TOP 50 FIRE & GAS DETECTORS QUESTIONS & ANSWERS

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1. What is the primary purpose of a Fire & Gas (F&G) detection system?

- Life Safety – Detects fire, gas, or smoke early to protect personnel. Asset Protection
- – Prevents escalation of fire/gas leaks into catastrophic incidents. Process Safety –
- Interfaces with ESD/SIS to trigger shutdowns or deluge. Regulatory Compliance –
- Meets NFPA, IEC 61511, IEC 60079, API RP 14C.

2. What types of fire detectors are commonly used in Oil & Gas?

- Heat Detectors – Fixed temperature, rate-of-rise.
- Smoke Detectors – Ionization, photoelectric, aspirating.
- Flame Detectors – UV, IR, UV/IR, multi-spectrum IR (MSIR).
- Combination Detectors – Integrated smoke + heat.

Explanation: Selection depends on area classification, response speed, and false alarm immunity.

3. What are the types of gas detectors used in industry?

- Point Detectors:
  - Catalytic bead (combustible gases).
  - Electrochemical (toxic gases like H2S, CO).
  - Infrared (IR for hydrocarbons, CO2).
- Open-Path Detectors: IR or UV beam across distances (10–200m).
- Ultrasonic Gas Leak Detectors: Detect high-pressure gas leaks via ultrasonic sound.

4. What is the difference between catalytic bead and infrared (IR) gas detectors?

- Catalytic Bead:
  - Detects flammable gas via combustion on sensor.
  - Requires oxygen presence.
  - Poisoned by silicones, lead, H2S.
- Infrared (IR):
  - Detects hydrocarbon vapors without oxygen.
  - Not affected by poisons.
  - Higher cost, needs line-of-sight.

5. What is a flame detector and how does it work?

- UV Detectors: Detect 180–250 nm UV radiation from flames.

- IR Detectors: Detect hot CO2 emissions at ~4.4 µm.
- UV/IR Combination: Cross-check to reduce false alarms.
- Multi-Spectrum IR (MSIR): Uses multiple IR bands for high immunity to false alarms.

Explanation: Widely used in oil & gas for hydrocarbon fire detection.

6. What is the role of a Fire & Gas (F&G) Control Panel?

- Receives signals from detectors.
- Executes logic based on cause & effect matrix.
- Drives outputs – alarms, sounders, deluge, ESD valves.
- Interfaces with DCS/SIS for shutdown actions.

7. What is a "Cause and Effect (C&E) Matrix" in F&G design?

- Tabulated logic of detector inputs vs. system actions.
- Defines how many detectors (1ooN, 2ooN) are required for trip.
- Links to outputs: alarms, sirens, deluge, shutdown.
- Example: 2-out-of-3 gas detectors → initiate ESD + deluge.

8. What standards govern fire detection system design?

- NFPA 72 – Fire Alarm & Signaling.
- IEC 60079 – Electrical equipment in explosive atmospheres.
- IEC 61511 – Functional Safety for SIS.
- API RP 14C – Offshore Safety Systems.
- EN 54 – Fire detection components.

9. What are the key considerations in selecting gas detector locations?

- Gas density (lighter/heavier than air).
- Wind direction and ventilation.
- Leak sources (flanges, compressors, pumps).
- Accessibility for maintenance.
- Hazard analysis (HAZOP/LOPA study).

10. What is the importance of detector redundancy (1oo2, 2oo3)?

- Improves reliability and reduces spurious trips.
- 1oo2 (One out of Two): High availability, lower safety.
- 2oo3 (Two out of Three): High safety, fault tolerance.
- Applied in critical ESD/fire zones.

11. Difference between "Fire Alarm System" and "Fire & Gas System"?

- Fire Alarm System (FAS):
  - Protects buildings/occupants.
  - Focus on smoke, heat, sprinkler activation.
- F&G System:
  - Industrial process safety.
  - Integrates with ESD/DCS, deluge, gas detection.

12. What are Sounder Alarms and Beacons?

- Sounders (Audible): Sirens, bells, electronic horns.
- Beacons (Visual): Flashing lights, strobes (for noisy areas).
- Combined Units: Sounder + beacon.
- Standards: NFPA 72, IEC 60079-29, ATEX.

13. What is the principle of an electrochemical gas sensor?

- Gas diffuses through membrane → chemical reaction → current generated.
- Advantages: High sensitivity, specific to target gas.
- Limitations: Limited life (1–3 years), cross-sensitivity.

14. Why is detector response time important?

- Defines how fast hazard is detected.
- Gas detectors: T90 (time to reach 90% response).
- Flame detectors: 2–5 seconds typical.
- Faster response → quicker shutdown & deluge → reduced escalation.

15. What is a zoning philosophy in F&G design?

- Plant divided into zones: process, utilities, living quarters.
- Each zone has detection coverage.
- Logic ensures local action + global escalation (deluge, evacuation).

16. What are common outputs of F&G systems?

- Alarms: Sirens, horns, flashing beacons.
- Shutdowns: ESD valves, blowdown valves.
- Firefighting: Deluge, sprinklers, foam systems.
- Ventilation control: Shut down HVAC, close dampers.

17. What is SIL (Safety Integrity Level) relevance to F&G?

- F&G loops often assessed under IEC 61511.
- Typical SIL for fire/gas detection loops: SIL 1–2.
- SIL verification ensures system probability of failure on demand (PFDavg).

18. What are the maintenance requirements of gas detectors?

- Calibration: 3–6 months (bump test, span check).
- Inspection: Visual check for blockage, corrosion.
- Replacement: Sensor cells (2–3 years).
- Documentation: Records per IEC 60079 & company standards.

19. What is the difference between Point and Open-Path gas detectors?

- Point: Localized detection, cheaper, multiple units needed.
- Open-Path: Covers larger area, detects gas clouds, high cost.
- Selection depends on: Area size, gas type, risk level.

20. What are the ATEX/IECEx requirements for detectors?

- Equipment must be Ex certified for hazardous zones.

- Categories: Zone 0 (intrinsically safe), Zone 1/2 (flameproof).
- Must withstand explosive environment without ignition.

21. What is the difference between Conventional and Addressable Fire Alarm Systems?

- Conventional:
  - Detectors grouped in zones.
  - Panel identifies only the zone in alarm.
  - Lower cost, less diagnostic information.
- Addressable:
  - Each detector has unique ID.
  - Panel pinpoints exact detector in alarm/fault.
  - Easier troubleshooting, higher cost.

22. What is the function of a Manual Call Point (MCP)?

- Installed at exit points/escape routes.
- Allows manual initiation of fire alarm.
- Provides redundancy in case detectors fail.
- Must comply with EN 54-11 / NFPA 72.

23. What are the installation guidelines for flame detectors?

- Direct line of sight to hazard area.
- Mount at 2–3 m above grade.
- Avoid welding arcs, sunlight reflections.
- Typical coverage: 90° horizontal × 90° vertical cone.
- Overlapping coverage improves reliability.

24. What are the installation guidelines for gas detectors?

- Heavier-than-air gases (H2S, hydrocarbons): Install near floor, pits.
- Lighter-than-air gases (H2, CH4): Install near ceiling or top of enclosure.
- Avoid dead air pockets, corners.
- Spacing: 5–8 m for point detectors (depends on risk study).

25. How is detector coverage determined?

- Fire modeling (CFD simulations).
- Gas dispersion analysis.
- Empirical rules (e.g., NFPA 72 spacing).
- Risk-based approach: identify high-leak probability areas.

26. What are the power supply requirements for F&G systems?

- 24 VDC primary supply (redundant).
- UPS-backed or battery-backed for minimum 30 minutes alarm duration.
- Separate feeders for sounders/beacons to ensure reliability.

27. What is the importance of segregation between F&G and DCS power supply?

- Prevents common mode failures.

- Ensures F&G system remains operational during process power disturbances.
- Complies with IEC 61511 design philosophy.

28. How are alarms prioritized in F&G systems?

- Low Priority: Supervisory alarms, system faults.
- Medium Priority: Gas detection – alert only.
- High Priority: Confirmed fire, multiple gas detection, evacuation alarm.
- Ensures operators focus on critical alarms first.

29. What is a “two-stage alarm system”?

- Stage 1 (Alert): Sounders slow pulse – early warning.
- Stage 2 (Evacuation): Continuous or faster pulse after confirmation.
- Prevents unnecessary evacuation from false alarms.

30. What are the typical alarm sound pressure level (SPL) requirements?

- 65 dB(A) minimum or 10 dB above ambient noise.
- Not to exceed 120 dB(A) (hearing protection).
- In sleeping areas: 75 dB(A) at pillow level (NFPA 72).

31. What is the significance of different alarm tones?

- Fire: Continuous tone.
- Gas: Intermittent tone.
- Fault: Different frequency.
- Helps workers distinguish alarms instantly.

32. What are flameproof (Ex d) vs. Intrinsically Safe (Ex i) devices?

- Ex d (Flameproof):
  - Withstands internal explosion.
  - Heavy enclosure, Zone 1/2.
- Ex i (Intrinsically Safe):
  - Limits energy to prevent ignition.
  - Lighter, safer, Zone 0/1.

33. Why is a gas detector calibration necessary?

- Sensor drift over time.
- Exposure to poisons (H2S, silicone).
- Temperature and humidity effects.
- Ensures readings match actual gas concentration.

34. What is a “bump test”?

- Functional test using known gas concentration.
- Confirms detector responds correctly.
- Quick test, not a full calibration.
- Usually done daily/weekly in hazardous areas.

35. What is redundancy in sounder/beacon design?

- Multiple sounders in one zone.
- Separate power supplies.
- Ensures coverage even if one fails.
- Required by NFPA 72 / IEC 61511.

36. What are typical cable requirements for F&G detectors?

- Fire survival cables (2-hour rated).
- Shielded twisted pair for analog detectors.
- Armored cables for hazardous areas.
- Comply with IEC 60079 / NFPA 70 (NEC).

37. What is “latched alarm” vs “non-latched alarm”?

- Latched: Once triggered, alarm stays ON until manually reset.
- Non-Latched: Alarm resets automatically when hazard clears.
- Fire alarms → usually latched. Gas alarms → can be non-latched
- (depends on philosophy).

38. What is “double-knock logic” in F&G?

- Requires two independent detectors to trigger an action.
- Reduces spurious trips.
- Example: 2 flame detectors in same zone → start deluge.

39. What are deluge systems and when are they activated?

- Water spray systems over equipment.
- Activated by fire detection (2ooN logic).
- Cools equipment, prevents escalation.
- Often triggered by flame detectors.

40. How are fire and gas detectors tested during commissioning?

- Smoke detectors: Aerosol test spray.
- Heat detectors: Heat gun test.
- Flame detectors: Test lamp simulating UV/IR.
- Gas detectors: Test gas cylinders with regulator.

41. What is a “proof test” for F&G detectors?

- Periodic test to detect hidden failures.
- Required by IEC 61511 for SIS-related detectors.
- Includes functional verification, alarm trip, and panel response.

42. What is the difference between Toxic and Combustible gas detectors?

- Toxic: Measures ppm concentration (H2S, CO, NH3).
- Combustible (LEL): Measures % of Lower Explosive Limit (LEL).
- Different sensor technologies (electrochemical vs catalytic/IR).

43. What is meant by LEL and UEL?

- LEL (Lower Explosive Limit): Minimum gas concentration in air that can ignite.
- UEL (Upper Explosive Limit): Maximum concentration beyond which no ignition occurs.
- Example: Methane LEL = 5%, UEL = 15%.

44. What is the Fire & Gas system interface with ESD?

- Detectors → F&G Panel → ESD/SIS.
- Triggers shutdown valves, blowdown, deluge.
- Critical for API RP 14C compliance.

45. What is Gas Dispersion Analysis and why is it done?

- Computational Fluid Dynamics (CFD) modeling of gas release.
- Predicts cloud shape, density, dispersion with wind.
- Used for optimal detector placement in high-risk areas.

46. What are the SIL verification requirements for F&G loops?

- PFDavg calculation for detector + logic solver + output.
- Typically SIL 1 or 2.
- Must meet IEC 61511 Clause 11.

47. What are common challenges in offshore F&G detector installation?

- Harsh marine environment (corrosion, salt).
- Limited maintenance access.
- Wind-driven gas dispersion.
- ATEX/IECEx zone restrictions.

48. How to reduce false alarms in flame detectors?

- Use multi-spectrum IR instead of single IR.
- Avoid reflective surfaces.
- Shield against hot work areas.
- Apply voting logic (2ooN).

49. What are the functional testing requirements for sounders and beacons?

- Verify coverage using sound level meter.
- Check flash visibility from all workstations.
- Test both normal and UPS power supplies.
- Ensure distinguishable tones from process alarms.

50. What are the key documents for F&G design and installation?

- Cause & Effect (C&E) Matrix.
- Detector Layout Drawings.
- Wiring Diagrams / Loop Diagrams.
- Zone Classification Drawings.
- Instrument Datasheets.
- Commissioning Procedures.
- FAT/SAT Checklists.