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Carbon dioxide Snuffing System

Akhil Raj[1], Dr.E.Palaniswamy[2], S.P.Venkatesan[3]
ME Student (ISE) [1], Professor[2], Associate Professor[3]
Department of Mechanical Engineering
Excel College of Engineering and Technology, Komarapalayam, Tamil Nadu, India

Abstract:
Fire protection in electrical control rooms can be a dispute subject, but it is an important thing, especially in today's regulated society. Fires in hydrocarbon industries are serious hazard to both life and property. Fire is the main cause of loss in the process industry. It causes extensive property damage. Fire protection measures constitute both passive and active fire protection. Passive protection comprises measures, which are taken to limit its spreading. Measures of active protection are to limit or prevent the escalation of fire, achieved by protective devices. The paper presents the solution for protection against fire in the Captive Power Plant (CPP). Existing firefighting equipment could be replaced with pressurized automatic carbon dioxide system. Carbon dioxide systems are typically used on equipment and devices that would have flammable or combustible liquids in use but which would be severely damaged by the use of dry chemicals.

Keywords: online weight monitoring, thermal detector, pneumatic time delay, snuffing system, halon.

I. INTRODUCTION

The evolution of the petroleum refining from simple distillation to today's sophisticated processes has created a need for health and safety management procedures and safe work practices. Safety and health professionals, working with process, chemical, instrumentation assure that physical, mechanical, chemical and health hazards are recognized and provisions are made for safe operating practices and appropriate protective measures. Processes used in the refinery are inherently safe by virtue of extensive HAZOP studies and risk analysis carried out prior to their adoption. HAZOP is done for even smallest modification in the existing system by multidisciplinary committee comprising experts from Process Engineering, Operations, Design engineering, Safety, Advisory Services and maintenances. A scheme is evolved after detailed deliberation on process as well as personnel safety aspects. After design and detailed engineering, the scheme is executed as per good engineering practices. Safety measures are taken in right from the design stage, by conducting the risk analysis studies. This applies to all the process design and equipment selection including its material of construction. The first of the major hazards in oil industries is fire. Fire is the main causes of loss in the process industry. It causes extensive property damages. Man's greatest asset and yet his most devastating foe is the element of fire. When under his control, it serves him faithfully when beyond control; it is prime element of his destruction. No other element has brought so much devastation in the course of human history. The damage caused by fire is continuously increasing and no installation is free from the damage of fire. Fire protection measure constitute both passive and active fire protection. The project mainly focused on the fire protection on electrical systems. Normal fire can be easily stopped by using any medium like water, foam etc. A fire occurring in an electrical system is very difficult to cutoff. At normal temperatures, carbon dioxide gas is 1.5 times heavier than air. Thus carbon dioxide extinguishes fire by smothering i.e. by displacing oxygen content in the surrounding air to 15% or lower. Materials that generate their own oxygen as they burn cannot be extinguished by carbon dioxide. Carbon dioxide is used for putting out fires in oils, petroleum and electrical apparatus. Installation is protected by automatic Carbon dioxide fire extinguishing system designed to sense and put off the fire. Carbon dioxide fire extinguishing system are useful in extinguishing fires in specific hazards or equipment, and in occupancies, where an inert electrically nonconductive medium is essential or desirable, where cleanup of other media presents a problem or where they are more economical to install than system using other media.

II. OBJECTIVES

The principal objective of carbon dioxide snuffing system is to reduce the spreading of fire in the plant and having less health effect. Snuffing system is having less environment pollution and is eco-friendly. Carbon dioxide is effective in areas where flammable solids, liquids and vapors are present. Fires in these hazards spread very rapidly. Deep seated fires associated with hazards such as electrical equipment are equally well protected with carbon dioxide system. A fixed pipe carbon dioxide system engineered, specifically for a particular hazard with rapid extinguishment. The design of carbon dioxide snuffing system is used based on the need to reduce the health problem due to Halon which is used for extinguishing. Carbon dioxide will reduce the level of oxygen and fire can be easily extinguished. This report covers the minimum requirement for the design, engineering, manufacturing, testing of Carbon dioxide snuffing system for Generator used in Captive power plant.

III. FEATURES OF SYSTEM

1. Electro/Pneumatically operated Valve (Master Valve) has facility for confirmation of opening of valve without discharge of carbon dioxide gas.
2. All carbon dioxide valves shall be pneumatic and reusable type and does not require any consumable during refilling and hence no additional cost for maintenance.
3. The solenoid valve for actuating the carbon dioxide valve shall be detachable type and capable to fit at site. It can be removed during transportation of cylinders. This will

helpful in preventing damage in transit & storage till the site is actually commissioned.

4. The solenoid Valve for actuating the carbon dioxide valve is not is pressurized condition even after fitment of valve & carbon dioxide cylinders. This avoids the chances of false discharge in event of non-fire situations.

5. Electro/ pneumatically operated valve (Master Valve) shall have facility to actuate the system by mechanical means that means during power failure & in fire condition, one can actuate manually.

6. Online Cylinder Weight Monitoring Device shall be hanging type &suitable for multi capacity cylinders. This allows you to use this weighing device in any capacity of carbon dioxide cylinders.

IV. MATERIAL SELECTION

Manifold Check Valve:

One manifold check valve is provided per cylinder connected to any working carbon dioxide battery. This valve is provided vertically at the stub pipe of the manifold and is connected by means of a high-pressure hose to the outlet point of the cylinder. The purpose of the valve is to serve as a one-way route valve, allowing flow of carbon dioxide into the manifold but preventing any flow in the reverse direction. The valve can only be used in the vertical positions. When a cylinder discharges, pressure of the carbon dioxide pushes the ball upwards, which is restricted from entering the manifold by the pin provided at the upper position of the manifold check valve. The manifold checks valve for the manifold is provided with 3-4" BSP threads at the manifold end ½ BSP at the H.P hose end.

Online Weight Monitoring Device:

At normal position when the cylinder is fixed on hanging type device, it is connected with limited switch which remain at normally open condition. In the event of weight loss more than 10% of the total weight of carbon dioxide gas is gone. The arm connected to the weight moves down and the changes in the position activate the limit switch to normally close. The limit switch connected through cables to weight monitoring panel. After operating the limit switch the panel will give the weight monitoring visual indication.

Solenoid Valve:

A solenoid valve is an electromechanical valve for use with liquid or gas controlled by running or stopping an electric current through a solenoid, which is a coil of wire, thus changing the state of the valve. The operation of a solenoid valve is similar to that of a light switch, but typically controls the flow of air or water, whereas a light switch typically controls the flow of electricity. Solenoid valve may have two or more ports, in the case of a two port valve the flow is switched on or off, in the case of a three port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold. Solenoid valves are the most frequency used, control elements in fluids. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long services life, good medium compatibility of the materials used, low control power and compact design. Besides the plunger type actuator which is used most frequently pivoted armature actuators are used. A solenoid valve has two main parts, the solenoid and the valve. The solenoid converts electrical energy into mechanical energy which in turn opens and closes the valve mechanically. A direct acting valve has only a small flow circuit. The diaphragm piloted valve multiplies this small flow using it to control the flow through a much larger orifice. Solenoid valves may use metal seals or rubber seals and may also have electrical interfaces to allow for easy control. A spring may be used to hold the valve opened or closed while the valve is not activated. The solenoid valves are controlled by an electrical signal from the thermostat to regulate the flow of heated water to the heating elements within the occupied space. Such valves are particularly useful when multiple heating zones are fed by a single heat source. Commercially available solenoid valves for this purpose are often referred to as zone valves. Another use for solenoid valves is in automatic irrigation sprinkler systems.

Manual Actuator:

A manual actuator is used to operate the carbon dioxide system manually and locally at the cylinders. The actuator is screwed into a port on the top of the cylinders valve. When two master cylinders are required, the levers of the two actuators are joined together with a connecting link for simultaneous operation. The actuator has a hole in the side of the main body fitted with a blank plug. The hole allows to actuator to be operated from an external pressure source. It is also used to connect to the discharge from the solenoid valve. The blank plug is removed from the actuator only for these two purposes. Otherwise the plug must remain tightly connected at all times.

The hand lever on the manual actuator can be operated from a remote location. This is achieved be connecting 1/16" diameter stainless steel cable to the end of the lever, and running the cable through ½" conduit or 3/8" pipe to a pull box using corner pulleys at each change in the cable direction. Using mechanical dual junction box, two remote pull boxes can be joined to operate one master cylinder arrangement. Or, one remote pull box can be used to operate two separate manual actuators.

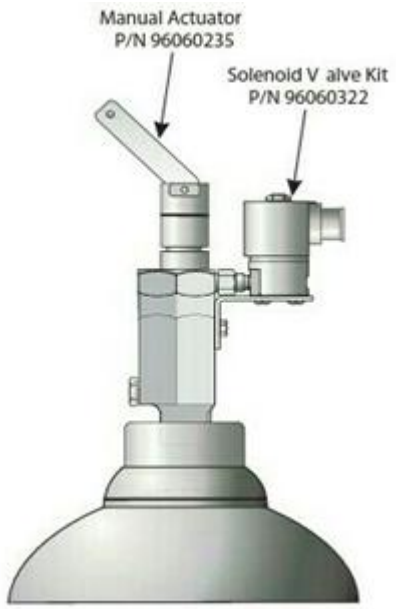

Figure.1. Manual Actuator

Directional Valve:

Directional control valves are one of the most fundamental parts in hydraulic machinery as well as pneumatic machinery. They allow fluid flow into different paths from one or more sources. They usually consist of a spool inside a cylinder which is mechanically or electrically controlled. The movement of the spool restricts or permits the flow, thus it controls the fluid flow. They are widely used in the hydraulic industry. These valves make use of electromechanical solenoids for sliding of the spool. However electrical solenoids cannot generate large forces unless supplied with large amounts of electrical power. Heat generation poses a threat to extended use of these valves when energized over time. Many

have a limited duty cycles, this makes their direct acting use commonly limited to actuating forces.

Explosion Proof Thermal Detector:

The explosion proof thermal detectors are used to detect the presence of heat beyond the detectors temperature set point for the purpose of activating a fire alarm and automatic snuffing system. The detectors are explosion rated for class I and class II hazardous environments. The maximum area coverage for each detector is rated at 50ft x 50ft in accordance with the manufacturer specified limitations. The thermal detectors are normally open devices designed especially for fire detection and alarm systems. The detectors are a rate anticipation type that operates immediately whenever the ambient area temperature reaches the present temperature setting of the detector, regardless of how fast or slow the temperature rises. When the temperature drops back down below the set point, the detector will reset itself. Under rapid heat increase situations, the rate anticipation features allows the detector to respond one or three degrees ahead of the set point. However the detector does not respond to momentary fluctuations of temperatures below that of the alarm setting, thus eliminating false alarms.

Pneumatic Time Delay:

A pneumatic time delay shall be provided for snuffing systems protecting normally occupied and occupiable enclosures and local application systems where the carbon dioxide discharge will expose personnel to hazardous concentrations. The pneumatic time delay delays the discharge of carbon dioxide for predetermined amount of time. This extra time allows additional time for ventilation and equipment shutdown. The time delay is installed between the master carbon dioxide cylinders and the discharge nozzles. The time delay has inlet port and outlet port. The actual time delay period is pre-set at the factory. Time delay will operate at temperature from 0 to 130^0F. The time delay is equipped with manual override lever. This lever allows the time delay to be bypassed and allows the carbon dioxide to discharge immediately.

Electric Actuator:

Electric actuator is achieved by using a solenoid valve kit. The solenoid valve is normally closed device, closed when de-energized and open when energized. The standard solenoid voltage is 24 VDC, but other voltages and special enclosures are available by special order. The standard electric connection is by a DIN connector, and a cable assembly is available for ease of connection to field wiring.

V. RESULTS AND DISCUSSION

The system is protected with Initial Cylinder Bank, which will discharge carbon dioxide gas within 1 minute to achieve 50% concentration & Extended cylinder bank that will discharge carbon dioxide gas slowly for the period of run down time of Generator. Both the systems start simultaneously in case of fire The first Master carbon dioxide cylinder filled with carbon dioxide gas is having Solenoid value connection. All cylinders of the carbon dioxide battery is fettled with pneumatically operated carbon dioxide Value. High-pressure flexible hose to the manifold connects outlet of each cylinder where a Manifold Check value is provided. To detect the Weight loss of each cylinder, online weighing device is provided for each cylinder. The limit switch being a part of the weighing device which will convey the signal output to Control Panel of cylinder weight loss of Initial and Extended cylinder bank. For Manual operation of carbon dioxide system Manual gas release is provider of generator & Turbine compartment. One abort switch is provided for generator. Both the initial and extended cylinder bank have been provided 100% stand by cylinders so as to keep the system protected in case the cylinders from main bank are empty removed for refilling. A selector switch is provided changing from main to stand by system.

Auto Actuation:

After getting the fire signal from detectors provided in the generator compartment, i.e. after cross zoning of the fire detectors, the control panel will sends the signal to solenoid valve of carbon dioxide cylinder to open the cylinder valve. The solenoid valve of master carbon dioxide cylinder will open the master valve and carbon dioxide gas will be discharged into the master valve and it will open the balance pneumatically operated valves connected in line with manifold. The pressure switches are provided near the outlet of the manifold. The pressure switches are connected in parallel to the control panel, which provides visual indication of "Carbon dioxide Discharged". While sending the cylinders for refilling, the hoses should be disconnected from the cylinder valve. The cylinder together with valve should be sent for refilling. A selector switch is provided to keep the system in manual or auto mode as required. When auto mode is selected, the system functions as given above. When manual mode is selected, the actuation does not happen after cross zoning and only alarm is given.

Manual Actuation (Remote)

For remote manual actuation, manual release switch is provided near generator area. After activating the manual release switch, the control panel sends signal to the solenoid valve of master carbon dioxide cylinder. The solenoid valve of the master cylinder will open the master valve and carbon dioxide gas will be discharged into the master valve of the carbon dioxide cylinders and it will operate the balance pneumatically operated slave valve connected in line with the manifold. The carbon dioxide valve of all cylinders will open and discharge carbon dioxide gas into the manifold

Manual Actuation (Local):

For local manual actuation, manual handle of master cylinders can be operated manually. The gas of master carbon dioxide cylinder will open all the pneumatically operated slave cylinders in the bank. The carbon dioxide gas will flow through discharge horn, manifold check valve, carbon dioxide discharge manifold, and piping, finally discharges through discharge nozzles in the protected area.

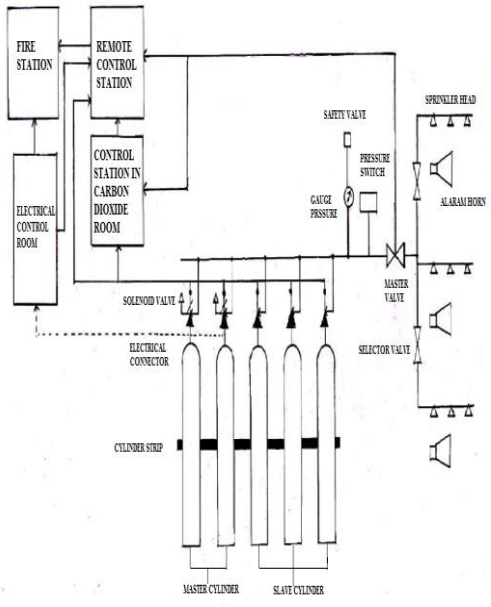

Figure.1. Line Diagram of Carbon Dioxide Snuffing System

VI. CONCLUSION

The proposed carbon dioxide snuffing system should be designed and engineered. Halon flooding system should be replaced completely and snuffing system should be designed to reduce the harms and damages caused due to halons. Halons are toxic and cause cardiovascular problems to humans. Halons can reduce the stability of the generator and get corrode due to the chemicals present in the halon. This project is done to insert carbon dioxide snuffing system in the generator area. The carbon dioxide snuffing system inserted is working satisfactorily and proposed idea will reduce the fire. Carbon dioxide has many of the positive attributes of a clean fire extinguishing agent for fire extinguishing application. Because of this, carbon dioxide has been and is being used for fire protection. Carbon dioxide system has a cooling effect on the surrounding atmosphere and it will be benefit in case of fire. Carbon dioxide is effective in areas where flammable solids, liquids and vapors are present. Fires in these hazards spread very rapidly. A fixed pipe carbon dioxide snuffing system engineered, specifically for a particular hazard with rapid extinguishment. Carbon dioxide extinguishes fire by reducing the oxygen content of the protected system. It protects the components from causing massive damage due to fire.

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