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CARDOX

CO_2

Application Bulletin

Carbon Dioxide Fire Suppression —

Hazardous Material Storage

In the fire extinguishing system business, it is common to refer to protected areas or equipment as hazards. This reference infers that these protected areas are important, where fire could seriously impact the facility and its use, and therefore are especially hazardous. In this bulletin we want to discuss another type of hazard.

This is protection of material that, if it were to enter the environment, could be hazardous to our health and well-being. In this regard,
proper fire extinguishment is imperative, not so much because of increased flammability concerns, value of contents, etc., but because the fire, or even its improper extinguishment, represents a possible means for turning the hazard loose.

Our modern life has created the need for producing and storing many hazardous materials. As an example, phosgene, one of the principal poison gasses used as a weapon in World War I, is used today as an intermediary in plastics production. Pesticides, insecticides, and herbicides are products designed to make our life better; but when not carefully and properly used, they are serious health hazards.

When we are forced to breathe or ingest hazardous products that get into the air, water table, or food chain as a result of a fire, it becomes readily apparent that any previously made logical decision that determined fixed fire protection to be unnecessary was obviously not the correct one. Serious consequential financial and social ramifications result.

Determining whether hazardous material storage needs fixed protection, or whether manual fire fighting would suffice, must obviously be influenced by the much higher risk to fire fighters from the hazardous combustion byproducts.

The money spent for appropriate, automatic, fixed fire protection is well spent when risk to personnel is added to the normal risks from fire.

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A World of Protection

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Selecting An Extinguishant

The choice of which fire extinguishant to use is considerably narrowed when you consider that the extinguishant, itself, may become contaminated in the extinguishing process. Therefore, its capture and retention becomes just as important as the containment of the hazardous material.

Water based extinguishing agents must be properly disposed of after use, which can complicate the storage problems. Water can also spread contaminants if it overflows curbs, etc.

Dry chemicals might be the answer in smaller areas, but as the volume of the storage space protected increases, a gaseous agent offers significant advantages. Gas provides extinguishment without spreading the contamination. It does not require provision for drainage and containment of liquids, nor does it affect the materials stored.

In considering gaseous agents, it's important to ensure that the combustible protected can be fully extinguished using the extinguishant alone. Fire suppression, requiring follow-up fire fighting, does not provide the best answer. While many of the materials to be protected involve combustible liquids that are considered surface burning, other materials, as well as the packaging, the pallets, etc., offer potential of a fire developing deep-seated burning.

Therefore, the best choice of a gaseous extinguishant is probably one that can be economically used in quantity at a high enough concentration to ensure full extinguishment.

Extinguishment of deep-seated burning may require holding concentrations for some time, in which case the construction of the storage building becomes a consideration. It is not uncommon to find hazardous material stored in a building that could never be thought of as gas tight. A system designed with the expectation of extinguishant losses is needed.

Carbon dioxide is often a logical choice after considering all of the above.

As the size of the protected space increases, the use of a low pressure CO_2 system becomes more cost effective. A suitable protection system can be designed with either method of CO_2 storage (high pressure or low pressure), and selection of type is likely to be an economic one. The accompanying drawing illustrates a low pressure system.

Design of the Facility and Its Protection

A review of the diagram, showing a typical hazard and its protection by a CO_2 system, indicates some important concerns.

First, the enclosure is designed to retain the hazardous material. Note that doors are curbed to retain any material spill. If the potential spill is large, a leak proof catch tank or basin may be required. The facility cannot drain to sewers or an open pump. The floor is sealed to prevent any of the material from coming in contact with the ground, and most importantly, the ground water. Containment is all important, so all material handling and transfer is done inside the building. Ventilation must be adequate. Provisions for containing, controlling, and/or neutralizing spills should be immediately at hand.

Second, the enclosure is designed to retain the CO_2 discharge and as much of the combustion by-products as practical. Ventilation is shut down, all doors and dampers closed. The fans are stopped by interlocking them with the detection system. The doors and dampers are arranged so that they are self-closing and released to close by initiation of the CO_2 discharge. (Care must be exercised to ensure that any doors or dampers are not blocked open.) Fan shutdown is also interlocked to a pressure operated switch on the CO_2 system so that shutdown is accomplished even if the CO_2 system is mechanically released. Porous block walls must be sealed (such as with epoxy based sealer) to prevent CO_2 gas from passing through the block.

The need for fast, positive detection is important to help minimize and contain potentially hazardous products of combustion. Depending on the type of material handled or stored, vapor or flame detection, backed up by heat detection, should be considered. Expertise in detection system design should be sought in the planning stages because of the various types of detectors available and the many different conditions under which they need to operate.

Initiating the CO_2 discharge as quickly as possible is important. However, all total flooding CO_2 systems that protect spaces accessible to personnel must have a predischarge alarm. This alarm must give audible and visual indication of an impending CO_2 discharge to allow evacuation. Where there is a possibility of the CO_2 vapor drifting into lower levels, odorizing the CO_2 is recommended. NFPA Standard No. 12, Carbon Dioxide Extinguishing Systems, provides data on the safeguards required when using CO_2 extinguishing systems.

The CO_2 concentration level is set by the material protected, the minimum being 34% by volume. Table 2-3.2.1 of Standard 12 provides design levels for a number of surface burning materials. If miscellaneous storage includes wood or paperboard materials, a minimum of 50% CO_2 is recommended. Some materials, such as particle board or cardboard, are more difficult to extinguish. They become deep-seated burning, which means the fire burrows into the combustible. When a fire becomes deep-seated, the CO_2 must penetrate the burning mass to reduce any oxygen supporting the burning. The higher the CO_2 concentrations, the quicker this type fire will be stopped. If corrugated cardboard is involved, for example, the fire becomes deep-seated burning quickly and a 65% CO_2 concentration would be in order.

Chemetr on can be consulted for help in determining CO_2 design levels.

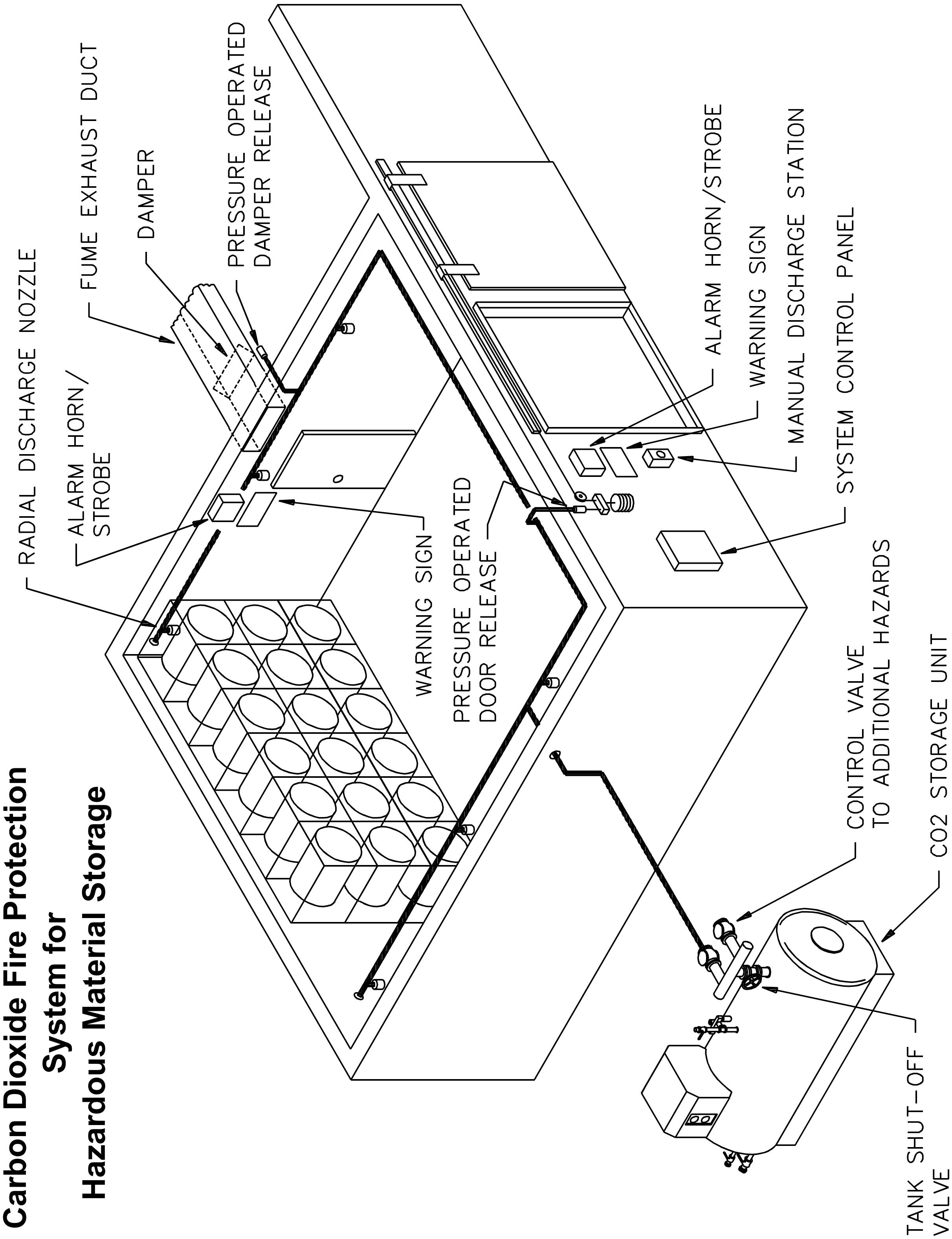
As mentioned earlier, many of these storage buildings are not designed to hold in a gaseous agent discharge. Therefore, consideration for CO_2 loss as it relates to the material protected is important. Vapor fires (fires above the surface of a liquid) are quickly extinguished and will not reignite if the ignition source is removed, while deep-seated burning fires require holding the CO_2 concentration for some time so the CO_2 has time to penetrate the burning mass. This may require an extended discharge (adding CO_2 to the space during the required holding period). The accompanying diagram shows combustible liquid protection that does not need an extended discharge.

Again, Chemetr on can be consulted if there are any questions regarding how long a CO_2 concentration should be held and how to accomplish same.

Interesting Sidelight

When it is discharged, low pressure CO_2 yields a substantial amount of dry ice particles. These dissipate quickly in a room flooding discharge; but if concentrated, as by a hand hose line nozzle, the dry ice, with its inherent cooling, can be used to cool and solidify certain hazardous material spills and facilitate cleanup. The same system providing automatic fixed fire protection can serve these hand hose lines if both applications — protection of storage areas and material processing — are within several hundred feet of each other, and adequate CO_2 is provided in storage.

Carbon Dioxide Fire Protection System for Hazardous Material Storage



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