2 which is considered a contributor to global warming. In this case, it is vital that the right valve equipment is utilised to minimize emissions.

Key valve areas within the coal-fired plant are many and include boiler feed booster pumps, high pressure heaters, soot blowers, scrubbers, coal pulverizers, burners, ash handling among others. Within these key areas, valves such as check valves, isolation valves, non-return valves, extraction check valves, butterfly valves, and strainers are used.

Crane bolted bonnet swing check valve

Parabolic trough technology

Parabolic trough technology is, simply put, a mirror designed to collect solar thermal energy. In general, power plants utilizing this technology also rely on fossil fuels during non-daylight hours. Thus, in addition to the types of valve equipment needed for the fossil fuel production, these plants also utilize valves in solar fields, thermal storage, steam systems, feed and condensation systems, and circulating water systems.

Specific valves used within parabolic trough technology include 3-way valves, control valves, heat transfer fluid, isolation valves, cold reheat non-return check valves, and vent & drain valves.

Flowseal high perfomance butterfly valve

Compact linear Fresnel reflector technology

Another important solar-based energy technology is the compact linear Fresnel reflector technology. This concentrating linear technology utilizes thin lengths of mirror to draw solar thermal energy toward a common point. This technology magnifies the solar intensity significantly. Compact linear Fresnel technology utilizes flow control solutions in the steam system and feed and condensate system.

Valves most often used for compact linear Fresnel reflector technology include check valves, non-return valves, HP/HT isolation valves, control valves, and both high and low pressure isolation valves.

Flue gas desulphurization

This technology is used to remove sulphur dioxide from the exhaust of fossil fuel powered plants, including coal-fired power plants. This is important because sulphur dioxide is considered to be one of the key elements in acid rain.

In the coal-fired power plant, for example, areas that support flue gas desulphurization and rely on valve systems include recycling pumps, limestone slurry preparation, dewatering systems, waste water systems, process water circulation, gypsum systems, and oxidation air systems.

Flue gas desulphurization requires specialty valves such as slurry service isolation valves in addition to butterfly valves, diaphragm valves, and ball valves.

Selecting proper valve type

Each of these technologies employs a variety of unique flow control needs. High integrity slurry service valves, isolation valves, flow reversal protection valves, special application valves, and strainers can be found throughout a power generation site in areas such as drums, supeheater, reheater, cooling water circulation, water treatment, and more. Selecting the proper valve for any given project is important, but choosing the right fluid handling solutions for hazardous fluid applications such as these is critical for safety. Additional key valve features that should be evaluated for extreme applications include the cost and ease of repair, reliability, meeting or exceeding standards and self-cleaning properties.

Valves for high integrity slurry service

Ideal valve solutions for high integrity slurry service are tailored for every unique service application. These should include tight shut off options, a replaceable cartridge seat, and a resistance to corrosion and abrasion. The best material for this type of service is ductile iron for the body, a Hastelloy, Superduplex, stainless steel, or Hostalen GUR disc, EPDM cartridge seat, and stainless steel shaft. For operation, a hand wheel, gear, electric, pneumatic, and hydraulic options are available.

Valves for isolation service

There are four types of isolation valves to consider, where necessary, for use in these applications. These include bolted

bonnet gate, pressure seal gate, pressure seal globe, and bolted bonnet globe.
The bolted bonnet gate is best made with a body that is cast with straight through ports to minimize turbulence, erosion, and pressure drop. Properly designed bolted bonnet gate valves offer seat rings that are seal welded to reduce potential leak paths behind rings. A one-piece flexible disc can provide accurate alignment of mating seating surfaces so the valve can absorb piping strains without leakage and prevents the tendency to stick in the seated position.
The pressure seal gate valves are generally offered in two designs: parallel disc and flexible wedge. The parallel disc gate valve eliminates excessive leakage, thermal binding, and maintenance with key features such as spring-loaded discs that seal with differential pressure and self-adjust for thermal growth and pipe stresses, integrally cast body stops that eliminate over travel and prevent wire drawing or steam cutting of seats, fully-guided carrier assembly which is position-seated rather than torque seated, parallel seating components that are hard-faced and self-cleaning, lower torque requirements, and easy in-line repair and fitting.
Pressure seal globe valves are available in both y-pattern and t-pattern, as well as both globe stop and stop-check (or non-return) configurations, bodies with streamlined flow path to minimize pressure drop. Additional valve features include fully body guided discs for perfect seating in high pressure service and disc, seat rings, and backseat have hardened surfaces for maximum service life.
Finally, the bolted bonnet globe valve is available in both globe stop and stop-check (non-return) configurations, these valves are designed for services requiring frequent operation and throttling when pressure drop across the valve is approximately 20% of inlet pressure. The body is cast with heavy sections, reinforced at points subjected to the greatest stress. The seat ring is welded

Flowseal MS triple offset valve

in to minimize leak paths and the disc stem ring connects the disc to the stem, permitting the disc to swivel and aid in securing tight seating. Stop-check valves are designed for steam applications from 100 to 375 psi (9-26 bar).

Valves for flow reversal protection

The best valves for flow reversal protection include bolted bonnet swing check, pressure seal check, nozzle check, and dual plate check valves. Bolted bonnet swing check valves are used to prevent reversal of flow in horizontal pipelines. There is no tendency for the seating surfaces to gall or score because the disc meets the flat seat squarely without rubbing contact upon closing. These valves can be furnished with outside lever and adjustable weight in certain sizes to assist in closing the valve more rapidly, thus minimizing reversal of flow and resultant surge and shock.
Pressure seal check valves are offered with tilting disc, y-pattern lift, and t-pattern lift configurations. The tilting disc check valve uses gravity to rapidly close the disc upon flow reversal. The valve design fully opens or closes through an arc of only 45 degrees and conical seating is self-aligning, tight, and always closed in a no-flow situation. In addition, hard-faced seating surfaces, large diameter hinge pins, and corrosion resistant bearing surfaces ensure long life, and an internal disc stop prevents flutter.
Nozzle check valves are engineered and sized for each specific application and offers one piece body casting which eliminates body penetration and fugitive emissions. This valve also has only one moving part which results in minimum

Krombach metal Seated ball valve

wear and longer life; it also has a short stroke length which results in quick, dynamic response and minimizes the reverse velocity through the valve. The dual plate check valve is lightweight and compacted in comparison to the traditional swing check valve. The valve has a spring-assisted closure and plates that are more responsive to changes in flow conditions. The faster response time, improved by the use of independent springs and support sleeves, minimizes water hammer risks for non-slam applications.

Valves for special applications

Valves suited for special applications in the power generation industry include triple offset, high performance butterfly valves, double eccentric butterfly valves, metal seated ball valves, and resilient-seated concentric butterfly valves. The triple offset valve offers bi-directional gas tightness, innovative self-centering, flexible disc sealing. The design flexibility allows for ease of use in customized solutions. The high performance butterfly valve offers a soft or metal seated design, is unparalleled in vacuum-to-low pressure environments, and is fire safe. The double eccentric butterfly valve boasts a soft seated design that provides tight shutoff and optimal flow profile of disc. The metal seated ball valve offers an interchangeable ball and seat design which allows for a lower cost of repair. It is also fire safe, anti-static, and useful in high temperature applications up to 800°C. And finally, the resilient-seated concentric butterfly valve is qualified for use in both gaseous and liquid service. It offers a positive bi-directional shutoff and a Phenolic backed cartridge seat.

Krombach triple offset valve

Pacific valve tilting disc check

Noz-Chek® high performance nozzle non-slam check valve

About the author

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