Controlling Fluid flow through proper Control Valve Operation

In the oil and gas industry whether upstream, mid stream, or downstream various pipe apparatus such as valves, elbows etc are needed to control the flow of fluid, to release the excessive pressure in the pipeline to eliminate the accumulation of air in the summits of the pipeline.

The control valve is known as the final control element. This is because it is the final element that ultimately manipulates the value of the variable in the control process. It is defined as the mechanism that alters the value of the manipulated variable in response to the output signal from a controller whether automatic, manual, or by direct human action. Controllers can be set an automatic or manual control.

The control valve has two parts: The valve body and the valve plug which differ in geometry and material construction. The combined body and plug geometry determines the flow properties of the valve. The valve flow differs in design, there are the through flow types, the blending and stream splitting types configurations. Likewise valve seat also differ in construction, there are the conventional and contoured valve seat types with parabolic and quick opening plugs, whose internals can only be inspected during servicing.

The control loop is a close system consisting of selected instruments that work together as a unit with the single objective of controlling the identified problem. A loop consists of a sensor which can be an orifice, thermocouple, or a venture meter, a transmitter which can be either differential pressure electro-pneumatic or pneumatic transmitter, an indicator which can be a pressure gauge, level gauge or temperature gauge, a transducer which converts the reported signal from the manipulated form, to the form understandable to the final control instrument or a positioner which gives proportion al positional action to the valve stem so as to correctly position the plug in the valve body and finally the control valve.

There are different types of valve that are used either to control the flow of fluids, or to control the pressure of fluids. They are:

- Relief valves
- Non-return valves
- Globe valves
- Gate valves
- Butterfly valves
- Ball valves
- Diaphragm valves
- Plug valves

Relief Valves: The relief valves are also known as pressure relief valves, cut off valves, or safety valves. These are automatic valves used on system lines and equipment to prevent over pressurisation. Relief valves normally have a spring which the power of the spring is so adjusted that the valve always remain in closed position up to some permissible fluid pressure in the pipeline. When the pressure of the fluid suddenly exceeds the permissible pressure, the valve opens (lifts) automatically and the excess pressure is released instantaneously and then resets (shuts). Thus the pipeline is protected from bursting. These valves are provided along the pipeline at some points where the pressure is likely to

increase. Other types of relief valves are the high pressure air safety relief valves and the bleed air surge relief valve. Both of these types are designed to open completely at a specified lift pressure and to remain open until a specific reset pressure is reached at which time they shut.

Non-return Valves: They are also known as reflux valves or check valves These possess some automatic device which allow the water to flow in one direction only, see fig 1. They are made of brass or gun metal. Usually, a valve is pivoted at one end and it can rest on a projection on the other end. This valve is provided in the pipeline which draws the fluid from the pump. When the pump is operated, the valve is open and the fluid flows through the pipe. But, when the pump is suddenly stopped or it fails due to power failure, the valve is automatically closed and the fluid is prevented from returning to the pump.

Globe Valves: These are probably the mostly common valves in existence. The globe valve derives its name from the globular shape of the valve body. However, positive identification of a globe valve must be made internally because other valve types may have globular appearing bodies. Globe valve inlet and outlet openings are used extensively throughout the engineering plant and other parts of the ship in a variety of systems.

In this valve fluid passes through a restricted opening and changes direction several times. It is extensively used for regulations of flow.

Gate Valves: Gate valves are usually used when a straight line flow of fluid and minimum restriction is desired. They are also named because the part that either stops or allows flow through the valve acts somewhat like the opening and closing of a gate. When the valve is wide open, it is fully drawn up into the valve, leaving an opening for flow through the valve the same size as the pipe in which the valve is installed. Therefore, there is little pressure drop or flow restriction through the valve. Gate valves are not usually suitable for throttling purposes because the control of flow would be difficult due to valve design and since the flow of fluid slapping against a partially open gate can cause serious damage to the valve. Gate valves used in steam systems always have flexible gates. The reason is to prevent binding of the gate within the valve when the valve is in close position. When steam lines are heated, they will expand causing some distortion of valve bodies. If a solid gate fits snugly between the seat of the valve in a cold steam system, when the system is heated and pipes elongate, the seats will compress against the gate, wedging the gate between them and clamping the valve shut. This problem is overcome by use of a flexible gate. This allows the gate to flex as the valve seat compress it, thereby preventing clamping.

Butterfly Valves: The butterfly valve is used in a variety of systems aboard vessel. These valves can be used effectively in salt water, lube oil and fresh water systems. The butterfly valves are light in weight, relatively small, quick acting, provides positive shut-off, and can be used in throttling. This valve has a body, a resilient seat, a butterfly disk, a stem, packing, a notched positioning plate, and a handle. The resilient seat is under compression when it is mounted in the valve body, thus making a seal around the periphery of the disk and both upper and lower points where the stem passes through the seat. Packing is provided to form a positive seal around the stem for added protection in case the seal formed by the seat should become damaged. Butterfly valves are easy to maintain. The resilient seat is held in place by mechanical means, and neither bonding nor cementing is necessary, because the seat is replaceable, the valve seat does not require lapping, grinding, or machine work.

Ball Valves: These are stop valves that use a ball to stop or start the flow of fluid. When the valve handle is operated to open the valve, the ball rotates to a point where the hole through the ball is in line with the valve body inlet and outlet. When the valve is shut, which requires only a 90 degree rotation of the hand wheel for most valves, the ball is rotated so the hole is perpendicular to the flow openings of the valve body, and flow is stopped. Most of ball valves are of the quick acting type, but many are planetary gear operated. This type of gearing allows the use of relatively small hand wheel and operating force to operate a fairly large valve. The gearing however increases the operating time for the valve. Ball valve is normally found in the following systems: desalination plants, trim and drain, air, hydraulic, and oil transfer etc. It is used for

general service, high temperature conditions and slurries.

Diaphragm Valves: In the diaphragm control valve, operating air from the pilot acts on the valve diaphragm. The substructure which contains the diaphragm is direct acting in some valves and reverse acting in others. If the substructure is direct acting, the operating air pressure from the control pilot is applied to the top of the valve diaphragm. If the substructure is reverse acting, the operating air pressure from the pilot is applied to the underside of the valve diaphragm.

They are also lined to pressures of approximately 50psi. they are used for fluids containing suspended solids and can be installed in any position. In this valve, pressure drop is reduced to a negligible quantity.

Finally, the only maintenance required in this valve is the replacement of the diaphragm which can be done without removing the valve from the line.

Plug Valves: It is a quarter turn valve that controls flow by means of a cylindrical or tapered plug with a hole through the centre which can be positioned from open to close by a 90 degree turn. They are used for general services slurries, liquids, vapours, gases, and corrosives.

Operating a Control Valve

For the effective operation, controlling and maintenance of a valve, certain activities are to be well known and acquainted with to an operator. The most important operations are as follows;

- How to Stroke a Control Valve
- How to Line-up a Control Valve
- How to By-pass a Control Valve
- How to Spot-in a Control Valve

To Stroke a Control Valve: Stroking of control valve is an action carried out jointly between the field or unit operator and the control room operator. It is the opening and closing of the valve in isolation to inspect whether it is responding correctly or not with the indications. The panel operator alters the valve positions and the unit operator visualises the position. Instruments are air actuated because they are pneumatic. So always confirm that the air is readily lined up to the control valve through the air filter.

a. Ensure that the control valve is isolated.

b. Ensure that both the unit operator and the panel operator have communication devices.

c. Open the valve to the maximum and close it suddenly, then reopen it to any position and confirm the real opening out onsite. It is recommended that the percentages of the opening can range from below 0%, 25%, 50%, 75%, 100%, and above 100%.

d. Return the valve to a close position while leaving it in the isolated status.

When errors are discovered the values should be recommended for rectification. The maintenance personnel should readily check to confirm the faults and urgently address it. When that is done the valve should be lined up for operation.

To line-up a Control Valve: Lining up of process control valve is just the commissioning of the isolation valves at its terminals. Operators need to know the location of every valve in the unit. That is the first thing a fresh trainee should do. Line tracing, knowing the chemical and physical properties of materials, and process equipment and chemistry knowledge is very essential to everyone who works therein.

a. Always confirm that the instrument air is available foe the valve use (if air actuated).

b. Commission the isolation valves.

c. Always notify the panel operator the process status of the valve.

To By-pass a Control Valve: When a valve during operation is to be by-passed, care must be taken not to disturb the flow, pressure or whatever parameter it controls. Valve by-passing is the diversion of the floe direction of the process stream away from the valve.

a. Inform the panel operator your readiness to divert the valve flow to the valve by-pass.

b. Gradually commission the by-pass valve (globe) to give a slight increase in flow. The flow increase can be noticed on the side indicator.

c. Thereafter start to block in the downstream valve of the control valve while increasing the percentage opening of the by-pass valve so as to maintain the same flow rate through the by-passing.

Valves are by-passed when they are faulty or when more flow than the maximum flow through the control

valve is needed. This requirement is usually abnormal and is applied in rare occasions. By-passing valves are not regular control valves, therefore as soon as the fault is rectified or the flow stabilises, the by-pass valves should be returned to its close position. Most by-pass valves are globe valves because they are regulatory in operation.

To Spot-in a Control Valve: This is defined as a method used to usually determine whether the valve seat and the disk make a good contact with each other. In spotting-in a valve seat certain procedures are to be follwed;

a. First apply a thin coating of perussian blue (commonly known as Blue Dykem) evenly over the entire machined face surface of the disk.

b. Insert the disk into the valve and rotate it one-quarter turn, using a light downward pressure. The perussian blue will adhere to the valve seat at those points where the disk makes contact. After noting the condition of the seat surface, wipe all the perussian blue off the disk face surface.

c. Apply a thin, even coat of the perussian blue to the contact face of the seat, place the disk on the valve seat again, and rotate the disk one-quarter turn.

d. Examine the resulting blue ring on the valve disk. The ring should be unbroken and of uniform width. If in any way the blue ring breaks, that means the disk is not making proper contact with the seat(then retry the spotting-in again).

Preventive Maintenance

Preventive maintenance is the best way of extending the life of valves. When making repairs of more sophisticated valve types, always make use of the available manufacturers manuals. As soon as you observe a leak, determine its cause, and then apply the proper corrective maintenance, and later follow its preventive maintenance. Maintenance may be as simple as tightening a packing nut or gland. A leaking flange joint may need only to have the bolts tightened or to have a new gasket inserted. Dirt and scale if allowed to collect will cause leakage.

Whenever you are going to install a valve, be sure you know the function the valve is going to perform, that is whether it must start flow, stop flow, regulate flow, regulate pressure, or prevent backflow. Always inspect the valve body for the information that is stamped upon it by the manufacturer like type of system (oil, gas, water), operating pressure, operating temperature, direction of flow, and other information.

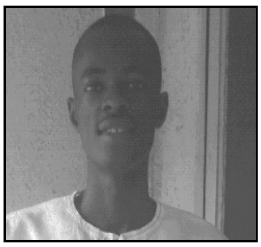
You should also know the operating characteristics of the valve, the metal from which it is made, and the type of end connection with which it is fitted. Operating characteristics and the materials are factors that affect the length and kind of service that a valve will give; end connections indicate whether or not a particular valve is suited to the installation.

When you install valves ensure that they are readily accessible and allow enough headroom for full operation. Install valves with stems pointing upwards if possible. A position of a stem between horizontal and straight up is acceptable, but avoid stem pointing downwards, because if allowed sediments will collect in the bonnet and score the stem. Also, in a line that is subject to freezing temperatures, liquid that is trapped in the valve bonnet may freeze and rupture it.

Addendum

In summary, a good understanding, operation, and maintenance of a control valve will go a long way towards extending the life of the control valve. Team work between the unit operator (field operator) and panel operator must be very essential.

About the author.



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