

# Net Safety Monitoring Solutions for Turbine Enclosure Fire & Explosion Hazards

## Background

Industrial turbines are typically mounted on a frame skid, and are used to drive rotating equipment such as compressors and electrical generators to provide power. In addition to the internal combustion control systems, leading manufacturers and end-users of industrial gas turbines also install high performance oil mist detection, optical flame detection and combustible gas detection systems for critical plant and personnel protection.

## Application Principles

Fire and explosion hazards are located throughout a typical turbine enclosure. Most combustion turbines are designed to burn natural gas, light oils, diesel or different fuels in combinations. Modern designs incorporate combustors generally between the compressor and the turbine itself. Fuel is mixed with air and burned within the combustor through a delivery system similar to boilers, but with additional safety interlocks. Naturally, internal or external fuel leakage is extremely hazardous in these areas.

Lubricating oil systems are also critical to the function of the turbines. This system must also continue functioning even during a shutdown event to prevent destruction of the turbine. Unfortunately oils (diesel and lubricating oil) have auto ignition temperatures (AIT) significantly lower than gas. Combined with the large hot areas in the turbine enclosures, they form a high risk scenario. Even small leaks in this system can be extremely hazardous and must be identified as quickly as possible to allow turbine coast down and then mitigation.

In addition, the large amount of heat generated by the power generated must be continuously cooled while in operation. This is often accomplished using hydrogen, which is highly flammable and an asphyxiant. Air intakes and exhaust must also be accurately monitored for the presence of smoke or flammable vapor clouds to prevent pre-ignition within the compressor section.

Combustion turbines are typically much more valuable than the surrounding structure. In many applications, numerous



turbines will be installed within a single structure. In the case of gas turbine pipeline compressors, these structures are often situated in remote locations. This remoteness usually increases the fire hazard risk of the facility because any available emergency response team is often under-sized and can be located far from the site. In an offshore installation, an escalation could be truly catastrophic for the entire platform and its personnel.

For all of these stated reasons, automatic detection and suppression systems are critical for turbine facilities. Flammable gas detectors, optical flame detectors, and oil mist detectors are integral components of these systems.

## Optical Flame Detection

Clearly early detection and preventative action is critical in order to prevent disastrous results and to minimize any potential shutdown. Turbine enclosures should have dedicated flame detectors aimed directly at the likely ignition point(s) and set to the desired sensitivity and required response time.

The benefit of dedicated ignition point detectors is that fire detection and suppression will occur as quickly as possible, ideally before a fire reaches uncontrollable proportions. Some applications may have variable or unknown fire ignition points. In this case, a total area coverage design scheme should be used. Optical flame detection combined with fire suppression systems is the last line of defense against a combustion event.

The Net Safety Monitoring Phoenix Triple IR flame detector provides several advantages in these challenging conditions. The highest level of immunity to false alarm sources is achieved by using three advanced infrared sensors, each tuned to specific wavelengths generated by flame. Infrared sensing technology also provides fast response and continuous coverage, even through oil films, mists and smoke, which are common in this environment. Net Safety's proprietary ADZ technology also greatly enhances performance, our wide voltage range increases overall stability, and our exclusive no-external-reflector design lowers maintenance and operating costs.

### Phoenix Triple IR Flame Detector

- No External Reflector Greatly Reduces Faults And Maintenance
- Lowest Power Consumption of Any Flame Detector on the Market
- Wide Voltage Range Allows For Greater Stability and System Compatibility
- Automatic Digital Zoom Eliminates False Alarms and Maximizes Sensitivity
- Market Leading 7 Year Warranty
- Field-selectable Sensitivity and Delay Settings Allows Operators To Fine Tune At Installation Site
- Wide Area Coverage, Extended Ranges with Fast Response Times



### Combustible Gas Detection

Fixed combustible gas detection will provide fast, reliable coverage against flammable gas concentrations before an ignition event occurs. Circulation systems, enclosures, fuel storage and transport lines, and pressure relief valves are typical installation locations. Often these areas operate in temperatures that require sampling systems in order to ensure sensor performance. An area that can be overlooked is floor drainage wells, where liquid leaks and spills can accumulate and generate potentially explosive levels of combustible gas. Toxic gas concentrations and oxygen depletion are also serious hazards that should be monitored using an advanced fixed gas detection solution.

Net Safety Monitoring offers a variety of reliable gas sensing technologies. Catalytic and Infrared combustible gas sensors are available for detection of virtually any combustible gas, and electrochemical and NE-MOS gas sensors are available for monitoring of toxic gases and oxygen. Our sensors offer some of the fastest response times available, features that improve performance and simplify maintenance, and the best warranties in the industry.

In addition, our Millennium II transmitter allows two SMART sensors to be connected to a single transmitter with the ability to remote mount each of the sensors up to 2000ft. away, this means greater coverage and flexibility with less cost.

### Millennium II Series — Fixed Gas Detection

- Single, Multi-Channel, or BASIC Controller Configurations
- Lowest Power Consumption of Any Gas Detection package Available on the Market
- Wide Voltage Range Allows For Greater Stability and System Compatibility
- SMART Universal Toxic and LEL Gas Sensors Are Completely Interchangeable with Controller
- Highly Robust Construction and Reliable Performance Designed for Extreme Conditions
- Advanced NE-MOS Solid State, Catalytic Bead, Electrochemical, and Infrared Sensor Technologies



### Oil Mist Detection

Turbine enclosures have forced ventilation and both gas and oil mist detection should be installed in the enclosures intake and exhaust ducting. Most turbine enclosures are fitted with gas and flame detection but only a few have robust and reliable oil mist detection.

Oil mist detection in the enclosed areas and exhaust ducts of the turbine enclosures will provide an early warning of any pressurized oil leaks. This allows for the rapid shutdown of a turbine thereby minimizing the leakage of flammable liquids into the enclosure and hence minimizing its fire load. If an oil spray or gas leak ignites immediately, a fire results. If there is a delay in ignition it is probable that there will be an explosion event. Should an explosion occur, even a 'low overpressure event', it is foreseeable that the turbine enclosure will be damaged such that it will lose its fire protection integrity. Hence any fire following the explosion will have the potential to escalate to a facility/platform threatening event.

The Net Safety Millennium Smoke and Oil Mist Detector fitted within the enclosure and exhaust duct would quickly detect smoke and oil mist leaks from all sources. It would complement the gas detectors and provide early indication of any airborne flammable fluid or smoke, thus reducing the risk of an explosion and hence loss of enclosure integrity.

Table 1. Gas and flammable liquid leak and ignition data

Fluid	No. of Leaks	Detected	Ignited	Undetected	Ignited
Gas	134	104	1	30	18
Liquid Fuel	61	11	2	50	31
Oil (Mist)	42	1	1	41	40
Unidentified Fluid	35	Unknown	31	Unknown	Unknown

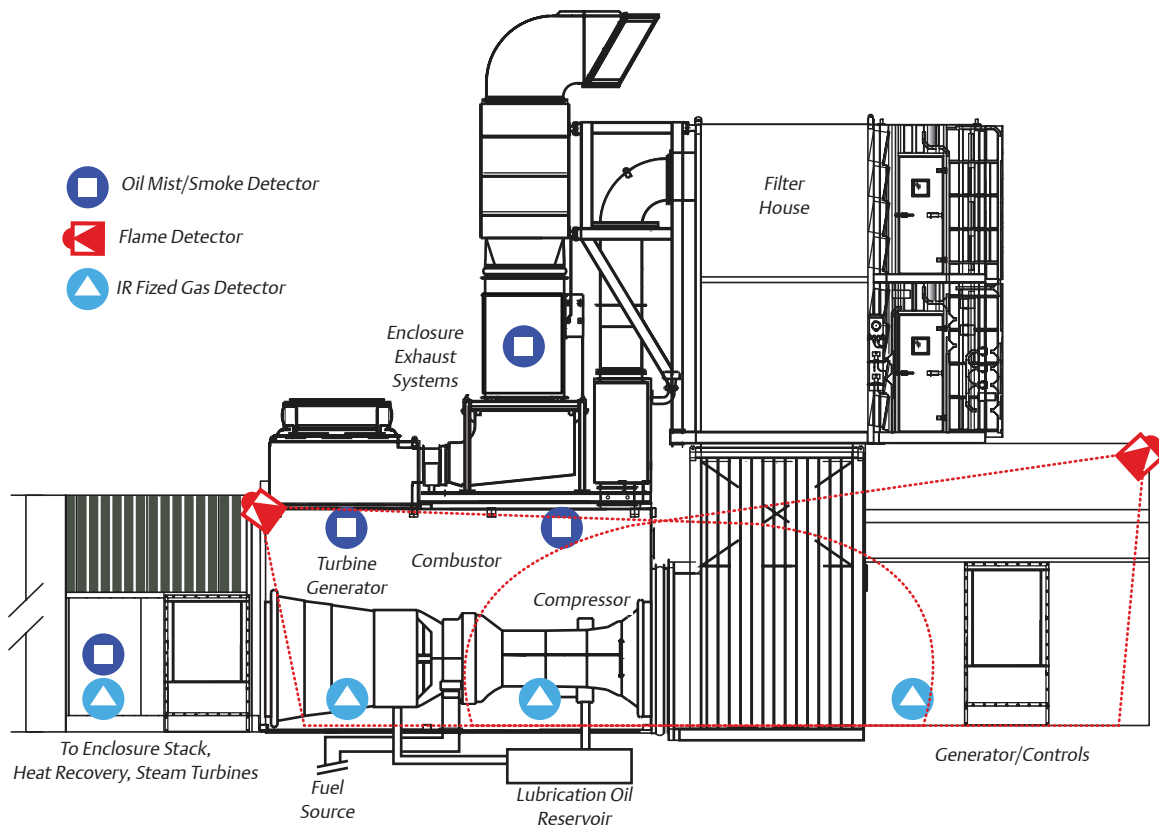
**Smoke & Oil Mist Detector (APM)**

- Explosion-proof – Class 1, Division 1 -- Suitable for hazardous locations
- 4-20 analog signal and Form ‘C’ mechanical relays -- Easily integrates into existing systems
- Not Effected By High Air Volume or Air Velocity -- Ideal for duct installations
- Low Power Consumption -- For use with 12 or 24 VDC systems
- Field Adjustable Sensitivity -- Settings for low/medium/high concentrations
- Remote Sensor -- Separation of up to 2000 feet, several mounting configurations



Based on a recent offshore platform analysis<sup>1,2</sup> indicated in Table 1. above, of the 134 gas leaks 30 were undetected. But 50 of the 61 liquid fuel leaks were undetected, and of the 42 oil leaks, 41 were not detected. The proportion of undetected leaks that subsequently ignited is self-evident.

Gas Turbine Enclosure Showing Detector Types With Suggested Location



## Summary

In summary, there are advantages and limitations with all detector types and technologies and these must be carefully evaluated for each specific application before selection. The performance and reliability are absolutely critical in turbine applications as well as eliminating false alarms and the production downtime they create.

Only Net Safety Monitoring offers the combination of all these safety solutions – optical flame detection, industrial fixed gas detection, and IR based smoke and oil mist detection. We can provide your turbine installation with the most complete level of coverage, the highest level of performance, with unique advantages and product features that only we can offer.

## References

- Gas turbine hazardous incidents; A review of the of UK Onshore and Offshore installations. Roger C. Santon c/o Health and Safety Laboratory
- Accident statistics for fixed offshore installations units on the UK Continental Shelf 1980-2005 Research Report 566 HSE Books 2007
- Offshore Information Sheet No. 10/2008 Health and Safety Executive 2008

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### Emerson Process Management Net Safety Monitoring Inc.

2721 Hopewell Place NE  
Calgary, AB T1Y 7J7 Canada  
T +1 (403) 219 0688  
F +1 (403) 219 0694  
T 1 866 FIREGAS  
email: nsmsales@net-safety.com  
www.net-safety.com



For more information:  
[www.Net-Safety.com](http://www.Net-Safety.com)

