Offshore structures under special loads including Fire resistance
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Module – 03
Fire Resistance
Lecture – 42
Explosion and Fire Protection – II

Friends, we will continue with the discussion on Explosion and Fire Protection; lecture 42 is a continuation of the last lecture, where we discussed to start about the explosion by protection methods.

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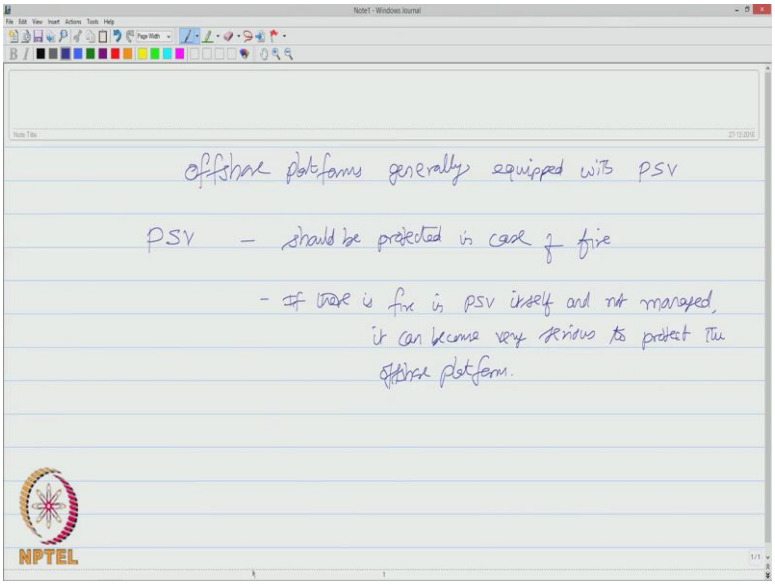

As referred in the last lecture, we said that offshore platforms are generally equipped with platform support vessels. It is very important that the platform support vessels should be ensured thoroughly a fire protection because if this PSVs are not saved and supported under fire then rescuing of the platform or fire protection to the platform will become a big challenge.

Therefore we understand and agree now that PSVs should be protected in case of fire because we agree that if there is fire in PSV itself and not managed, it can became very difficult to protect the platform subsequently. Then the question comes; how do we actually design a fire protection system for PSVs.

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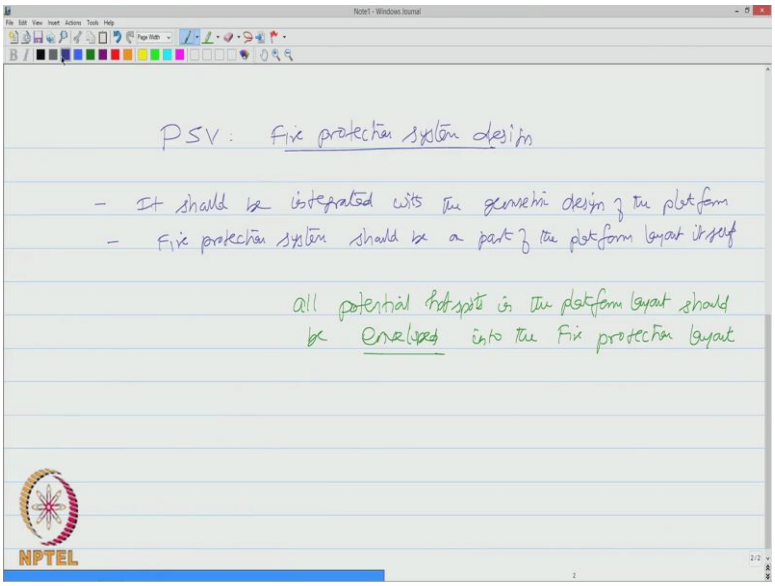

It should be integrated with the geometric design of the platform; fire protection system design should be a part of the platform layout itself. What does it mean is that all potential hotspots in the platform layout should be enveloped into the fire protection layout, what are the common types of fire protection used in offshore platforms.

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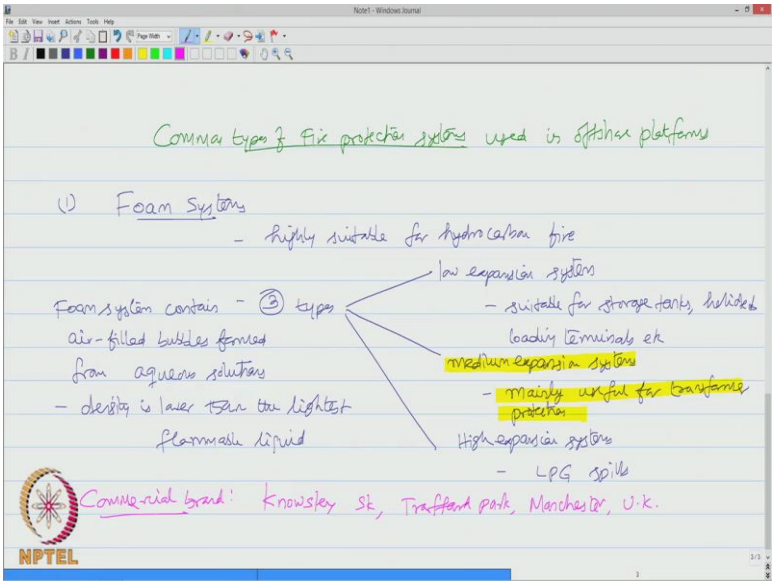

Let us ask this question and look few more details on this. The foremost system which is commonly used in PSVs as well as in offshore platforms is foam systems. These kind of systems are very highly suitable for hydrocarbon fires, there are three types of foam

systems; namely the low expansion system which is suitable for storage tanks, helidecks, loading terminals etcetera.

The second variety is medium expansion systems, which are mainly useful for transformer protection. The third type is high expansion systems, which are highly applicable for LPG spills. So friends under the foam system category, you will see that for electric fire and short circuiting fire; people generally use medium expansion systems.

Foam systems essentially contain air filled bubbles which are formed from agueous solutions. The density is so low that it is lower than the lightest flammable liquid so that they can fill up in these cases very easily and can do effective higher protection. The commercial brand available, I am just quoting an example is Knowsley SK which is Trafford park, Manchester, U K; that is one classical brand available in the international market who does design and development of foam systems for fire protection design in PSVs (Refer Time: 08:32) offshore platforms.

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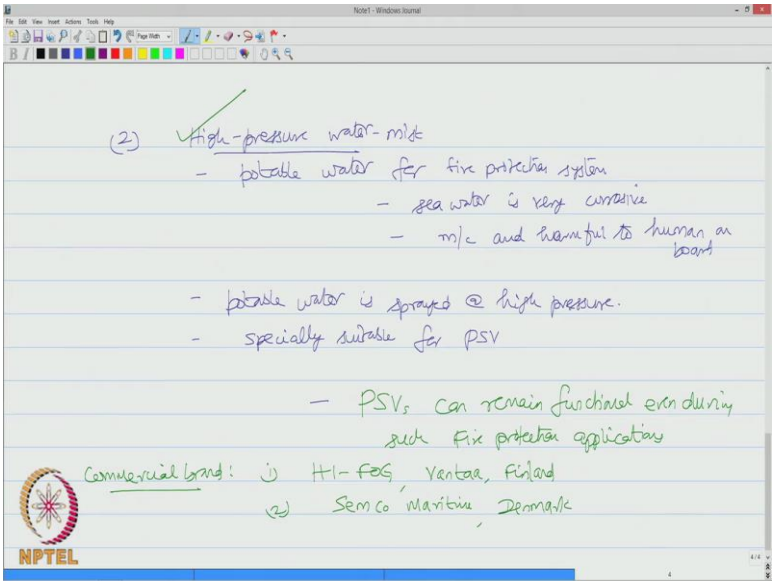

The next type which is commonly deployed is high-pressure water mist, as we said in the last lecture itself that we should actually use potable water for fire protection. One of the main reasons is sea water is very corrosive, it may spoil the machinery and it may be harmful to human on board.

So in high pressure water may system, potable water is sprayed at a very high pressure. These systems are specially suitable for platform support vessels, the main advantage of the system is PSVs can remain functional even during such fire protection applications. So, that is one of the advantage of this kind of system, the commercial brand available in the market of this system is HI-FOG, which is from Finland and the other brand is Semco Maritime; which is essentially from Denmark. Let us discuss more in detail about explosion protection.

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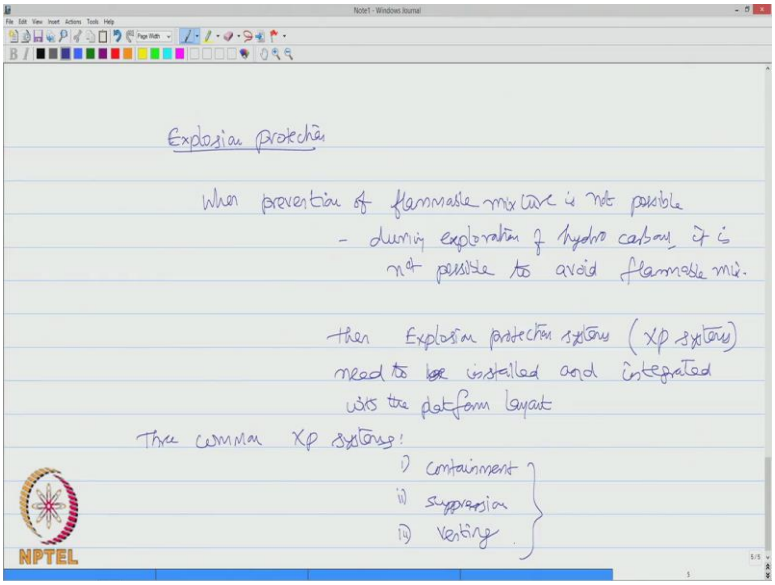

Friends, when prevention of flammable mixture is not possible: this is a classical example where we are dealing with explosion of hydrocarbons. So during exploration of hydrocarbons, it is practically not possible to avoid flammable mixture. So, when presence of flammable mixture is not possible then explosion protection systems, which is briefly said as x p systems; explosion protection systems, need to be installed and integrated with the platform layer. There are three types of common, three common x p systems which are practiced in offshore installation; one is containment system, other is suppression system and the third one is venting.

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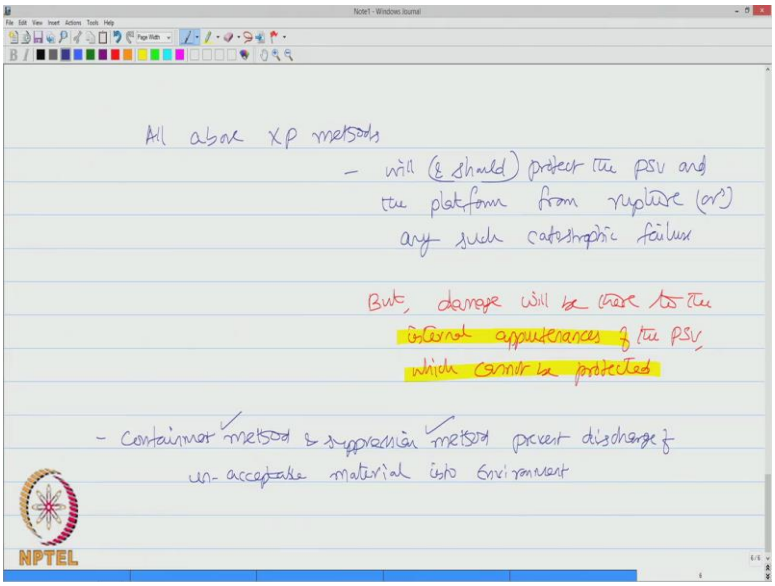

All the above protection methods, all above x p methods will and should protect the PSV and the platform from rupture or any such catastrophic failure, but damage will be there to the internal appurtenances of the PSVs, which cannot be protected.

So, friends please realize and understand that even when explosion protection equipments are installed in the layout of the platform itself and they are automated, damaged internal appurtenances is unavoidable. Out of these three methods of explosion protection, containment method and suppression method prevent also the discharge of unacceptable material into environment. Therefore, under the recent environmental bi laws; which are applicable to offshore production facilities, containment method and suppression method of explosion protection devices are strongly recommended urged to be practiced in offshore platforms as well as for PSVs.

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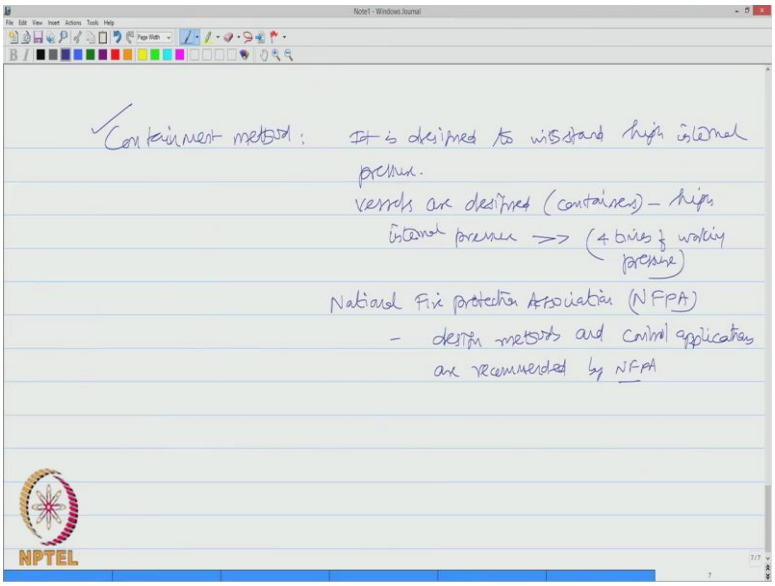

In the containment method of explosion protection which is actually designed to withstand, high internal pressure. It means vessels are designed what we call as containers; to withstand high internal pressure as a part of the design itself and this pressure will be at least 4 times of working pressure. As a precaution in measure, the containers are design to withstand very high internal pressure and that method of design is what we call as containment method of explosion protection. National Fire Protection Association recommends detailed design procedures for explosion protection of PSVs and container vessels. So, detailed design methods and control applications are recommended by NFPA, which are exclusive for platform support vessels and platforms itself.

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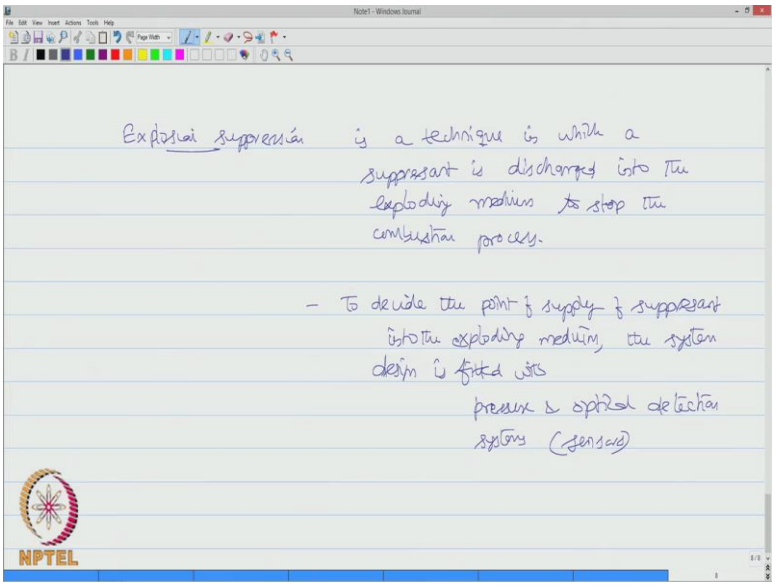

Explosion suppression is a very interesting technique in which a suppressant is discharged into the exploding medium, to stop the combustion process. Now to decide the point of supply of suppressant into the exploding medium, the system design is fitted with pressure and optical detection systems, which are nothing but type of senses. These senses will command the time of intervention of the supressant into the explosive medium, which is in subsequently retard or stop the entire combustion process. So, we call that as explosion suppression systems of explosion protection design.

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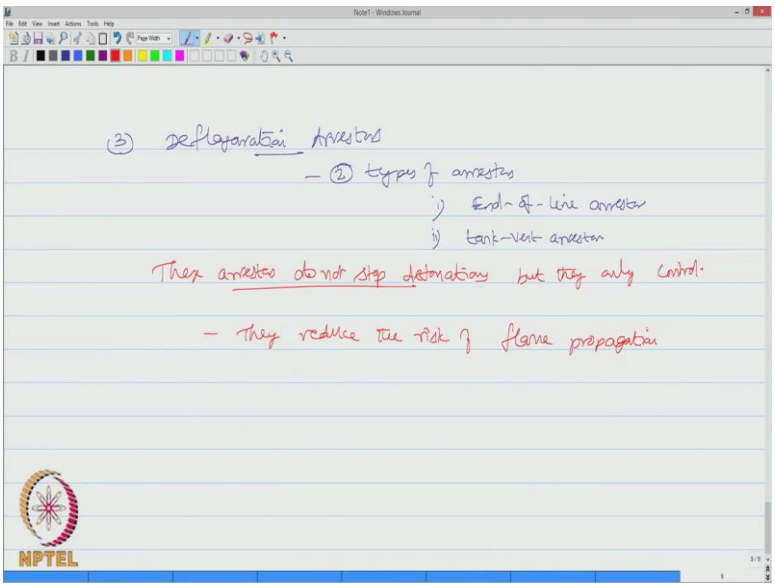

The next one what we have is deflagaration arrestors, which I have very commonly used again in PSVs. There are two types of arrestors; one is end of line arrestor, two is tank vent arrestor. Please note that these arrestors do not stop detonations, but they only control them. So, they actually reduce the risk of flame propagation that is the main function of deflagaration arrestors.

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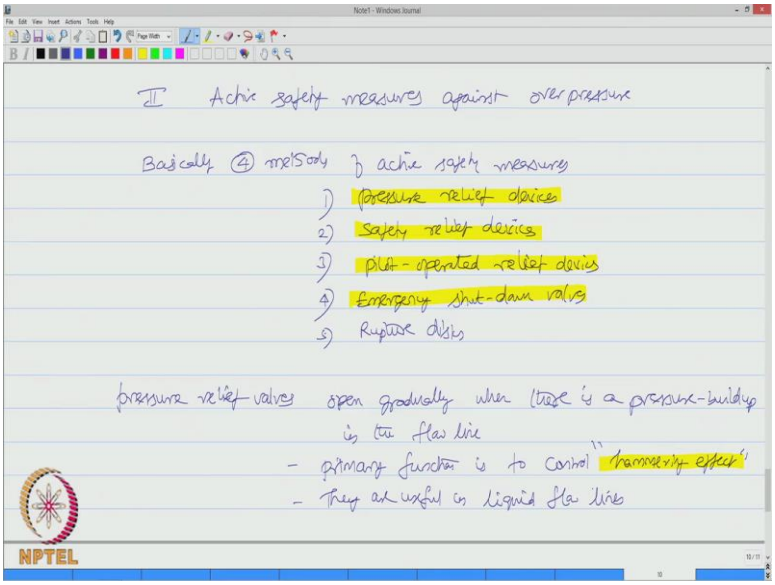

In addition to this, we also have many active safety measures apart from the passive systems what we so far discussed; there are active safety measures to control over pressure which results in explosion. There are basically four methods of active safety measures, namely pressure relief devices, safety relief devices, pilot-operated relief devices, emergency shut-down valves and rupture disks. Friends, being engineering graduates and practicing professionals; you would have heard and come across many type of pressure relief devices; pressure relief valves, safety relief valves, pilot operated relief valves and ESVs; Emergency Shutdown Valves.

So, we will not discuss them in detail about their mechanical layout and the design concepts of these valves and devices; however, rapture disks are quite interesting and different, which are commonly you also deployed as an associate devices along with these above four methods of active safety measures, we will discuss them very briefly here.

We know pressure relief valves open gradually when there is a pressure build up in the flow line. Actually the primary function of this type of device is to control hammering effect,

hammering effect is one which can actually cause damage the pipe line which is of a very catastrophic nature; they are very useful in liquid flow lines.

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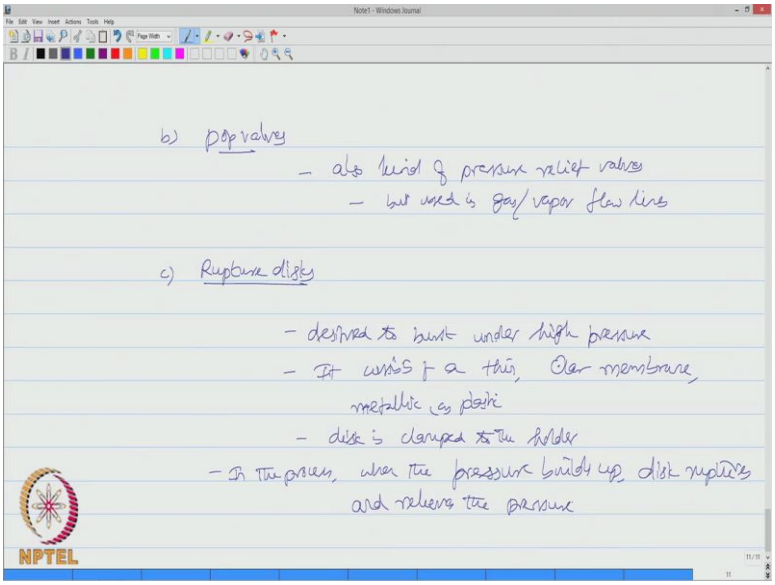

The common one used again is a popup valve or simply pop valves, they are also kind of pressure relief valves, but used in gas or vapour flow lines. The interesting allied part is the rupture disks, they are designed to burst under high pressure, let us say they are called as rupture disks. It consists of a thin circular membrane which is generally either metallic or plastic by material. The disk is clamped to the holder in the process when the pressure builds up; the disk ruptures and relieves the pressure.

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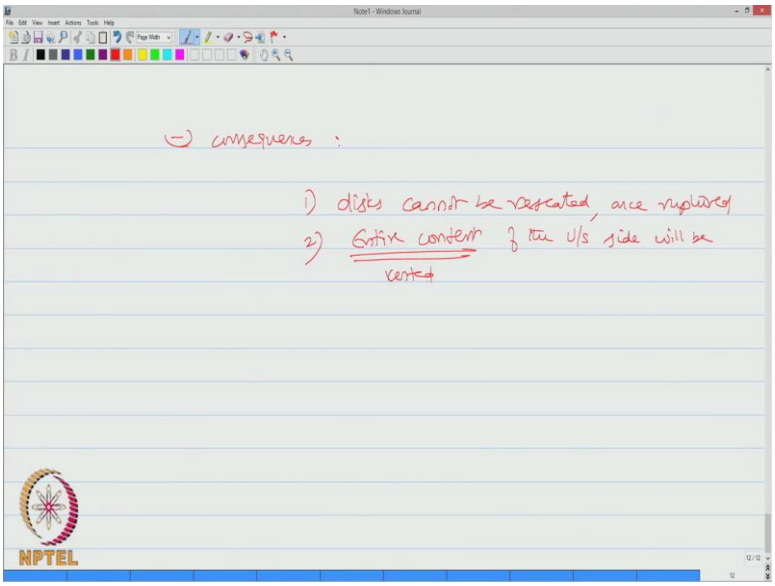

Interestingly friends, it has got a very important negative consequence; the positive part is, it relieves pressure and saves the flow line from any further damage but the negative consequence is disks cannot be re-seated. So, it is kind of a destructive system which is consumed during the process of fire fighting or fire protection.

It cannot be re-seated once it is ruptured, secondly and most importantly the entire content of the upstream side will be vented. So you lose the entire pressure build up available in the line whereas, the other kind of devices what we just then saw they will control the pressure and regulate the pressure flow, but it is in went off; the content whereas, in rapture disk the entire content of the upstream side will be vented to atmosphere. Under this discussions we have realize that explosion is not far away from blasting.

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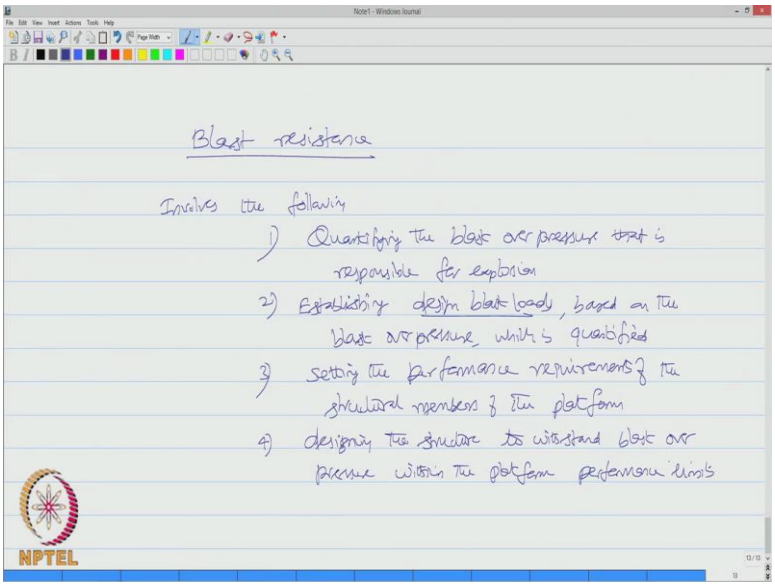

So, we should now discuss more interesting part on blast resistance as a part of explosion protection. Blast resistance involves the following; one quantifying the blast over pressure which is responsible for explosion, two establishing the design blast loads based on the blast over pressure, which is quantified.

Thirdly, setting the performance requirements of the structural members of the platform, please understand blast resistance cannot be directly applied to non-structural members of course, blast distance can be applied to protect machineries and equipments, but machineries equipments cannot be designed to be blast resistant, you need to have some passive cover which encircles the equipment and therefore the equipments are protected.

So, we must also set the performance requirements of the structural members of the platform and lastly designing the structure to with stand blast over pressure within the platform performance limits.

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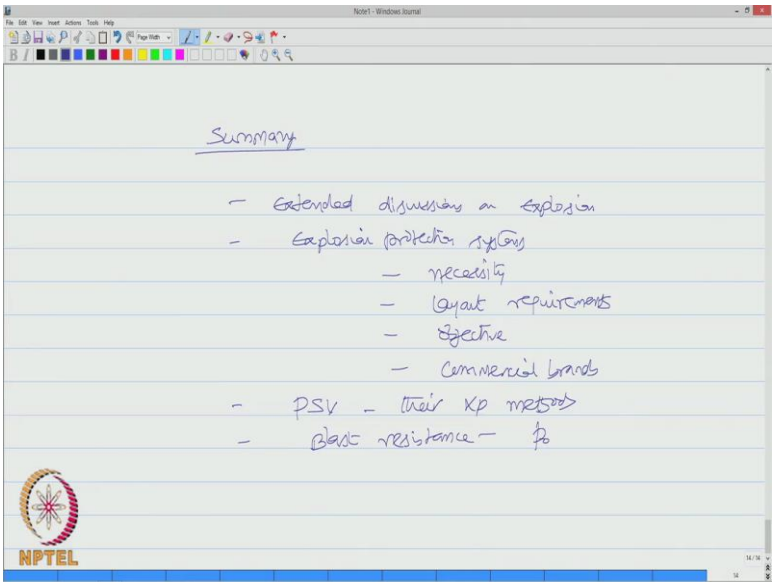

So friends in this lecture, we extended discussions on explosion, we also discussed about explosion protection systems, the necessity, their layout, requirements, their objective and various commercial brands suitable for PSVs. We discussed about platform support vessels and their explosion protection methods, we also discussed about some note on blast resistance with reference to over pressure; which can arise during explosions.

Thank you very much.