Hazard Detection in Gas Turbines & Pipeline Compressor Stations

PARALOS
MARINE & INDUSTRIAL SOLUTIONS

MSA
The Safety Company

WE KNOW WHAT'S AT STAKE.

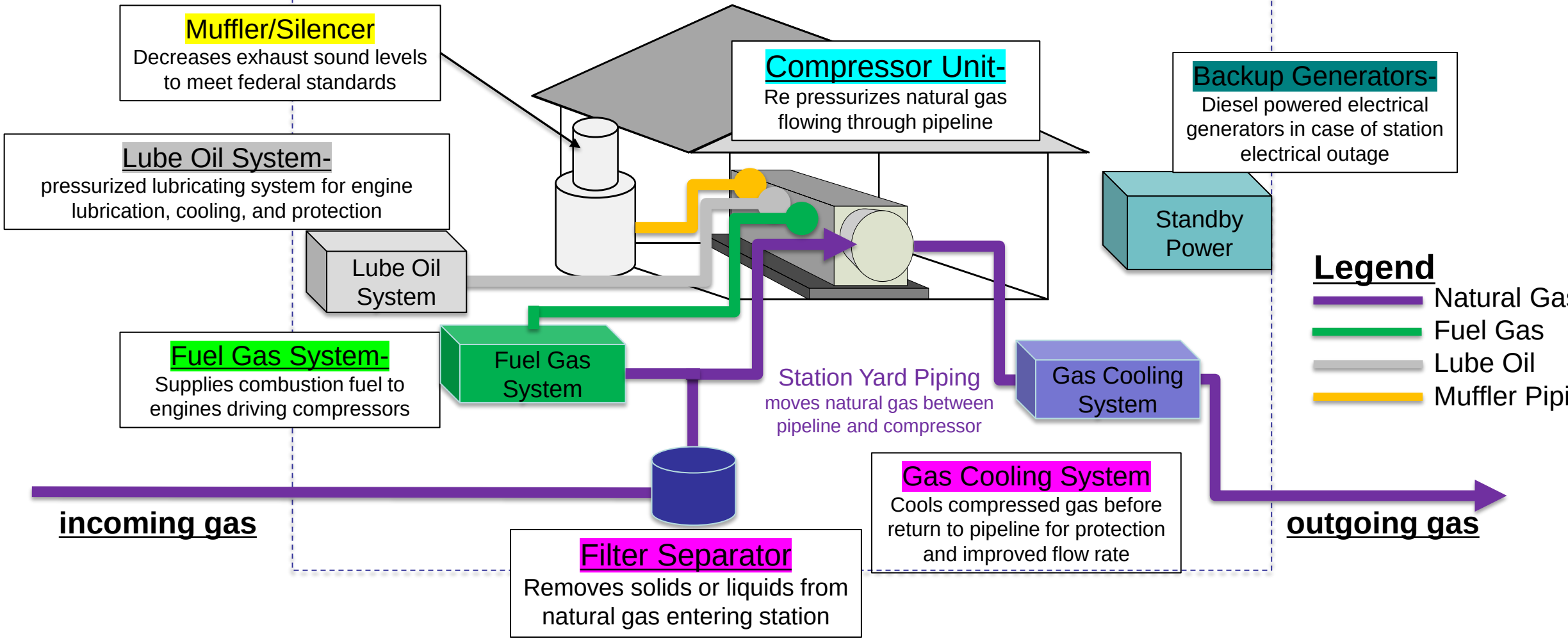
Contents

- Definition and Overview
- Engines and Fire/Gas Hazards
- Coverage Examples
- Safety Regulations
- Summary

Compressor Station Definition

- Mission is to compress either natural gas or oil - providing energy to move product through a pipeline. Also called Pumping stations….
  - Station intervals of every 40-100 miles are not uncommon
  - Frequent elevation changes and more wells in the area generally require more compressor stations
- Engines types may include
  - Combustion Turbine/Centrifugal Compressor
  - Electric Motor/Centrifugal Compressor
  - Reciprocating Engine/Reciprocating Compressor
- Natural Gas Compressor Station example follows…

Gas Pipeline Compressor Station
- Overview



Reciprocating Engines

- Reciprocating engine fuels include diesel, natural gas, gasoline, propane, or methane
- Benefits include fast start and ramp-up and good partial-load performance
- All use cylindrical combustion chambers and pistons that travel the length of each cylinder
- All use a crankshaft to transform piston motion into rotary motion of the Power Take Off (PTO)
- Most engines use multiple cylinders that power a single crankshaft PTO

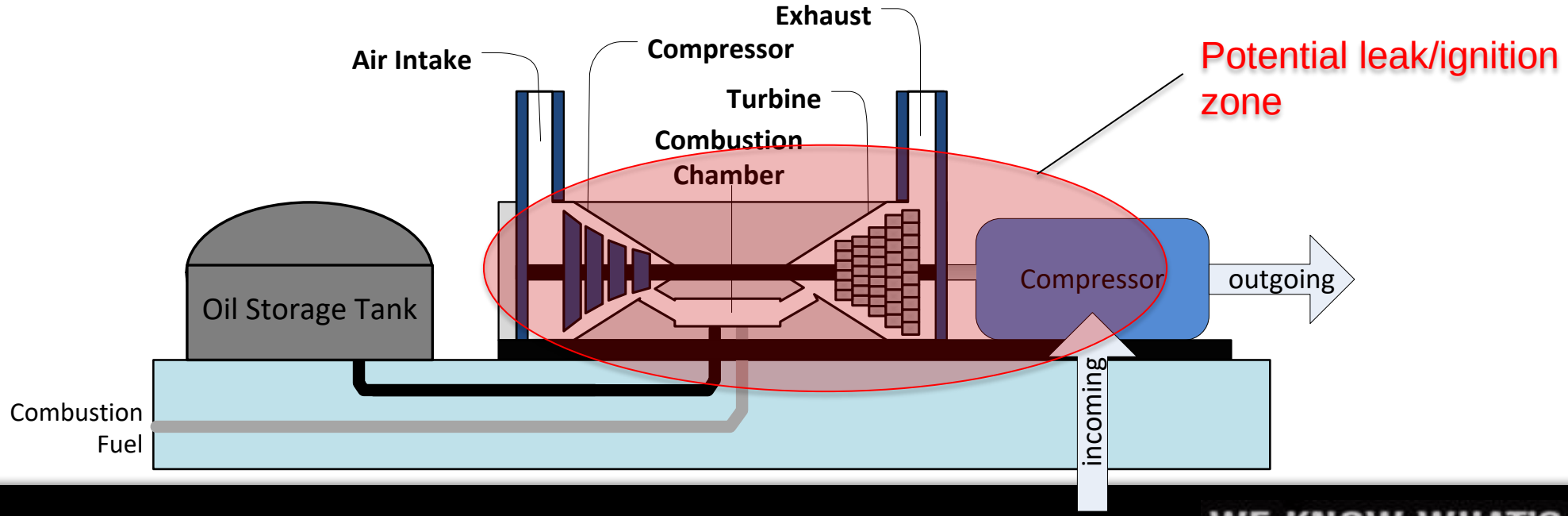
Reciprocating engine CHP installation at an industrial facility.
Photo courtesy of Caterpillar.

Reciprocating Engine Fire & Gas Hazards

- Pipeline Transmission Products
  - Natural gas, oil
- Combustion Fuel Delivery Systems
  - Natural gas, gasoline, propane, and methane
- Low O_2, CO, H_2S toxic gases possible
- Lubricating and Hydraulic Oil Systems
- Building structures or enclosures common
  - Weather protection and reduce ambient noise levels
  - Creates enclosed space
  - Potential hazardous gas levels

Combustion (Gas) Turbines

- Gas turbines create energy through rapid expansion of gases through a centrifugal or axial compressor
- Combustion chamber heats inlet air gas, increasing volume
- Hot gases expand through turbine rotor – creating energy
- Used to drive pipeline compressor or electric generator



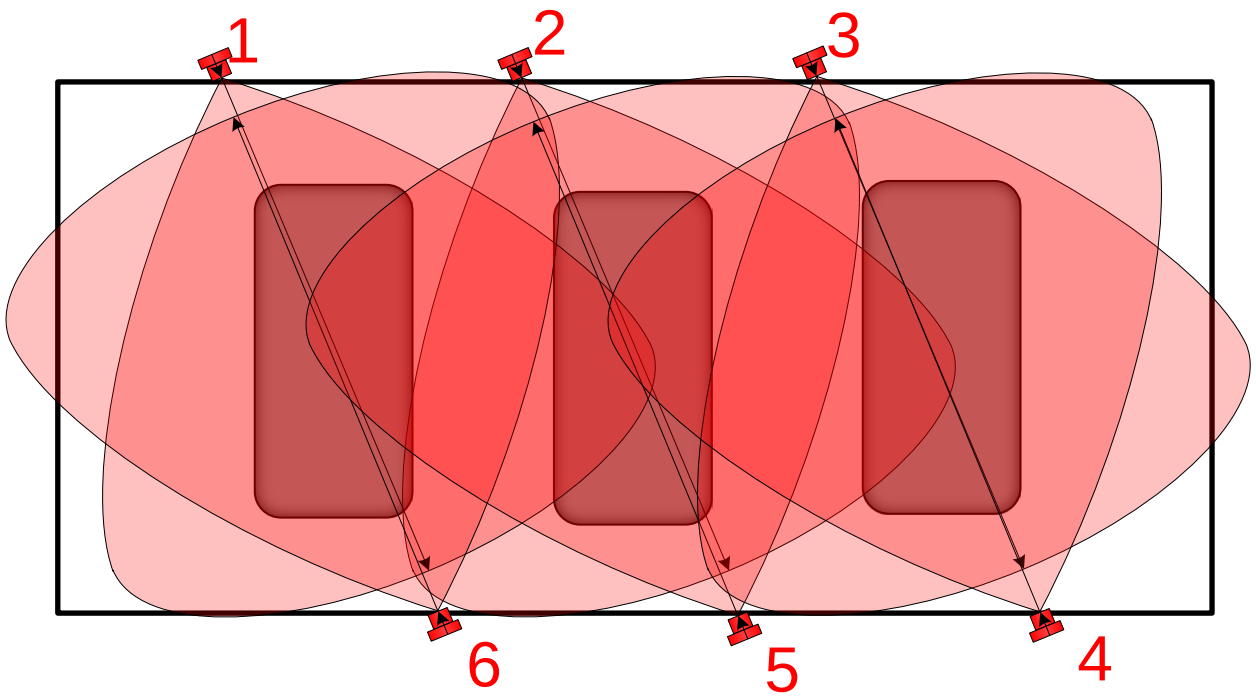
Land Based Gas Turbines

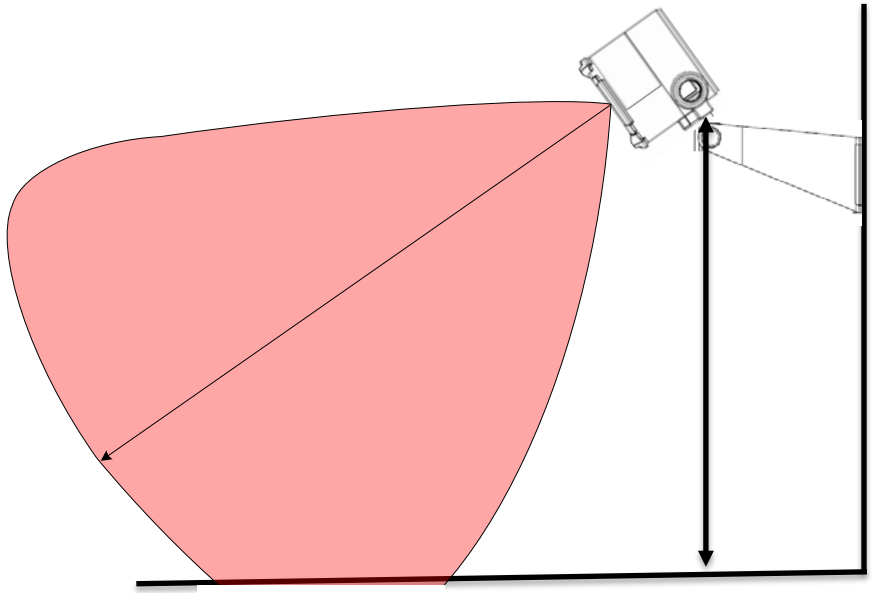
- Two main types:
  - Heavy frame engines
    - Physically large and immobile
    - Lower pressure ratios
  - Aeroderivative engines
    - Derived from jet engines
    - Smaller / compact / transportable
    - High compression ratios
    - Rapid power-up / shutdown cycle time
  - Long continuous operating cycles, eg months
- Both require Flame and Gas detection systems
- Carbon Dioxide Fire Suppression recommended

Turbine Fire & Gas Hazards

- Pipeline Transmission Products
  - Natural gas, Oil
- Combustion Fuel Delivery Systems
  - Natural gas, Naphtha, Diesel, Hydrogen
- Lubricating and Hydraulic Oil Systems
  - Lube oil, hydraulic oil
- Acoustic enclosures installed to reduce ambient noise
  - Creates enclosed spaces
  - Potential hazardous gas levels

Basic Flame Detector Coverage Techniques

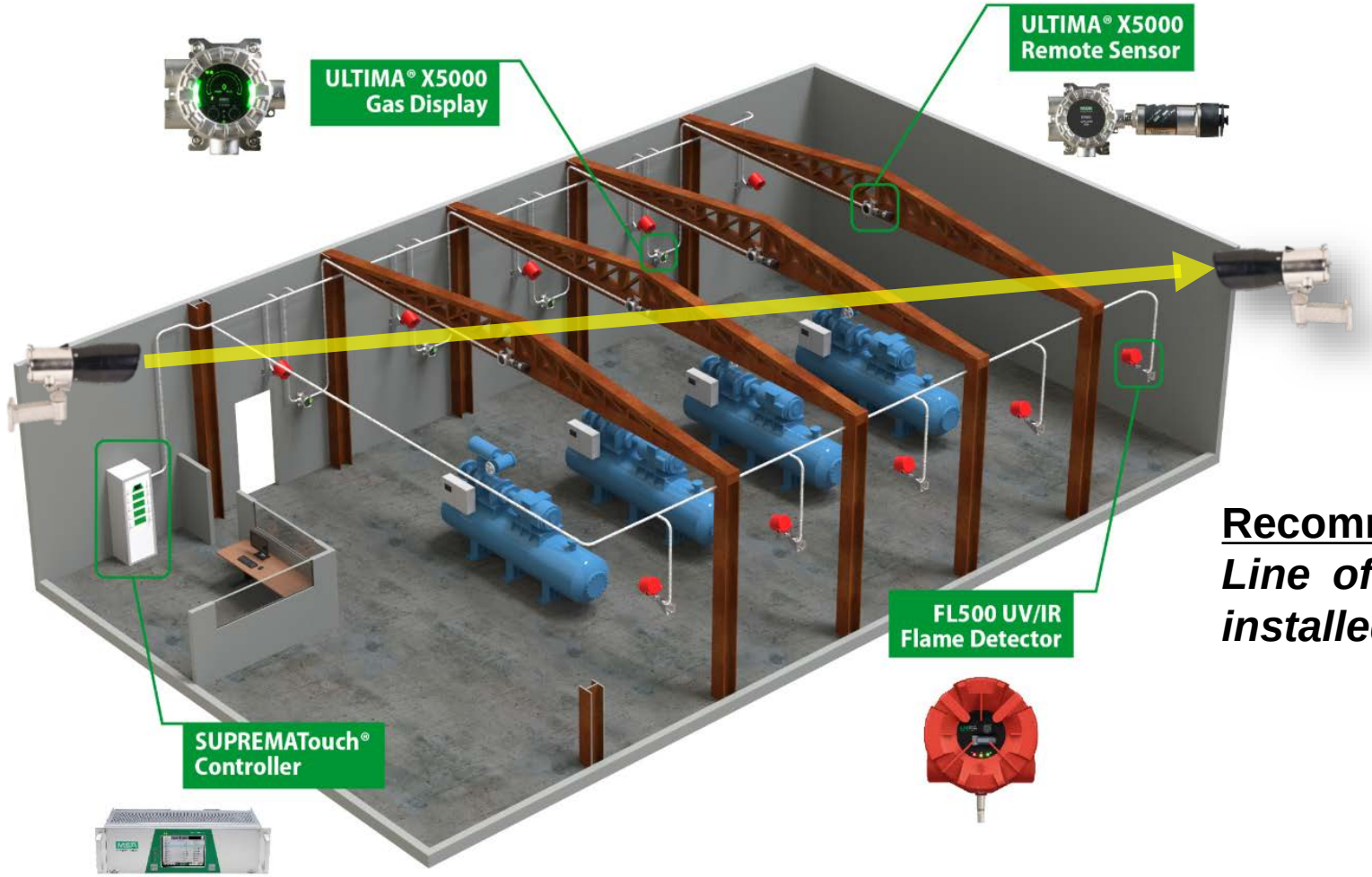




Mounting elevation recommended slightly above protected equipment height

- Select placement options that efficiently utilize each FoV
- Select placement options that are accessible for maintenance
- Document installation locations and aim points for future use
- Use cross-zone voting coverage if suppression systems will be triggered by confirmed fire alarm

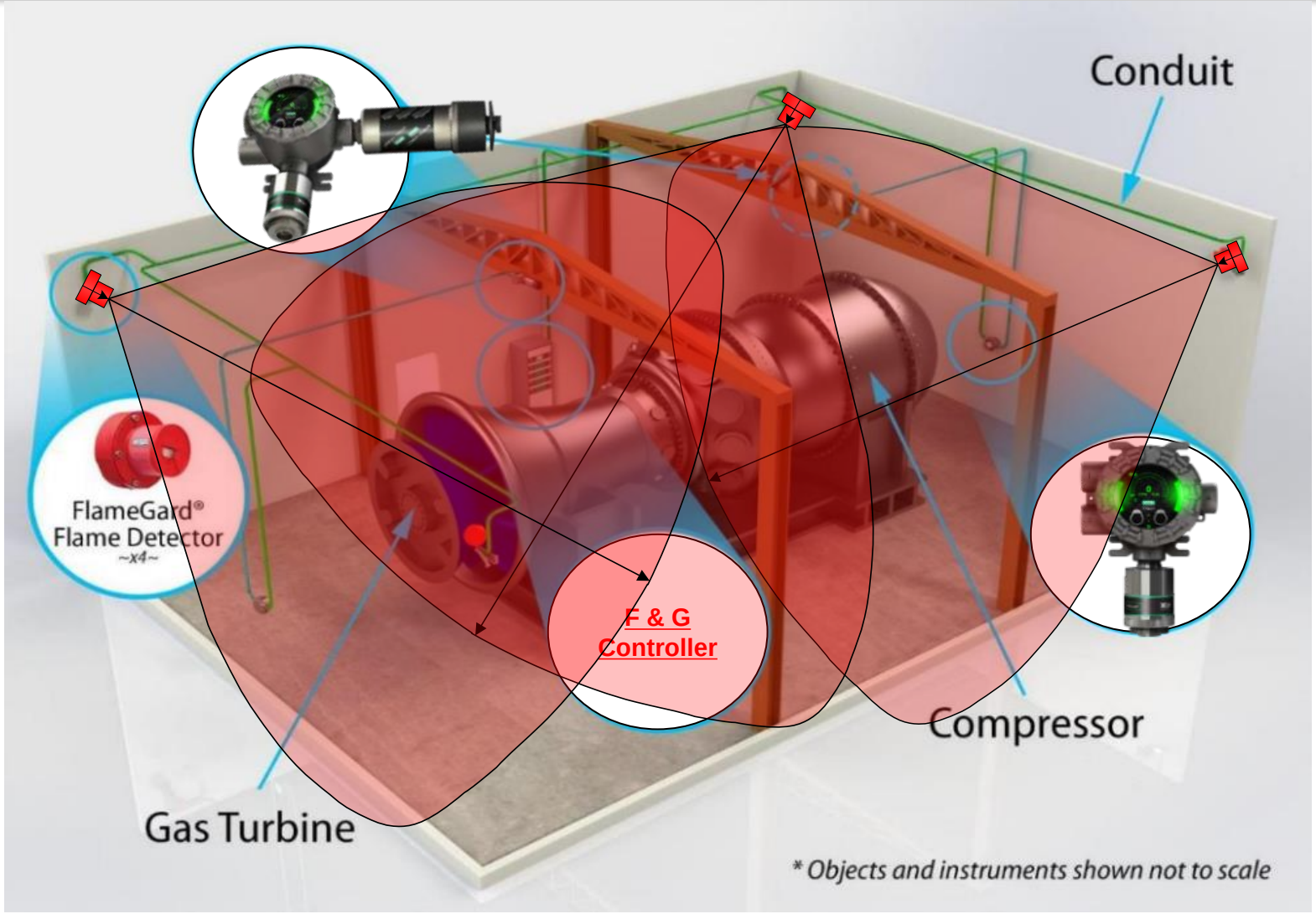
Recip Engine Compressor Station - Example



Recommended :

Line of Sight IR Gas System installed at ceiling ridgeline

Gas Turbine Compressor Station
- Example



Compressor Station Safety Regulations

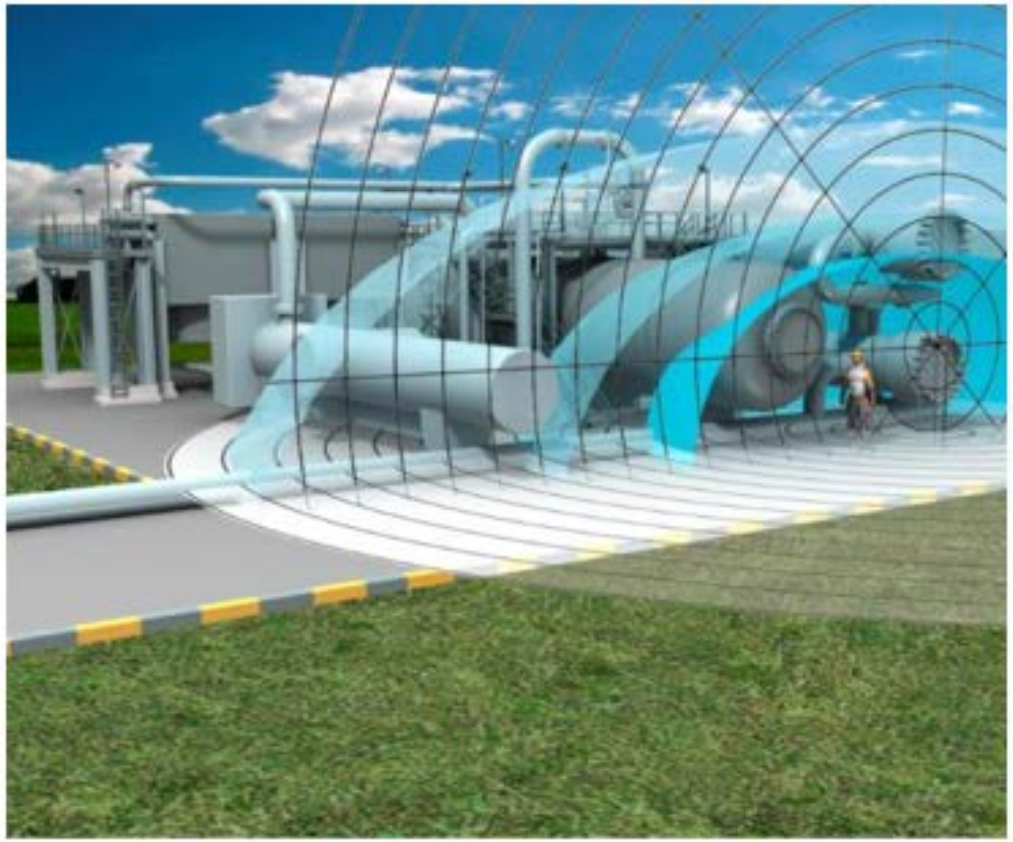
- Compressor station safety regulations defined in Code of Federal Regulations 49 CFR 192.163 through 49 CFR 192.173
  - Compressor station buildings must be ventilated to ensure that employees are not endangered by the accumulation of gas in rooms, sumps, attics, pits, or other enclosed spaces
- Identify all flammable and toxic gas hazards and release scenarios
  - Define performance requirements for gas and fire hazards present
  - Select the optimal detection technologies to enable reliable detection
- Potential leak origin points should be prioritized and modeled to determine cloud size, dispersion behavior & potential ignition sources

Summary

- Pipeline Compressor Stations are designed to ensure safe efficient transmission of flammable gases & liquids through a pipeline
- Common prime movers include reciprocating engines, combustion turbines, and electric motors along with compressors
- Proper fixed flame and gas detection equipment can significantly increase the level of fire & life safety protection in compressor stations
- HAZOP analysis is recommended to identify the primary hazards and select the optimal detection technologies for maximum protection

Detection Coverage for UGLD

First and Second Generation UGLD



High-noise areas:
Background noise <78dB
5 – 8 m (16 – 26 ft) coverage (84dB)
Ex: Turbo compressor area or complete open offshore weather deck

Low-noise areas:
Background noise <68dB
9 – 12 m (30 – 39 ft) coverage (74dB)
Ex: Areas with no machinery or low-frequency machine made noise

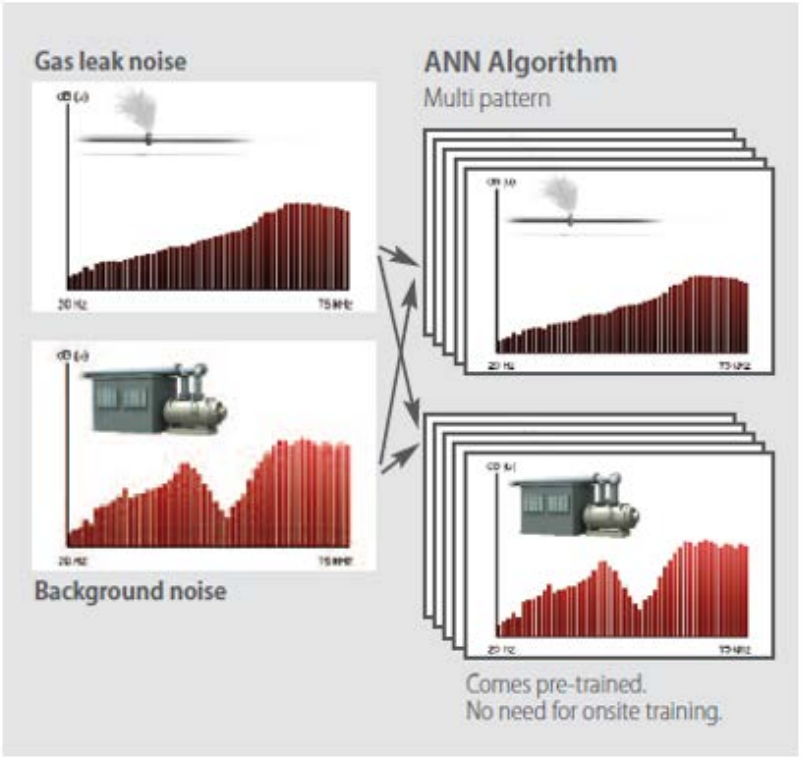
Very low-noise areas:
Background noise <58dB
13 – 20 m (43 – 66 ft) coverage (64dB)
Ex: Gas storage or onshore wellhead area in calm environment

The coverage of a 0.1kg/sec leak is based on the trigger level setting and can be as low as 5 metres

The Generations of UGLD

Third Generation

- Utilizes Artificial Neural Network (ANN) technology
- ANN algorithms are pre-trained to recognize real noise from various types of gas leaks and background noise signatures
- Plug and play and no need for training during installation or re-training over the life of the system
- No Trigger Levels needed
- Maximum coverage in all areas



Detection Coverage for UGLD

Third Generation UGLD

Detection is based on ANN algorithms and not trigger levels in Enhanced Mode.

Maximum coverage of 28 metres can be achieved in all background noise levels.

PARALOS
MARINE & INDUSTRIAL SOLUTIONS

Please contact us for a detailed analysis of your needs

MSA
The Safety Company