CHEMETRON™
Fire Systems

CARDOX

CO_2

Application Bulletin

CHEMETRON™
Fire Systems
A World of Protection

4801 Southwick Drive
Third Floor
Matteson, IL 60443
Telephone: 708/748-1503
Fax: 708/748-2847
email: info@chemetron.com

CARBON DIOXIDE FIRE SUPPRESSION —

Steam Turbine Generator Bearings

The protection of the oil hazards associated with a steam turbine generator by the local application of Carbon Dioxide is shown on the accompanying drawing.

Many such systems have been installed in large utility generating stations. In most of these installations, the bearings are often protected with individual controls for each bearing, or for a group of bearings located in close proximity to each other. In some cases, the CO_2 protection is backed up by a manually operated water system. The CO_2 is favored because there is no need to be concerned about rapid cooling (quenching) of hot metal parts on and around the turbine (see note on the following page). For the unit shown, all bearings are protected as a single entity. CO_2 is used to protect the other components of the lube oil system, including oil storage, filtering, cooling, and pumping equipment. The controls are arranged to protect the equipment in close proximity to each other as an entity. In large plants, this equipment is covered by water spray or water/foam sprinklers installed on the levels below and underneath the turbine deck. For smaller generating units found in cogeneration plants or the smaller utility (municipals, etc.), the use of a single CO_2 system can be more cost effective. Automatic controls direct discharges at the equipment involved in the fire. Provisions are made for simultaneous discharges where needed.

One of the important provisions of the protection shown is to minimize as much as possible any concerns over the use of a limited supply extinguishing system. In a limited supply system, if the agent is exhausted but the fire not controlled, the system has not done its job. The fire protection system designer's job is to see that adequate agent is available to prevent this.

With a turbine that is hot (surfaces above auto-ignition temperatures) and which is designed to maintain oil pressure during a long run-down period after shutdown, the need for continuous application of fire extinguishant for long periods of time should be obvious. The system shown is often designed to give cycling of continuous discharges for an hour or more on the bearings and connecting oil lines. This maintains the fire suppression condition until the oil pressure can be reduced and the fire controlled by eliminating the fuel source.

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Cooling Effects of CO_2 Discharges

Since a discharge of liquid carbon dioxide creates fine particles of dry ice at approximately -109 °F, there is a misunderstanding of the thermal effects of this discharge on massive equipment, such as discussed here.

The total heat absorbing capacity of low pressure CO_2 is only about 125 BTUs per pound. For the limited quantity of CO_2 used, the cooling capability of the discharge is really quite small. When the CO_2 is discharged from a fire system nozzle, the dry ice particles should sublime almost immediately as they are dispersed, avoiding any buildup of snow.

In addition, the heat transfer between the hot surfaces and the CO_2 gas is not good. There is no wetting and the only contact is gas to metal, with the gas heated very rapidly. There is little heat absorbed by change of state, such as occurs when water turns to steam.

The direct impingement on metal of CO_2 from an orifice, which could result in localized cooling, is avoided by the type of CO_2 discharge nozzles used.

The protection consists of the local application of CO_2 to cover the equipment and associated oil line connections. The equipment is enveloped in the CO_2 discharge at rates calculated from the ratings of the nozzles used and the requirements of NFPA Standard No. 12. The bearing inside the exciter enclosure is protected by flooding the exciter and then maintaining an inert concentration. Where bearings and oil lines are beneath turbine lagging, a combination of local application and total flooding is used.

While the protection system shown is just covering the oil hazards, obviously the same system can protect coal pulverizers, cable areas, switchgear — any other hazard that is suitable to CO_2 protection. It can also serve high capacity LPCO$_2$ hose lines (high flow rate with 30-35 ft. projection). (All of these applications are covered by other CO_2 Application Bulletins.)

The unit shown has a hydrogen cooled generator and the CO_2 storage unit would be the supply of CO_2 for purging the hydrogen (this is not shown).

In the case of the industrial steam turbine, where the generator is air cooled, it may be appropriate to protect the generator as well. (Protection of rotating electrical equipment is another application covered by a bulletin.)

When the carbon dioxide system is designed, the provision for personnel safety must be considered as strongly as the fire protection. A safe system includes provision for:

- Alarms that absolutely, positively indicate that the system is about to discharge.
- Analysis of the CO_2 gas flow to identify where the CO_2 will be after a discharge. (Provision for odorizing the CO_2 may be appropriate.)
- Adequate instructions and training, including warning and instructional signs.

NFPA Standard No. 12 provides good information in this regard.

Fire protection practices in power generation facilities have changed over the years, resulting in more protection being installed today than years ago.

When plants go into an Extended Life Program, it is reasonable to review the fire protection. The LPCO$_2$ system really fits the bill here as it is self-contained and eliminates concerns for water supply, drainage, and the effects of water discharges on older equipment.

Detailed design information on this application is available from Chemetr on.

Note

For many older units, oil operated stop valves are used for the steam lines and protected by local application. This protection is not shown on the drawing.

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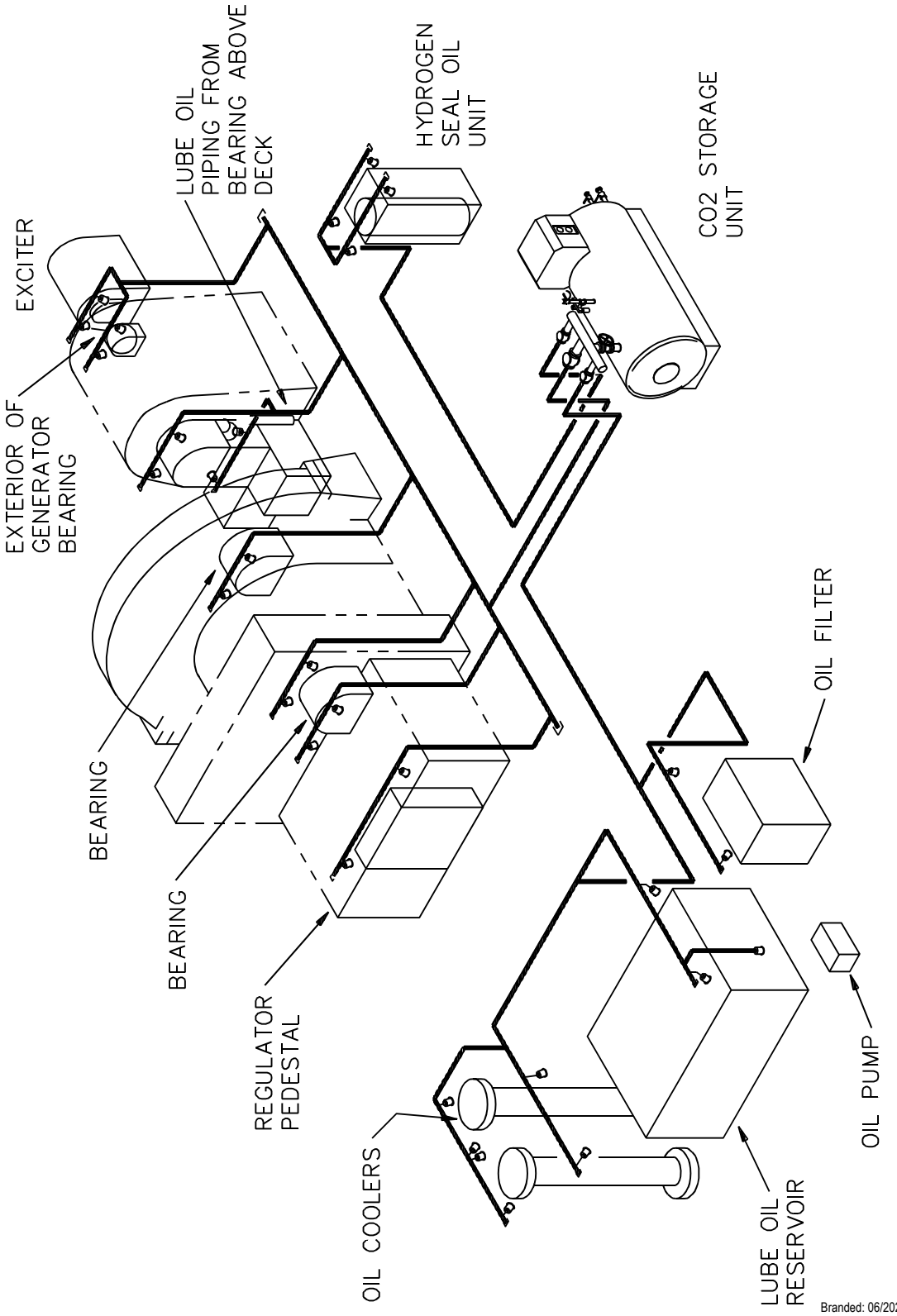
Low Pressure CO_2 Steam Turbine Generator Lube Oil System Protection



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