Power Plant Gas Detection Applications

*Safety and Reliability*

The coal-fired power plant is a highly engineered complex of material handling, combustion, electrical generation and pollution reduction equipment, all designed for continuous operation. Power plants have many safety hazards, some of which are addressed by fixed gas detection. Major plant systems include coal handling, combustion controls, feedwater and boiler, cooling towers, electrical generators, flue gas cleanup and stacks, emissions monitoring and the control system. Most areas of the plant have sub-systems or operations with the potential for personnel exposure to dangerous levels of Combustible and Toxic gases, plus Oxygen Deficiency, not to mention fire.

Most Larger Electrical Generators have a pressurized direct or indirect Hydrogen cooling system. Hydrogen conducts heat 7 times better than air, has a very low density relative to air, \((0.07)\) which minimizes windage losses, and so is an ideal coolant for the generator despite the flammability issues.

Hydrogen has a wide flammability range \((4\% \text{ to } 74\% \text{ by volume})\), detonates \((\text{explodes})\) from \(18\% \text{ to } 59\%\), and its ignition requires very little energy. It burns with a pale blue, nearly invisible flame, and can cause serious injury to personnel, as well as severe equipment damage. A common method of detecting a Hydrogen fire is to use a broom to cautiously “sweep” the suspected area. Ambient gas detection is used to detect Hydrogen leaks. Older detector types consisted of a non-specific catalytic detector which was sensitive to all combustibles. The use of a Hydrogen specific gas detector is preferred, so that the detected leak is tramp Methane, so that corrective measures can be taken quickly.

Hydrogen leaks occur at the generator bearings and shaft seals, in the seal oil supply system, and from the \(\text{H2} \) supply piping, mechanicals and purity / purging cabinet. Deploying Hydrogen-specific leak detection versus the cost of personnel injury or generator shutdown is considered very low-cost insurance indeed. Many plants monitor the seal oil system area and Hydrogen purity cabinet. Older generating units may require bearing journal monitoring where access is available.

Battery rooms are notorious Hydrogen “generators” and monitoring the room(s) to turn on a ventilation fan is good practice and is often required by the Fire Codes. The last thing you need during a power outage is the loss of the control room UPS system, or to have it unavailable during normal operations. A single Hydrogen sensor high inside the battery room, with annunciation outside the door and supervisory notification is the accepted solution.

Gas sensors have reached a new technology level over the past decade and a half. Percent remaining sensor life, extended calibration intervals, fully configurable electronics, Real time clocks with time-stamped even data, large illuminated easy-to-read displays, multiple communication modes and “calibrate sensors in the shop – hot swap in the plant,” have all contributed high reliability and added value for the end user.

Sensidyne trains the facility personnel in the routine maintenance associated with Intelligent plug-in gas sensors. This usually takes 2 or 3 hours and is done during start-up and commissioning of the gas detection equipment. Annual service agreements are available in the continental US.
The Clean Air Act Amendments of 1990 mandated stationary source emission compliance on a phased-in basis. This required extensive investment in continuous emissions monitoring (CEM) systems for reporting, and emission reduction equipment to comply with the new EPA requirements.

The afore-mentioned CEM shelters have been the site of tragic accidents since they came into common use. The potential for asphyxiation in these shelters due to the gases piped in the interior, requires a minimum of an Oxygen sensor inside with annunciation outside the door. Other gases are often monitored depending upon the hazards present. Note: In a depleted Oxygen environment, the average person is down in three breaths! A personal or portable monitor may not offer adequate protection.

Selective Catalytic Reduction (SCR) systems spray Ammonia into the flue gas to react out Oxides of Nitrogen (NOx). The bullet tanks, loading rack, Ammonia handling and injection equipment are monitored for leak detection and personnel protection. Ammonia is a highly toxic and flammable chemical and is covered by OSHA 29 CFR 1910.119, Process Safety Management, or the EPA Risk Management Program, 40 CFR 68.

EPA requirements for reducing Oxides of Sulfur (SOx) emissions have many utilities burning Powder River Basin Coal. This low-sulfur, higher ash coal has an amazing propensity to burn without human intervention. Users often employ Carbon Monoxide (CO) gas sensors to detect rising levels of CO which occur as the coal smoulders. The areas most often monitored are coal pile conveyor tunnels, tipper rooms, coal bunkers, hoppers and silos. If a bunker or silo is relatively enclosed, Methane may also be monitored, although the as-shipped coal analysis can determine this necessity. A 100 ppm CO sensor and an Infrared Methane LEL sensor can be open air mounted or flange mounted for coal storage vessels and tunnels as needed.

Super critical boilers (>3,200 psi steam pressure) often use chemical Oxygen scavengers (Hydrazine, et al) to reduce free Oxygen in the feedwater to one ppb or lower. Hydrazine is a toxic material and must be handled with extreme care. Because it’s a suspected carcinogen, federally published guidelines must be followed for handling and reporting. Pure hydrazine has a low flash point, so a 35% solution is usually used. A leak detection gas monitoring system (1.00 ppm gas sensors) is usually employed for leak detection and personnel protection.

Natural gas fired utility boilers have large gas trains and associated burners with the potential for large or even catastrophic gas leaks. Infrared Methane LEL gas sensors and optical flame detection are commonly placed in these areas to detect gas leaks or fire and initiate shutdown as required. Areas and platforms around the boiler with frequent personnel traffic or offices may also be monitored for Carbon Monoxide from boiler casing leaks.

Other areas in the modern electrical generating station may require fixed gas sensors for process leak detection and personnel safety. These monitored gases include but are not limited to CO2, SO2, SO3, Cl2, HCl, ClO2, O3, and NO2.

Additional information on gas detection applications in power plants can be obtained by contacting Sensidyne at 800-451-9444 or by visiting: www.SensidyneGasDetection.com

SensAlert Plus is an advanced point gas detector that enables power plants to minimize burdens and lower costs associated with maintenance of their gas detection systems.