NPTEL CERETIFICATE EXAMINATION

HSE practices in offshore & petroleum industries- SET 2

- ***This question paper contains three sections. Answer all sections.***
- ***No codes and additional support material is allowed for reference.***
- ***Any data missing, may be suitably assumed and stated.***
- ***Use of calculators is permitted.***

Time: 3 hrs **Total Marks: 100**

Section A: Each question carries one mark. Use appropriate key words to answer

1. Drilling accidents are classified as _____ and _____ (catastrophic and routine)
2. Conducting marine surveys cause _____ to marine environment (physical hazards)
3. Dense gas dispersion is commonly studied using _____ model (Britter-McQuaid model)
4. Estimation of uncertainties associated with the entire process of risk assessment is called as _____ (Risk characterization)
5. _____ are vital to create continual awareness and improvement towards risk reduction (Tool-box meetings)
6. _____ is defined as frequency at which every individual may be expected to sustain a given level of harm from realization of hazard. (Individual risk)
7. According to UK health and safety executive, acceptable FAR is ____ (One)
8. If the hazard evaluation show low probability and minimum consequence, then the system is called _____ (Gold plated system)
9. _____ is defined as a measure of potential and economic loss. (Risk)
10. _____ is a chemical or physical condition, that has potential to cause damage to people, property or environment. (Hazard)
11. A short word describing a deviation of the design/process intent is _____ (Guide word)
12. Facilities that help to reduce the occurrence frequency of the deviation or to mitigate its consequences is _____ (safe guard)
13. _____ the temperature above which the material does not require any external ignition source to catch fire (Auto-ignition temperature)

14. The temperature at which a particular organic compound gives off sufficient vapor to ignite in air is called as _____ (Flash point)
15. HSE rules in workplace impose legislative control on both _____ and _____ (employer; employee)
16. F-N curves are used to represent _____ (societal risk)
17. State the main difference between risk and hazard

    Hazard is a scenario but risk is realization of the scenario
18. Name any one method used as preventive measure of fire and explosion (flammability diagram, inerting and purging, controlling static electricity,, ventilation)
19. What does TLV-TWA abbreviate for? (Threshold Limit Value- Time weighted average)
20. What is meant by maximum mixing depth?

    Depth of the convective mixing layer in which vertical movement of pollutants is possible is called as MMD

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Section B: Each question carries TWO marks. Answer briefly

1. What are the objectives and aim of HSE guidelines.

   Objectives:

   - to describe a process by which client can select contractors and award contracts with a view
   - to increase client-contractor relationship while ensuring safety in all stages of operation

   Aims

   - To increase the performance , while assuring safety
   - To provide effective management of HSE in the contact environment
   - Facilitate interface of the contractors activities with that of client
   - Integrates contractors, sub-contractors, and clients into a single group, under all the activities

2. What is near-miss event and its importance in HSE plan?

   Near-miss is an event not causing harm, but has the potential to cause injury or ill health. Near-misses are very important events which have to be recorded and investigated thoroughly, respective corrective measures need to be implemented to make the place feel safe from hazards.

3. Write short notes on safety assurance and safety assessment.

   Safety assurance is the application of safety engineering practices, intended to minimise the risks of operational hazards. Strategies include reactive, proactive, predictive, and iterative. Risk analysis is an example.
   Safety assessment, examines the potential severity of impact and probability of occurrence. Risk assessment, hazard identification etc. are the methods.

4. What are hazard identification and hazard analysis techniques as per IS 15656:2006

   Hazard identification methods

   - Comparative methods: checklist, safety audit, hazard indices
   - Fundamental methods: What-if analysis, FMEA, HAZOP,

   Hazard analysis methods

   - Fault tree analysis
   - Event tree analysis

5. What are different types of FMEA and where is it applicable

Two types of FMEA

Design FMEA: Identifies the potential failure modes of components, sub-components etc of a main system

Process FMEA: Identifies the potential failure modes of processes deployed in making the components

6. Write a short notes on risk priority number (RPN)

   Risk priority number (RPN) identifies the important areas of concern. It evaluates a severity rating, the occurrence rating, and the detection rating for a potential failure mode. It is product of Severity, Occurrence and Detection

7. Calculate OFSC and ISOC for ethane (C_2H_6) for the following data in Table 1

Table 1: Flammability limits and LOC of Ethane

Flammability in air	LFL: 3.0% UFL : 12.4%
Flammability in oxygen	LFL: 3.0% UFL : 66.0%
LOC	11%

OFSC= $\frac{LOC}{z[1-\left(\frac{LOC}{21}\right)]}$

ISOC= $\frac{z* LOC}{z-\left(\frac{LOC}{100}\right)]}$

8. What are different ways of evaluating toxicity of chemical releases?

   PEL or TLV-TWA, based in ERPG as recommended by NIOSH; guidelines as recommended by National Research Council, Canada (NRC)

9. List different types of inversions?

   Subsidence inversion, radiation inversion, and its combination

10. State different stages of ecological monitoring

    First stage: identification of possible potential hazards from impact sources through regular observations of marine biota

    Second stage: to establish cause-effect relationship between biological effects and impact factors

    Third stage: assessment of total impact on marine biota including commercial species

    Final stage: recommendation of corrective measures to check marine pollution

11. List different stages of oil and gas development

    G&G survey, exploration, development and production and decommissioning

12. List a few consequences of marine pollutants

Oil slicks, tar balls, suspended solids, oil hydrocarbons such crude oil, and hydrocarbon of methane series.

13. Define risk as per ISO 2002 and ISO 13702
    ISO 2002: Combination of probability of an event and its consequences
    ISO 13702: Term, which combines the chance that a specified hazardous event will occur and severity of consequences of that event
14. Define flash point temperature
    It is the temperature of the liquid at which a mixture corresponding to the lean flammability limit is formed due to its vapor mixing with ambient air.
15. Define stoichiometry
    It is the relationship between quantities of substances that take part in combustion reaction to form a compound. It is typically ratio of two integers. It is a measurable relationship of reactants and products in a balanced chemical reaction.
16. What do you understand by failure rate of a component, with respect to FMEA analysis?
    Failure rate is the rate at which a component can fail when put to use over fixed period of time. It is estimated using bath-tub curve. Highest failure rate is seen at infant mortality stage and old stage of a component.
17. List different types of explosions
    CVCE, VCE, BLEVE, VE and dust explosions
18. What are main hazards in oil and gas industries?
    safety and injury hazards, health and illness hazards
19. Write a brief note on process hazard analysis
    PHA is a thorough, orderly and systematic approach for identifying, evaluating, and controlling hazards in the process involving hazardous chemicals. PHA should be carried out on all process hazards, well in advance to identify the causes and possible consequences.
20. Write a brief note on Fault tree analysis
    FTA is a logical, structured process that can help identify potential causes of system failure. It is helpful in identifying initiating events, and failure of barrier systems.

Section C: Each question carries 5 marks. Answer in detail. Draw figures, wherever necessary to support your answer

1. Write a short note on Shelf ecosystem

The continental shelf is a shallow, near horizontal seafloor extension from the shoreline to the upper continental slope, which is characterized by a very gentle slope. The coastal zones habitat account for about 90 percent of marine commercial organisms. Prospective locations of oil and gas fields are in the shelf zone, often overlapping unfortunately causing serious ecological disturbance.

2. Classify marine pollutants based on their hazardous nature and consequences

The marine pollutants are grouped based on the increasing order of their consequences:

- Substances causing mechanical impacts that damage respiratory organs, digestive systems etc.
- Substances provoking eutrophic effects that cause mass rapid growth of phytoplankton and disturbs the balance, structure and functions of water ecosystems.
- Substances causing saprogenic properties that result in oxygen deficiency
- Substance causing toxic effects that damages physiological process and functions of reproduction
- Substances with mutagenic properties that cause carcinogenic, mutagenic and teratogenic effects

3. Discuss anthropogenic impact on hydrosphere and its impact arising from accidents and abandonment activities of oil and gas sector.

Anthropogenic impact refers to assessing the state of hydrosphere and water eco-systems. The effects depends on change in temperature, radioactive material, discharge of toxic effluents, destruction of shore line etc.

Anthropogenic impact on hydrosphere due to accidents -

- considerable impact on hygiene, very high impact on ecology & very high impact on fisheries at local level

- minor impact on hygiene, ecology & fisheries at regional level.

Anthropogenic impact on hydrosphere due to abandonment

- considerable impact on fisheries at local & regional level
- minor impact on ecology at local & regional level

4. Explain ALARP in terms of risk acceptance and its importance? how do the values vary as per various codes.

   ALARP (As low as reasonably practicable) - is a tolerable risk, only if further risk reduction is impractical, or the cost is not proportionate to the benefit gained

Authority and Application	Maximum Tolerable Risk (per year)	Negligible Risk (per year)
VROM, The Netherlands (New)	1.0E-6	1.0E-8
VROM, The Netherlands (existing)	1.0E-5	1.0E-8
HSE, UK (existing-hazardous industry)	1.0E-4	1.0E-6
HSE, UK (New nuclear power station)	1.0E-5	1.0E-6
HSE, UK (Substance transport)	1.0E-4	1.0E-6
HSE, UK (New housing near plants)	1.0E-6	1.0E-7
Hong Kong Government (New plants)	1.0E-5	Not used

5. What are goal setting and rule based regimes?

Goal setting regime:

- Duty holders assess risk,
- Should demonstrate its understanding,
- Control over management, technical and system issues
- Keep pace with present trends
- Opportunity for workforce engagement

Rule based regimes

1. Legislator sets the rules
2. Emphasise compliance rather than outcome
3. Slow to respond

4. Less emphasis on continuous improvement
5. Less work force involvement

6. List three systems that are commonly use to measure an accident

OSHA, Fatal accident rate, Fatality rate or deaths per person per year. All three methods report number of accidents or fatalities for a fixed number of working hours during a specified period.

7. Explain hazard control, hazard evaluation and hazard monitoring

Hazard control: Sometimes hazard can be eliminated altogether, but most often measures has to be put to manage hazard efficiently and it also helps to be systematic. This is a step by step procedure which starts from the big ones, like whether to repair or upgrade the equipment and working down until you find a practical solution.

Hazard evaluation: Hazard evaluation can be performed at any stage. If the hazard evaluation shows low probability and minimum consequence, then the system is called GOLD PLATED. Potentially unnecessary and expensive safety equipment and procedures are implemented in the system.

Hazard monitoring: Hazard controls need to be reviewed periodically to make sure they are still effective and appropriate. This can be part of your regular safety inspections. Talking with staff and the Joint Health and Safety Committee (if you have one) is an excellent way to start to get an idea about how well controls are working and what could be done even better. Some questions to consider when reviewing hazard controls are:

- Is the hazard under control?
- Have the steps taken to manage it solved the problem?
- Are the risks associated with the hazard under control too?
- Have any new hazards been created?

8. Define fire and explosion characteristics of flammable materials

Fire characteristics of flammable materials are discussed below:

a. Auto-ignition temperature (AIT):

It is the fixed temperature above which material may not require any external ignition source for combustion.

b. Flash point:

It is the lowest temperature at which liquid gives up enough vapor to maintain continuous flame.

c. Flammability limits:

It is the range of vapor concentration that could cause combustion on meeting the ignition source. There are two limits in which the fuel will catch fire namely: lower flammability limit (LFL) and upper flammability limit (UFL). LFL is the limit below which mixture will not burn due to lean mixture and UFL is the limit above which the mixture will not catch fire as the mixture is too rich to catch fire.

d. Limiting Oxygen concentration (LOC):

It is the minimum oxygen concentration below which combustion is not possible, with any fuel mixture. It is expressed as volume percentage of oxygen. It is also called as minimum oxygen concentration (MOC) or maximum safe oxygen concentration (MSOC).

e. Shock wave:

These are abrupt pressure waves moving through a medium. A shock wave in open air is usually followed by wind, which is called as a blast wave. One of the important characteristics of the shock wave is that the pressure increase in shock wave is so rapid that the process is mostly adiabatic.

f. Over pressure:

It is that pressure imparted on an object by a shock wave.

Fig. 3.5 shows the flammability characteristics of materials.

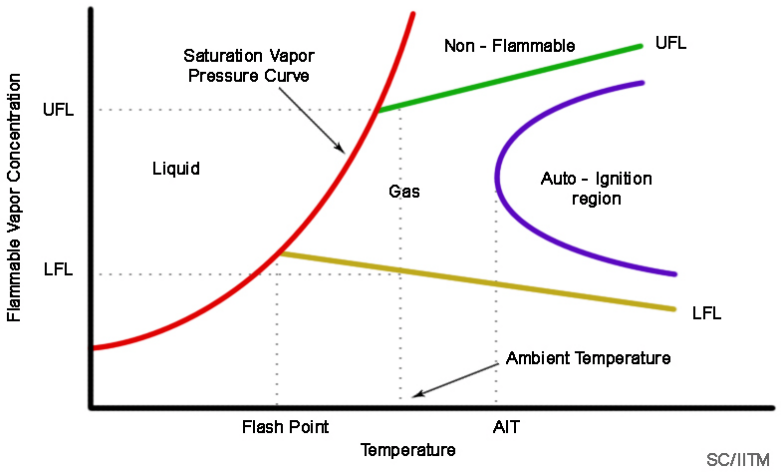

Figure. Flammability characteristics of materials