Final Exam
What Every Energy Engineer Needs to Know
About Liquefied Natural Gas Safety

1. When an LNG spill ignites the fire above the pool?
- ○ a. Oxygen, nitrogen, and heat are formed as products of combustion
- ○ b. Radiates heat into the LNG pool causing even more flammable vapors to be formed by the pool.
- ○ c. The fire above the pool lessens the evaporation of LNG because it has a single point of consumption
- ○ d. Does not represent a hazard unless someone is in direct contact with the flames

2. What three things are required to result in a fire or explosion?
- ○ a. Oxygen, nitrogen, and heat
- ○ b. Fuel, oxygen, and heat
- ○ c. Fuel, carbon dioxide, and nitrogen
- ○ d. 1 molecules of CO2 and 2 molecules of H2O

3. Spilled LNG will turn into a cold vapor. The vapor is?
- ○ a. Heavier than air
- ○ b. Lighter than air
- ○ c. Not flammable when mixed with air
- ○ d. Water vapor

4. LNG is so cold that?
- ○ a. Coming in contact with it can cause injury or (death with extreme exposure)
- ○ b. Special materials need to be used to contain it
- ○ c. It can cause a pipe or valve failure if trapped between two valves without a pressure relief device
- ○ d. All of the above

5. LNG Vapor, when mixed with air, will propagate fire, or cause an explosion for which of the following mixture concentrations?
- ○ a. 100% methane gas
- ○ b. 40% methane gas in the air
- ○ c. 10% methane gas in the air
- ○ d. 3% methane gas in the air

6. Impound areas are?
- ○ a. Areas where personnel should muster for protection in the event of an LNG spill
- ○ b. Areas intended to capture spilled LNG to reduce its associated hazard
- ○ c. Areas where plant visitors are held for vetting before being allowed to enter the LNG facility
- ○ d. Areas where LNG is stored as a surge containment before being sent to the vaporization systems

7. What is true when working in an environment with insufficient oxygen?

○ a. A cloth over the mouth will help you survive
○ b. A wet cloth over the mouth will help you survive
○ c. Work activity needs to be limited to 5-minute intervals
○ d. Workers can be asphyxiated

8. What is one of the vapor properties of boiled-off LNG?
○ a. It smells like rotten eggs
○ b. It is odorless
○ c. It is green in color
○ d. It is blue in color

9. What is the normal oxygen content in the outside air environment?
○ a. 23%
○ b. 21%
○ c. 19%
○ d. 16%

10. A BLEVE is?
○ a. The Best Level of Evaluated Vapor Exposure used for the evaluation of environmental hazards
○ b. Boiling Liquid Expanding Vapor Explosion, which is a mechanical explosion
○ c. Pipeline explosion caused by hydrogen-assisted corrosion cracking
○ d. Best practice for leveling and evaluating vapor exposure to personnel

11. A BLEVE is?
○ a. Likely to occur in an LNG tank because it is not stored in a pressurized tank
○ b. Likely to occur on an LNG tank because relief valves are provided on the top and not the bottom of the LNG tank
○ c. Not likely to occur due to a fire on an LNG tank because there is a layer of insulation between the inner and outer tanks of an LNG tank.
○ d. Unlikely to occur in an LNG tank because methane is non-toxic

12. A purged vessel where channeling has occurred, may?
○ a. Be the same as a diffusion purge
○ b. Be the same as a displacement purge
○ c. Indicate that the purge is complete when some parts of the vessel are not purged.
○ d. Be desirable because the purge can be completed quickly

13. Vessels containing solid materials like adsorbents or perlite can be challenging to purge because?
○ a. Solid materials like adsorbents or perlite can decay into flammable vapors.
○ b. Solid materials like adsorbents or perlite may adsorb gases that are not easily purged out due to channeling and the adsorbing nature of the material.
○ c. The vessels containing solids or perlite do not typically have ports for purging.
○ d. Typically, solid materials and perlite are pyrophoric, which results in them oxidizing upon contact with air.

14. A condensation water hammer can occur when?
○ a. Water is heated to above its critical point
○ b. The water flashes to vapor and a liquid as it is dropped in pressure
○ c. A liquid like LNG is in a high-pressure line with a warm leg when it is depressurized and then repressurized
○ d. Water is traveling at its sonic velocity

15. A Joukowsky equation hydraulic hammer effect may occur when?

○ a. Water is heated to above its critical point
○ b. The water flashes to vapor and a liquid as it is dropped in pressure
○ c. A valve in a fluid flow line is suddenly closed
○ d. Water is traveling at its sonic velocity

16. Fill-induced stratification can occur when?
○ a. A low-density LNG is placed under a high-density LNG
○ b. A low-density LNG is placed on top of a denser LNG
○ c. A high-density LNG is placed on top of a light-density LNG
○ d. A zero-nitrogen content LNG in a tank self-stratifies.

17. Nitrogen-induced LNG stratification can be caused by?
○ a. Using too much nitrogen in the mixed refrigerant mixture of an MR refrigerant system
○ b. Using a nitrogen expansion refrigeration system
○ c. LNG containing more than 1% nitrogen content
○ d. All of the above

18. Nitrogen-induced LNG rollover can be caused by?
○ a. Using too much nitrogen in the mixed refrigerant mixture of an MR refrigerant system
○ b. Using a nitrogen expansion refrigeration system
○ c. The lower layer of a stratified inventory reaches its bubble point.
○ d. All of the above

19. An LNG rollover is?
○ a. A sudden mixing or flipping of the upper layer of a stratified tank inventory within itself makes for an unusually low boil-off rate resulting in a vacuum in the LNG tank.
○ b. A sudden mixing or flipping of the upper layer and the lower layer of a stratified tank which results in an unusually high boil-off rate which may cause the tank relief valves to vent.
○ c. A rare occurrence during a hurricane when a very high wind gust can roll over a nearly empty LNG tank
○ d. A rare occurrence during a storm surge whereby a nearly empty LNG tank can be rolled off its foundation due to excessive water levels.

20. LNG geysering can occur when?
○ a. A horizontal pipeline leg of LNG is attached to a vertical leg of LNG, and the LNG in the two legs are allowed to warm
○ b. Geothermal formations under the LNG plant site are unstable
○ c. A geyser alert is announced over the plant alarm system due to import pipeline pressures exceeding their normal operating pressure
○ d. LNG is splashed onto a non-cryogenic piping system

21. LNG geysering can also result in?
○ a. The fire water system containing slugs of air that pulse on the monitor nozzles
○ b. Oscillating of the LNG piping can result in expansion joint cycling and subsequent failure
○ c. Freeze and slip conditions when waters are sprayed by geysering during cold temperatures
○ d. Pressure pulsations that result in inaccurate meter readings

22. Embrittlement is?
○ a. The freezing of LNG into a solid occurs when the refrigeration system is operated at too cold of a temperature
○ b. Susceptibility of a material to failure due to the material being exposed to temperatures colder than it was designed to withstand

○ c. The cracking of an adsorbent material when it is exposed to hot regeneration gas
○ d. The flashing of LNG from a high-pressure liquid to a lower-pressure liquid and vapor

23. Large-diameter piping must be cooled down with cold vapor before introducing LNG to avoid?
○ a. The LNG being contaminated with the air in the piping
○ b. The boil-off gas heating value being too low to support end-use customers
○ c. The shock cooling of the bottom of the pipe before the top of the line is cooled down results in excessive thermal stresses
○ d. Geysering

24. Ice Management is important because?
○ a. Ice formation concerns include over-stressed hangers, jammed sliding supports, and injury or damage due to falling ice.
○ b. Ice forming within the LNG can plug valves and cause internal tank valves to fail
○ c. Ice formations on the top of LNG tanks will cause painted surfaces to peel
○ d. LNG brought down to -296 F will freeze, causing LNG circulation in the plant to stop

25. Over and under-pressure relief devices are critical because?
○ a. They protect the piping and vessels from too low a liquid level
○ b. They protect the piping and vessels from overflowing
○ c. They prevent rollovers and geysering
○ d. They prevent tank, vessel, and piping from damage due to too high or too low of a pressure.

26. Some types of overpressure devices include?
○ a. Spring-loaded and pilot-operated relief valves
○ b. Fusible plugs and buckle pin relief devices
○ c. Rupture discs and weight-loaded relief devices
○ d. All of the above

27. Lock Open and Lock Closed are?
○ a. Valves that contain internal locks that operate only during an emergency shutdown
○ b. Valves locked in one position can be moved out of that position only with authorization and the implementation of a special procedure that will allow such a change in that position.
○ c. Valves are outside the LNG plant's limits and are controlled only by the gas dispatching personnel.
○ d. Are valves used only during the plant's commissioning and are never changed in their operating position after the plant is commissioned

28. Hazard protection equipment includes?
○ a. Self-Contained breathing apparatus and water sprays to warm vapor clouds
○ b. Portable and fixed fire extinguishers
○ c. Protective clothing and automated systems like the System Integrated System
○ d. All of the above

29. Operating procedures, emergency procedures, and MOC procedures?
○ a. Are developed by the regulatory agency and must be used whenever regulatory personnel are on-site
○ b. Must be fully developed for safe operations and must be followed thoroughly for safe operations
○ c. Are required only for inexperienced operators who are in training
○ d. Are identical from plant to plant to assure standardization.

30. An Emergency Shutdown (ESD) is triggered by?

○ a. The plant's Distributed Control System (DCS)
○ b. The plant's Safety Integrated System (SIS)
○ c. The plant's Fire and Gas system (F&G) system
○ d. A signal from outside the plant (typically the gas system dispatcher)

31. Valve failure modes are used to?
○ a. Calibrate the valve trim proportionally to the valve stem travel
○ b. Set the plant into an ESD position if the air supply to the valve is lost or intentionally vented
○ c. Set to not occur until the end of the reasonable life of the plant - typically no failure within the first 25 years of plant operation
○ d. Optimize the productivity of the plant

32. To avoid false alarms many sensors
○ a. Use 2 #12 aluminum cladded wire cables
○ b. Use multiple sensors along with a voting system (two out of 3 sensors to trigger)
○ c. Alarms must be confirmed by a visual confirmation
○ d. Require NFPA proofing officer of each sensor before its use

33. An open-path gas detector?
○ a. Uses two different infrared frequency beams, one of which is attenuated by gas molecules
○ b. Can have a display read out in parts per million meters (PPM m)
○ c. Can have a display read out in Lower Explosive Limit meters (LEL meter)
○ d. All of the above

34. What size and concentration of gas cloud would result in a reading of 2.5 LEL·meter
○ a. 50% LEL x 5 meters
○ b. 100% LEL x 1 meter
○ c. 25% LEL x 4 meters
○ d. 1% LEL x 2.5 meters

35. A Pellistor sensor type on the 0-100% LEL scale requires what in the sample gas to obtain a reading?
○ a. Nitrogen gas
○ b. Platinum gas
○ c. Oxygen gas
○ d. Argon gas

36. Where might you expect to find a point source gas detector in an LNG plant?
○ a. A Pellistor-type sensor at the oil and paint storage area
○ b. A Pellistor-type sensor at the halogen storage area
○ c. A Pellistor-type sensor in the nitrogen-blanketed space of a heating loop expansion tank
○ d. A dual IR beam or Pellistor-type sensor at the plant's combustion equipment's inlet air.

37. An ionization-type smoke detector?
○ a. Uses a radioactive material that emits alpha particles
○ b. Smoke must enter the sensor chamber to sense the products of combustion
○ c. The electrical conductivity of the ionized gas changes due to the products of combustion
○ d. All of the above

38. A photoelectric-type smoke detector?
○ a. Uses a light which reflects off of smoke particles to trigger an alarm
○ b. Smoke must enter the sensor chamber to sense the products of combustion

○ c. May be triggered by dust
○ d. All of the above

39. The characteristics of thermal-radiation-type flame detectors include?
○ a. They do not need to have the products of combustion enter the detector to work]
○ b. They sense either or both infrared and ultraviolet radiation from a fire
○ c. They typically are set up with two detectors sensing at different angles
○ d. All of the above

40. What is true about oxygen detectors?
○ a. LNG technicians must wear portable belt clip detectors at all times
○ b. Must be used when entering a confined space
○ c. Use a Pellistor sensor for sensing oxygen
○ d. Use a light scattering technology to sense oxygen molecules

41. What are two types of temperature detectors?
○ a. Pellistor and Light scattering
○ b. IR and UV sensing
○ c. Ionization and stress sensing
○ d. Resistance Temperature detectors and thermocouples

42. If an LNG spill occurs and catches fire, what lessons have you learned in this study?
○ a. Water sprays can be used to cool personnel and equipment but not to extinguish an LNG fire
○ b. High Expansion foam can be placed over the LNG pool fire to lessen the size of the fire
○ c. Dry chemical is the only substance approved for extinguishing an LNG fire
○ d. All of the above

43. In electrical or computer rooms what is a common fire suppression system used?
○ a. Water deluge
○ b. Water curtains
○ c. Fire inhibiting gas systems
○ d. High-expansion foam systems

44. Lock-out, Tag-out (LOTO) is a procedure that?
○ a. Requires that locks and tags be put on valves that are to be in a particular position during a procedure for a project
○ b. Allows for many locks to be put on the locking devices. Each craft working on the project places its lock on the locking device
○ c. It can never be waived
○ d. All of the above

45. Which permits are critical for plant safety?
○ a. Work permits for any work to be performed in the LNG plant
○ b. Hot work permits for any job where a source of ignition may be present
○ c. Special entry permits, such as entrance into a confined space
○ d. All of the above