



Water Mist Fire Suppression —

Steam Turbine Generator Bearings

The importance of protecting the bearings of a steam turbine has long been recognized⁽¹⁾⁽²⁾ and is covered by NFPA Recommended Practices #850, Electric Generating Plants (Para 5-7.4.2). The potential exists for a large, sustained fire fed by the lubricating oil released, under pressure, as a result of a loss of the integrity of the lube oil system piping at the bearings. Therefore, the installation of a closed-head water spray sprinkler system, backed up by a large fire protection water supply, is being recommended (Para. 5-7.4.2.1). However, the potential damage to bearings and hot metal surfaces by the accidental release of such systems is also recognized (Para 5-7.4.2.2).

Since a similar concern does not exist when the bearings and associated oil piping are covered by a local application CO₂ discharge, the value of the installation of automatic gaseous systems is recognized (Para. 5-7.4.2.3). This application is covered extensively in Chemetron's CO₂ Applications Bulletins #0010 and #0015. The benefits of these systems is in an ability to extinguish a three-dimensional oil fire and to quickly extinguish small fires involving oil leakage with little or no damage or agent clean-up. Such a system can be designed and installed with fully approved equipment and to an appropriate code (NFPA Standard #12).

However, there are installations in which the use of CO₂ may not be appropriate. Recent expansion of Water Mist applications, resulting from considerable fire testing, indicates that Water Mist can offer protection similar to the local application of CO₂. However, the standards development and system approval process has not at this time (1999) recognized this type of protection, and therefore, such an installation would have no formal approvals. Chemetron has confidence (as a result of the fire tests) that we can design and furnish a system that offers this valuable "first strike" protection with equipment that has been approved for other applications. Such systems should require little or no change to verify an "approved system" when the approval process catches up.

The Gas Turbine Water Mist system test program included testing to verify that there would be little possibility of thermal distortion of equipment as a result of a Mist discharge. Therefore, while water is being used in the Mist system, the concern over potential distortion of equipment from a discharge is minimal.

This applications bulletin is prepared to further describe this Water Mist protection application. A “typical” system is illustrated on the accompanying drawing.

The system coverage consists of the bearing surfaces, particularly the seal areas and the area where the high pressure lube oil supply piping leaves the guarded piping to connect to the bearing. (This high pressure piping runs concentric between the lube oil system and the turbine inside the low pressure return oil piping, except at the bearing.)

While Water Mist is not a gas, it does have a much more three-dimensional discharge characteristic than that of the water spray from a sprinkler system, and thus can provide better coverage in and around congested equipment.

In the Gas Turbine Water Mist approval tests it was learned that a cycled discharge of 20 seconds ON followed by 10 seconds OFF is very effective in fire suppression. We recommend following this approach here. Typical coverage of a bearing would be two (2) nozzles covering the bearings from above, where the bearing seals are accessible, and one (1) nozzle covering the oil connections and piping below. On the turbine shown (a 65MW unit) there are only three (3) bearings, and thus a single system can protect all three.

The cycled discharge has the advantage of conserving water use. However, some owners prefer a continuous mist discharge, which can be at least as effective.

Nozzles must be placed so as to avoid significant obstructions to the Mist pattern. Therefore, the design of such a system is not of the “cookie-cutter” variety. A survey of each machine is needed and the Chemetron organization is available to handle same.

For larger turbines, multiple systems would be used as the Mist systems are limited in size. The hazard survey can establish the best arrangement to recognize operator’s preferences and establish the most cost effective approach.

Chemetron currently offers two styles of Water Mist nozzles. The CFS-style nozzles used are the gas turbine type that discharge 1.87 gpm (7.08 lpm) at 350 psi (24.13 BAR) each, and the FS nozzles are the machinery space type that discharge at 1.68 gpm (6.36 lpm) at 350 psi (24.13 BAR) each. This 350 psi pressure is classified in the NFPA Water Mist Standard (#750) as an intermediate pressure system. These nozzles have different discharge characteristics and can be used to match the coverage requirement for the area where installed.

Chemetron recommends that for a “first strike” type system, as described above, the total Mist application period be 10 minutes (total of ON and OFF periods) if cycling is used. This will allow plant operators time to evaluate what is happening and initiate appropriate emergency actions. Systems with reserve supplies can be provided.

Chemetron Mist Systems include a flow switch that can initiate shut down, as well as signal that water is flowing.

Safety concerns involving the use of Water Mist include insuring that:

- clearances from uninsulated and/or unshielded energized electrical components are maintained in accordance with NFPA #70, National Electrical Code, and NFPA Standard #750.

- personnel are not exposed to the direct impingement of the water mist discharge with its high pressure and discharge velocity.

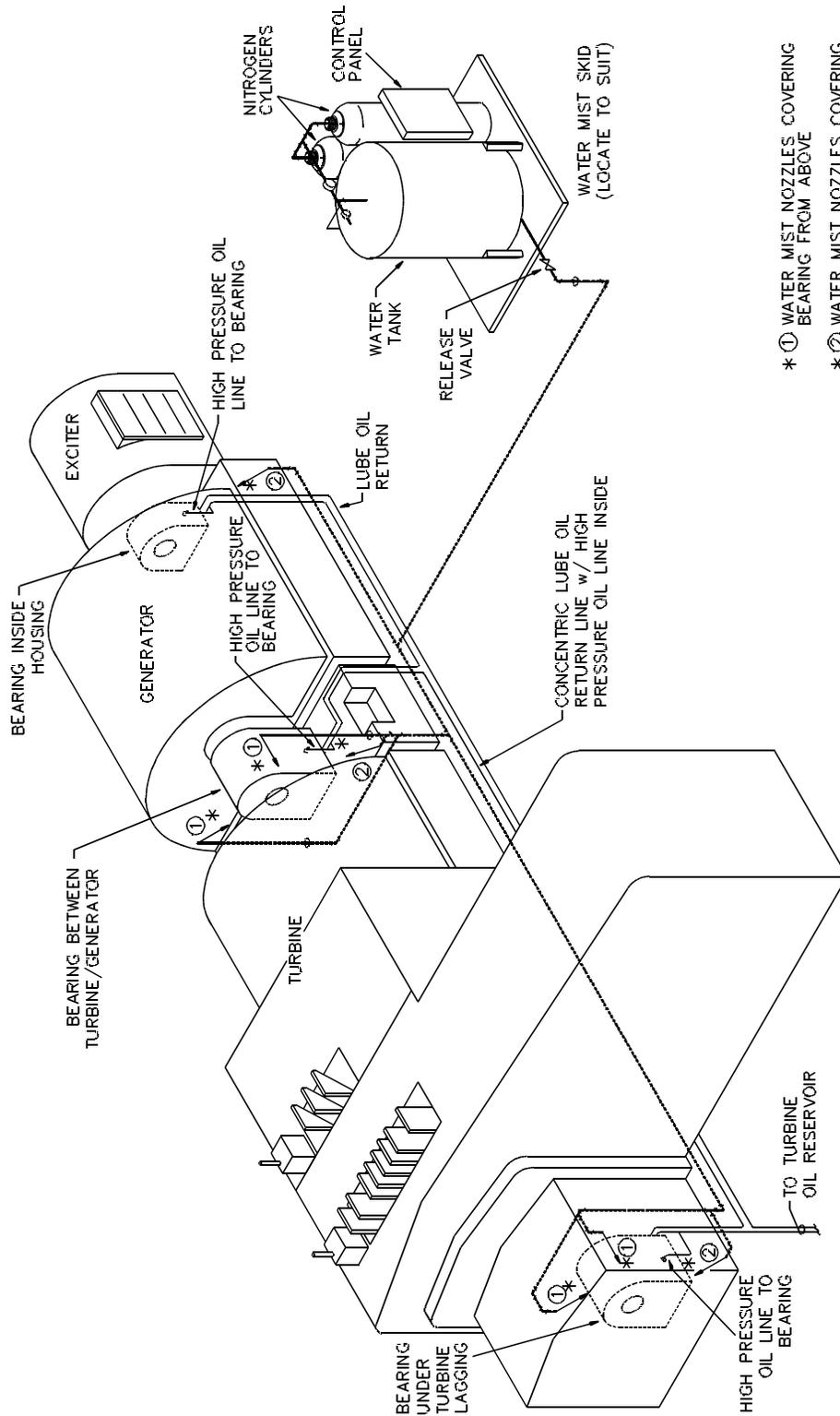
These systems should be automatic and the site survey or engineering evaluation should include determination of type, number and location of detectors.

It is important that the system be arranged to alert personnel to system operation, not only in the immediate area of coverage, but at a constantly attended location (the control room in most cases.)

For help in evaluating a specific application, please contact Chemetron Fire Systems at (708) 748-1503 or info@chemetron.com.

References

- (1) EPRI Research Project 1843-2 report, Turbine Generator Fire Protection, by Sprinkler Systems, July 1985
- (2) SFPE Technology Report 85-6, Fire Protection for Power Plants Past, Present And Future.



- * ① WATER MIST NOZZLES COVERING BEARING FROM ABOVE
- * ② WATER MIST NOZZLES COVERING HP OIL CONNECTION TO BEARING

**Water Mist Fire Protection System for
Steam Turbine Generator Bearings
Mechanical Arrangement**