CHEMETRON™ Fire Systems

CARDOX

CO_2 Application Bulletin

CARBON DIOXIDE FIRE SUPPRESSION —

Coal Storage Silos and Bunkers

Active coal storage consists of storage of coal in a bin, silo or bunker. For the purposes of this bulletin, we will discuss silo storage in a common power plant configuration. The coal is fed by conveyor into the top of the silo; it then flows by gravity out the bottom to the coal feeder (as shown on the accompanying drawing), or to a conveyor to the coal feeder, and then to the processing equipment (in this case, the coal pulverizer). (See Power Generation Bulletin #0045 for information on Coal Pulverizer Inerting and Fire Protection.)

The protection techniques discussed apply just as well if the storage is a bin or bunker.

Coal stored in silos before it is fed into the coal mills of a steam electric generating station (or other similar short term storage application) continually oxidizes and generates heat. In the event of an unscheduled shutdown, coal trapped in the silo will oxidize enough to eventually start to burn. The length of time that it takes to heat the coal to burning is a function of the reactivity of the coal. Some of the Western United States coal will reach this point in just a few days.

Fires will be more frequent if the silo/bunker is not cleaned periodically and/or proper filling procedures are not followed. In the event of a fire, it is usually not practical to run the coal from the silo out onto the ground; therefore, fire control in the silo/bunker is necessary. Inerting and fire control with CO_2 vapor is widely used.

The techniques described here are based on work done by Cardox Corporation (predecessor to Chemetron Fire Systems) and Commonwealth Edison in 1953, and refined by hundreds of installations at many different sites, with many different coals, in the interim.

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A World of Protection

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CO_2 System Design

The principle of this protection is to push CO_2 vapor through the coal, reach the level of adsorption, and fill all the void spaces between the coal particles to reduce the oxygen available to the fire to near zero. At some point, the generation of heat by oxidation will become less than the heat loss by conduction, and the burning mass will cool. Holding this condition long enough will effect fire extinguishment. To inert the coal, CO_2 vapor is used. If liquid CO_2 is discharged to atmospheric pressure, dry ice particles are formed, which could block the gas flow.

It is well known that carbon will adsorb CO_2. (Carbon filters specifically designed for this purpose will adsorb many volumes of CO_2.) Coal, while not particularly efficient in removing CO_2 from a CO_2 /air mixture, will still cause CO_2 to adsorb to its surface.

The U.S. Bureau of Mines has evaluated and quantified this characteristic and Chemetron Fire Systems has tested for this as well, which allows estimating anticipated CO_2 use. If fire is detected down in the coal, the minimum recommended amount of CO_2 needed for inerting is approximately three gross volumes of the silo, assuming minimal loss out the bottom of the silo.

At the time that the coal is burning in the storage silo, combustible gasses (carbon monoxide and methane) will be created, and they could cause a problem in the air space above the coal. Detection for these gasses is common practice and identification of a high level indicates a need for inerting (fire control). Therefore, it's advisable to inert the space above the coal to a safe level, and do it quickly.

Procedure Used

In the event a fire is detected (or suspected), the CO_2 vapor flow is started by injecting the CO_2 above the coal, as well as into the coal at the sloping surface of the silo. (The bottom of the silo is sloped to 70° or more to ensure a smooth flow.)

Ventilation in the air space is shut down and a CO_2 concentration of 75% or more achieved as quickly as practical.

Injection of the CO_2 vapor above the coal is done gently to reduce the turbulence that might unnecessarily stir up coal dust.

When the air space above the coal is inerted, the CO_2 application rate there is cut back, and the rate of CO_2 application into the coal at the bottom of the silo is increased until this CO_2 vapor starts to come out the top of the stored coal. At this point, this CO_2 flow is also cut back to a maintenance rate. The CO_2 is held in the silo as long as necessary.

Equipment Used

CO_2 is stored as a liquid and vaporized by a vaporizer. Flow controls (throttling valves with pressure gauges and metering orifices) are used to properly distribute and measure the CO_2 flow.

The system is designed so that CO_2 application at the top or at the bottom of the silo can be increased or decreased as needed.

Chemetron's system design limits the CO_2 vapor pressure at the nozzle orifice to reduce turbulence.

If the silo is in the popular 20 - 25 foot diameter range, only one injection point at the top, plus another injection point at the bottom, are needed. With larger diameter silos, increasing the number of application points to three each is appropriate.

NOTE

USING THESE GUIDELINES, IF THE STORAGE SILO IS LARGE ENOUGH TO REQUIRE A CO_2 FLOW RATE OF MORE THAN 1,100 LBS./HOUR, THE CHEMETRON FIRE SYSTEMS APPLICATIONS ENGINEERING GROUP SHOULD BE CONSULTED BEFORE THE SYSTEM IS SPECIFIED.

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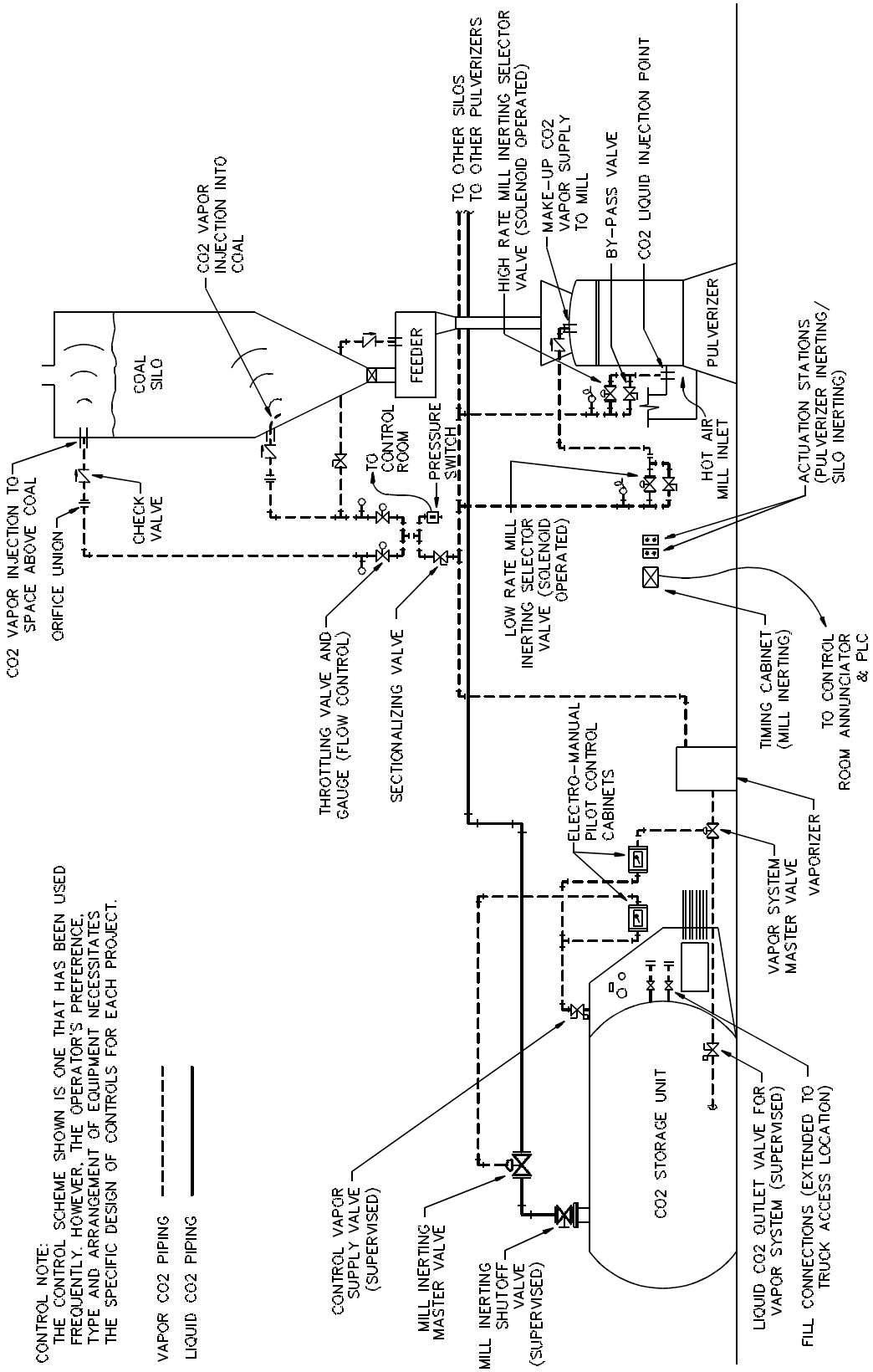
Bottom Seal

It's important that a good seal be made at the coal outlet at the bottom of the silo to prevent CO_2 vapor leakage and entry of air (which will chimneyup through the coal). Inserting an Inflated beach ball in this coal pipe has worked well. The coal valve, itself, is usually not a good seal in this regard. When prevented from leaking out, the heavier CO_2 works as a fire stop.

It should be noted that while this described application relates to power plants, Cement Plant bulletin #0160, titled Coal Grinding and Storage Systems, describes a similar application for cement plant kiln firing systems.

Other materials subject to spontaneous ignition have been protected in a similar manner when similarly stored.



Schematic Arrangement - Low Pressure CO_2 Fire Protection and Inerting System for Coal Silo and Pulverizer

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