Health, Safety and Environmental Management in Offshore and Petroleum Engineering

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Module - 03
Accident Modeling, Risk Assessment and Management
Lecture - 19
Safety Practices for Confined Spaces-I

Welcome friends to the 19th lecture on HSE practices.

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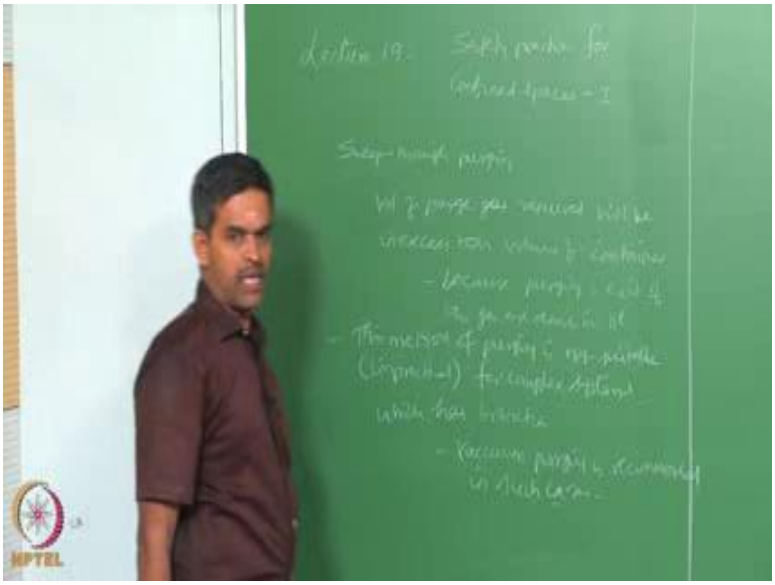

In this lecture, we will talk about safety practices for confined spaces. In the last lecture, we have been talking about different methods of purging; just overlay this slightly and extend it; then, we will talk about safety practices as applicable to confined spaces. So, the last discussion was on sweep through purging. So, we have understood that, this can be applied to pipes and more volume of gas if you want to really apply to the purge gas. Then, one can introduce a purge gas at one end and keep on releasing the mixture from the other end; both need to be done in parallel.

However, vessels require quantity of purge gas will be much excess of the volume because you are going to keep on doing it in parallel. So, in sweep through purging, volume of purge gas required will be in excess; than volume of vapor space contained in the container, because purging and exit of the gas are done in parallel. That is the reason

why the volume is more. If the system is complex, which involves side branches through which circulation cannot be established; then, sweep through purging cannot be recommended. So, one can very categorically say this method of purging is not suitable rather not practical. It is impractical for complex systems, which has branches through circulation; it is not practical. So, what you do in such cases? I think the literature or the practice recommends vacuum purging in (Refer Time: 03:03). That is one limitation of application of sweep through purging.

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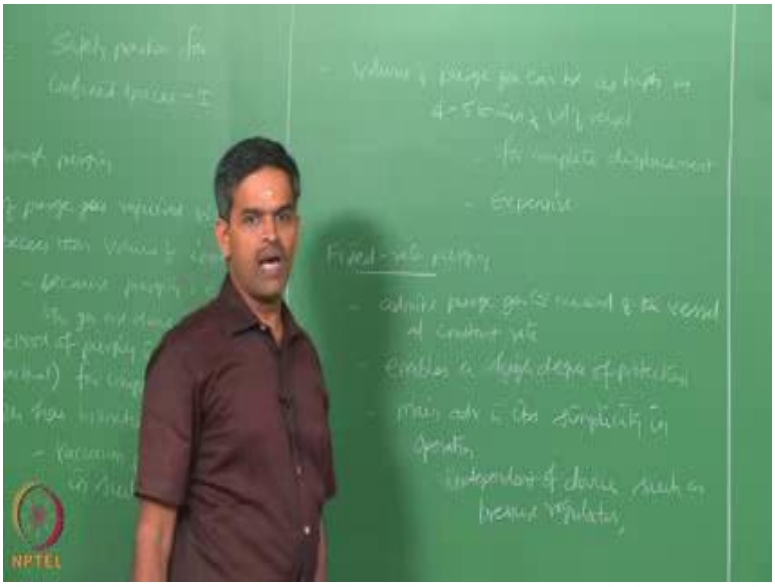

The second limitation could be the volume of purging as required in this case. It can be as high as four to five times of the volume of the vessel, if you really wanted to have a complete displacement. So, in that case, one can always say this kind of purging is expensive. The next is fixed rate purging. This method involves a continuous introduction of purge gas into the enclosure at a constant rate. So, it admits purge gas at one end of the vessel on the pipeline at constant rate. This should be rather sufficient to supply the peak requirements in order that, complete protection is provided. So, this kind of purging enables a high degree of protection. The main advantage is its simplicity in terms of its operation. It does not depend on – it is independent of devices such as pressure regulators, release valves, etcetera. Therefore, it is considered to be a safer operation.

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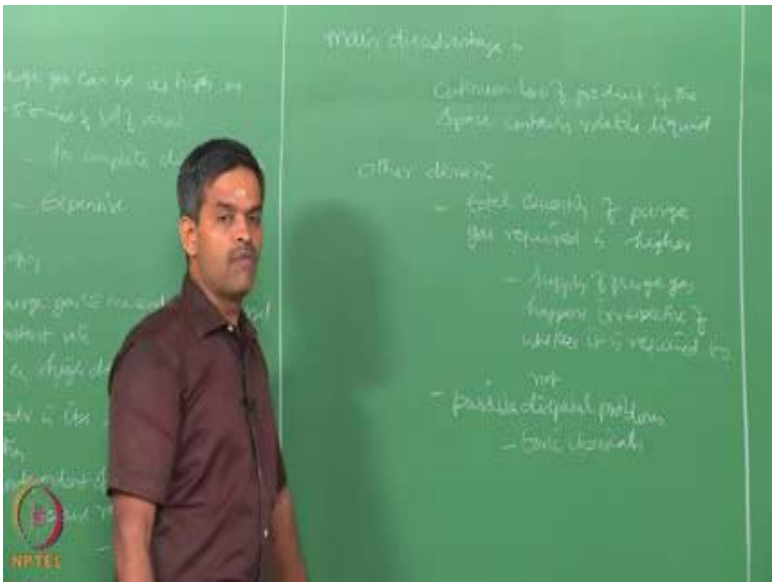

It has got a main disadvantage. The main disadvantage of this purging method is there is a continuous loss of product, where the space contains a volatile liquid – loss of product if the space contains volatile liquid, because there is a constant sweeping, which also takes away the liquid by the purging gas. Other demerits could be one – the total quantity of purge gas is high – is relatively higher, because you are supplying purge gas because supply of purge gas happens irrespective of whether it is required or not. That is very interesting. That is why we call this as fixed rate purging. Whether it is required or not, keep on pumping the purge gas. It also has possible disposal problems, because if you are talking about the disposal of toxic chemicals, which are actually purge; then, in that case, disposal of the container in the vessel becomes a big problem, which will have undesirable consequences.

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The other method of purging is what we call variable rate or demand purging. This method involves introduction of purge gas into an enclosure at a variable rate. So, purge gas is admitted into an enclosure at a variable rate, which is dependent on demand. The advantage is purge gas is supplied only when it is actually needed. Then, that is an advantage. Therefore, it is possible to completely prevent influx of air if desired in this operation. The demerit is operation depends on functioning of process control valve, etcetera. Operation is strongly dependent on effective functioning of pressure control valves, etcetera. Sometimes these valves may operate mistakenly at low pressure, which will also admit the purge gas, which is not necessary. Therefore, it is important to maintain these valves in a proper order, so that the purging operation becomes more efficient.

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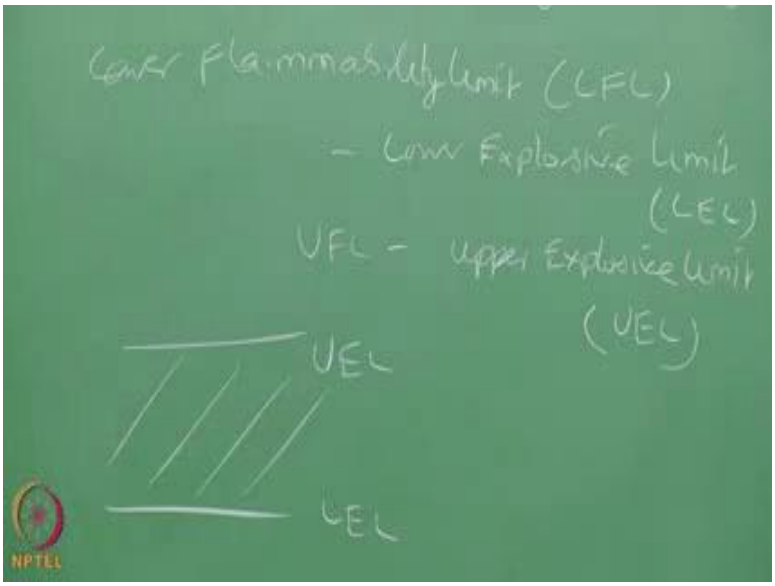

So, friends, when we extend the discussion of safety practices to closed containers, let us say closed containers; let us talk about safety practices. In that case, the moment we talk about closed container, which is having hazardous chemicals, we should bother mainly about the flammability limits of gas mixtures. That is the first parameter we have. We already studied their importance of flammability diagram in fire prevention and control. We already know how at all the importance of flammability limits and how to estimate them using stoichiometric balance equations.

So, one of the basic requirements in the purging operation is the knowledge of the flammability limits of the combustible gas in air. When small increments of a combustible gas are progressively mixed with air, a concentration is finally attained in which the flame will propagate in the presence of source of ignition. This is what we call as lower flammable limit in the gas or air.

The lower flammability limit is also called as lower explosive limit. So, lower flammability limit, that is, L F L is also called as lower explosive limit; it is L E L. As further increments of gas are added, a higher concentration of flammable gas will be achieved in which the flame will fail to propagate. Therefore, the concentration of the gas and air at this point is called upper flammability limit. For practical purposes, upper flammability limit is also as same as upper explosive limit. So, upper flammability limit

is also as same as upper explosive limit. So, we all know that it is between these regions, the mixture remains flammable.

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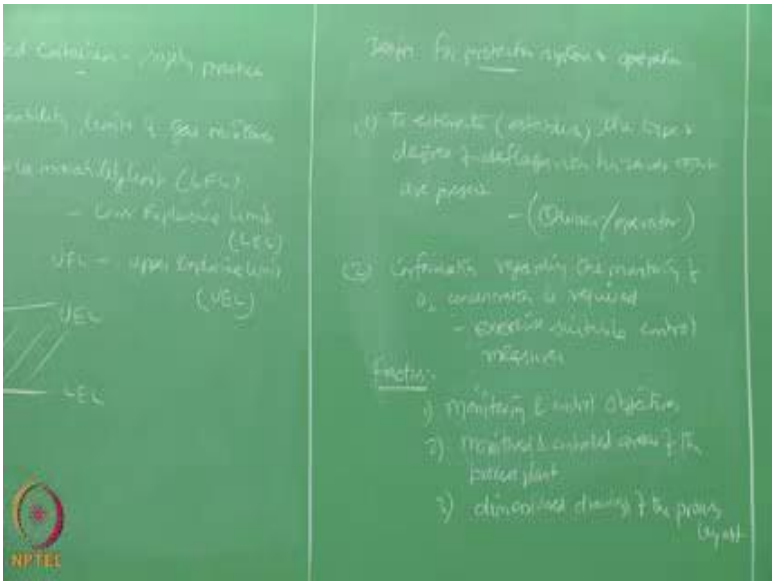

Now, after understanding this, let us talk about protection system design and operation; let us say design guidelines for protection systems and their operations. Let us talk about this. It is important that subcontracting is a segment or path of oil and gas exploration. The owner or the operator shall be responsible for a thorough analysis of process to determine the type and degree of deflagration hazards inherently present in the process. So, the first step would be to estimate – in fact, I should say establish the type and degree of deflagration – deflagration hazards that are present in the given system. Who is responsible for this? Either the owner or the operator; they are responsible for this.

Let us also try to fix up the responsibilities parallely in brackets of each operation of safety. So, we will know who is liable to follow this. The second issue could be information required for oxygen concentration monitoring, because when you start using the flammability diagram to control the flammability limits of a given mixture, one can always admit oxygen concentration further, so that the limiting oxygen concentration in a given mixture can be varied, so that the mixture either gets diluted or gets intensified, so that the flammable characteristics of the mixture is changed. Therefore, you also need information regarding the continuous monitoring of oxygen concentration in a given system – is required.

Then only, one can exercise – one can exercise suitable control measures. So, what are the factors, which will govern? The factors that govern this could be monitoring and control objectives. Monitor and control areas, which are the areas of the process plant; further, the dimension in drawing of the process in the layout. You also require additional information to have a healthy design for production systems.

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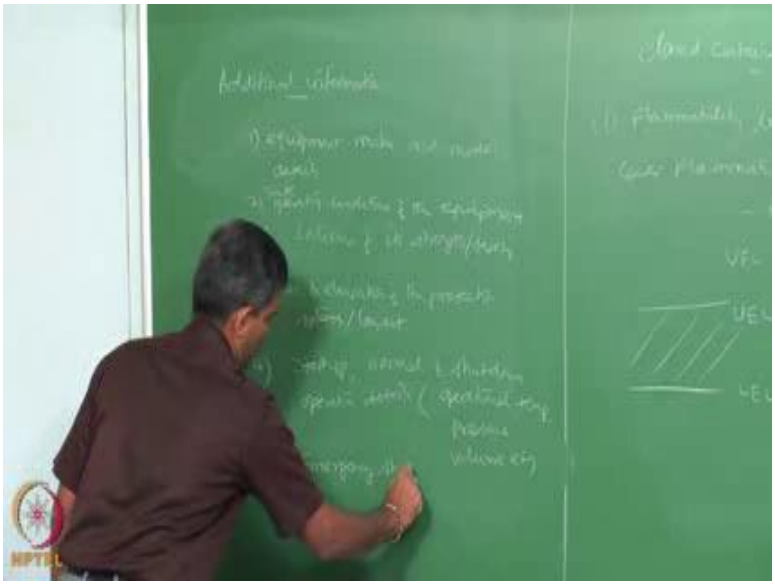

The additional information required for healthy design of protection system could be equipment make and model details, operating conditions of the equipment. In fact, we should rather put safe operating conditions of the equipment in terms of its strength and safety. That is important. Three – plan an elevation of the protection systems and their layout. That is also important. Further, we should also know information about the startup, normal and shutdown operations in terms of their operational temperature, pressure, volume, etcetera. We should also know details about emergency shutdown process.

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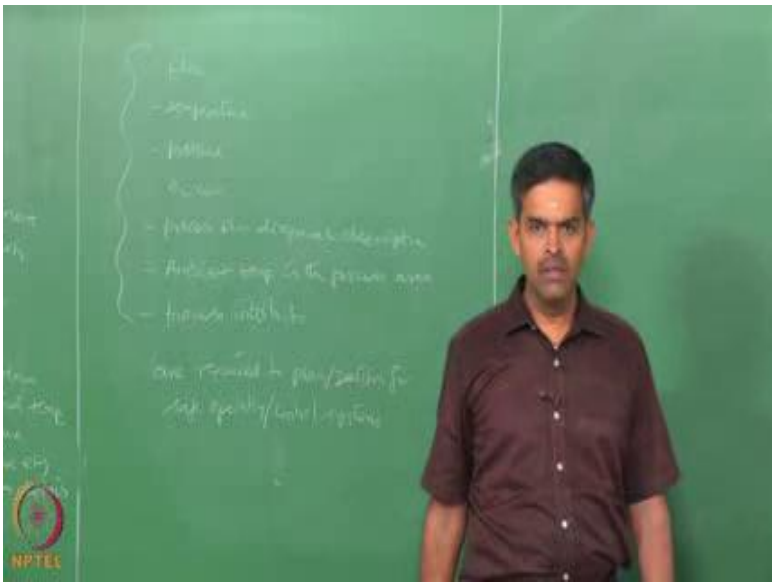

Now, what are those factors, which will affect further more details about this? Let us say low temperature, pressure, oxygen concentration, process flow diagram and description of the process, ambient temperature in the process area; further, process interlocks. So, all these details are required also to plan for a – are required to plan and design for safe operating or control systems. It is obligatory in the part of the owner or the operator to disclose all necessary process information in a documental form in a proper manner, so that they should also educate the employee through the periodic training programs. That is very important.

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The complete information as listed should be documented. That is the first obligation. It can be either the contractor or the owner; does not matter. The first obligation is full detail about the process should be documented to all employees should be educated about the process through periodic training programs. That is also important. Let us look forward now for specific compliances of explosion prevention systems. The owner or the operator shall maintain the system after installation acceptance based on procedures provided by the vendor. So, they should maintain the system as per the norms or conditions proposed by the manufacturer. Who should maintain? Either the contractor or the owner; this is an obligation on their part. They are also responsible for periodic instruction and servicing of the equipment, of course, by authorized person.

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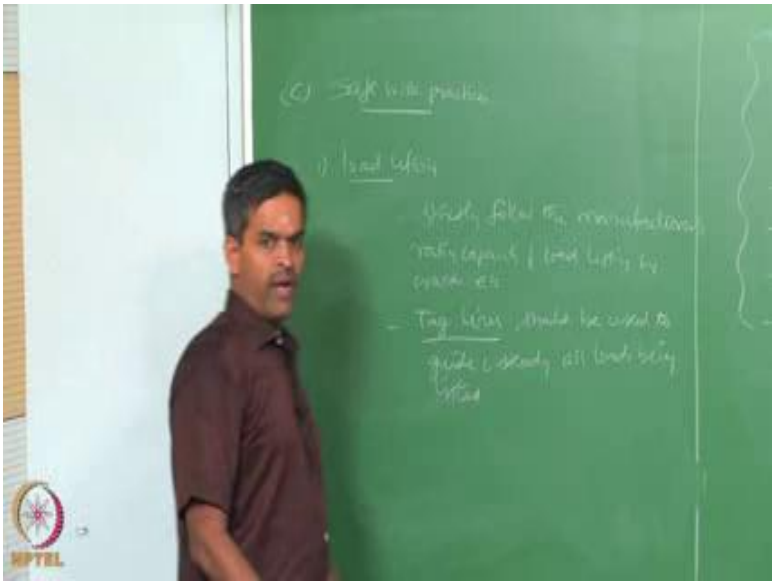

So, regarding safe work practices, there are few important work related practice issues, which can be discussed. Let us see 1 – load lifting. One should strictly follow the manufacturer's rating capacity of load lifting by cranes, etcetera. These equipments should be operated and maintained in accordance to the manufacturer's recommendation. Tag line should be used to guide and study all loads being lifted. Then, one should use what we call tag lines to guide and study all loads being lifted.

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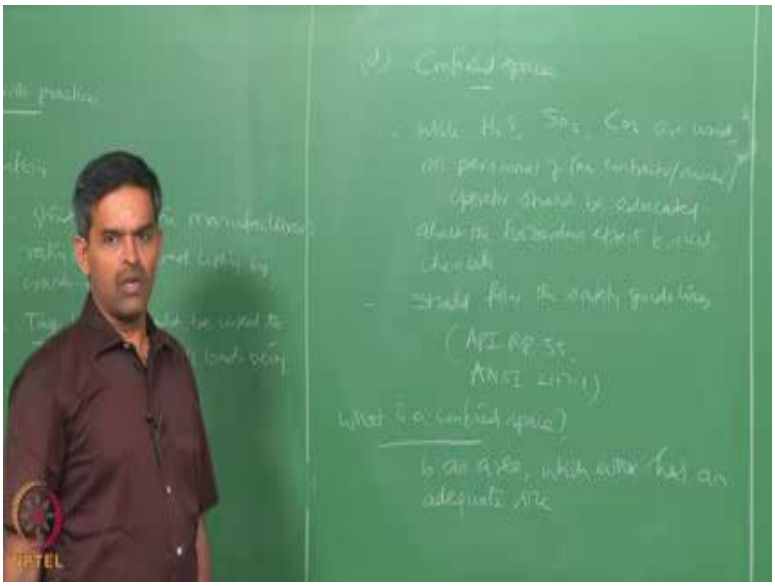

If we talk about confined space excavations and hazardous environments; when we look into safe work practices in confined space, we have a very common problem with hydrogen sulfide – chemicals like hydrogen sulfide; or, let us say while we use chemicals like hydrogen sulfide, sulfur dioxide, carbon dioxide and other hazardous atmosphere, one should remember that, operator shall ensure that all personal contractor and service companies are advised about the potential hazards.

So, while these hazardous chemicals are used, all personal of the contractor are owner or operator should be educated about the hazardous effects of such chemicals. That is important. It is mandatory. Safety guidelines and recommendations for using them in production operation should be also followed. So, various agencies recommend certain safety guidelines for using such hazardous chemicals. Few of them are A P I R P 55; second could be ANSI 2117.1. Now, the fundamental definition of a confined space – let us talk about this. What is a confined space? Because that is very important; it has got a classical definition given by the international standards. Confined space is an area, which either as an adequate size and configuration for people to enter – for people to enter.

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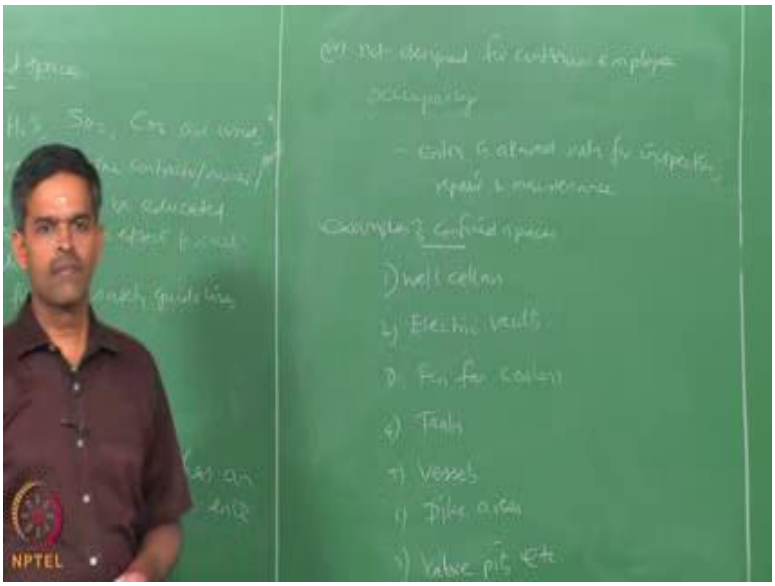

Or, it is not designed for continuous employee occupancy. Such spaces the area are called confined spaces. Employee entry is allowed only for inspection, repair and maintenance. Let us see some of the examples of confined spaces. Well cellars, electric vaults, fin fan coolers, tanks, vessels, dike areas, valve pits, etcetera. Confined space hazards should be identified for all facilities in a work place. Safe work practices therefore should be established for working in such confined spaces. A confined space entry permit shall be used to enter and exit the confined space.

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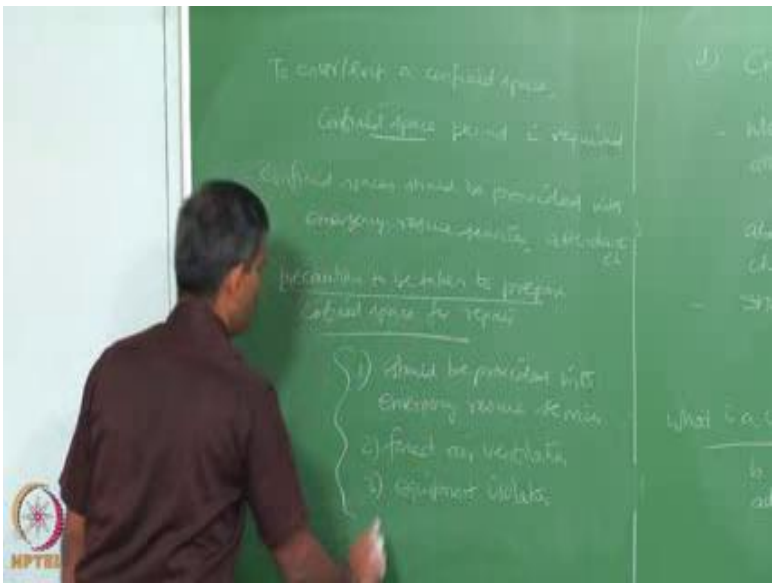

To enter or exit a confined space, confined space permit is required. That is important. Confined space entry permit shall be used to enter the any space of this order should have atmospheric engulfment or configuration hazards, which are adapted and practiced in a proper manner. Attendant and emergency rescue services must be provided for all permits required confined spaces. So, confined spaces should be provided with emergency rescue services and attendance, etcetera.

When preparing a confined space for entry, precautions must be in place to ensure that, the space remains safe for operation and maintenance. This may include four-star ventilation. So, what are the precautions to be taken to prepare confined space for – for repair let us say. It should be provided with – it should be with emergency rescue services. It should have forced air ventilation. It should have equipment isolation. These should be ensured, so that you can then prepare work permit for a confined space. For equipment isolation, blinding, double dock and bleeding or other equipment energy isolation controls should be considered.

So, friends, in this lecture, we talked about safety practices, which can be applied to design and operation stages. We mainly discussed about one important area of confined work space, where the regulations of safety are very strictly to be followed when you start giving a permit for confined work space entry, which is essentially accessed only during repair, emergency or maintenance purposes, not for continuous permanent occupancy of people.

So, string and norms are generally recommended by various international agencies as we discussed like A P R P 55, ANSI 2117.1, etcetera, which advises what are the guidelines to be followed, what are the emergency exits available, what is the assurance about the emergency rescue services, provision of attendance when especially when you start working on confined work spaces, because confined work space is one of the important segment, where accidents are very common if you do not take care of the permit requirements to work in such areas.

Thank you very much.