Health, Safety and Environmental Management in Offshore and Petroleum Engineering

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Module – 02
Operational Safety
Lecture – 19
Accidents in offshore platforms

Friends, welcome to the 19 Lecture of on Module 2 on HSE Practices in Offshore Engineering.

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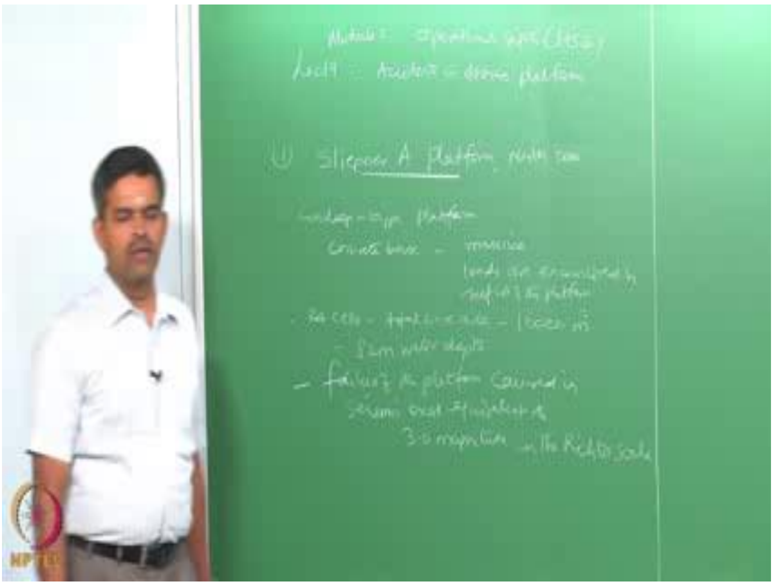

We talking about 19 Lecture, we discuss in the lecture Accidents in Offshore Platform and see how hazard analysis can be link to this. These are lectures on Module 2 where we talking about Operational Safety and the courses on HSE Practices in Offshore Petroleum Engineering.

To start with we take the first case study which is Sleipner A platform, in nocsey. It is a concrete deport platform, it is having a concrete base. So, one can say the structure is very massive and loads encounter by (Refer Time: 01:32) the platform, that is primary characteristic of the platform because of the gravity base structure. It consists of about course 24 cells because there are all (Refer Time: 01:48) type, total base area of about 16000 square meters. It is operating at the depth of 82 water depth relatively shall over to us. The platform as faced or encounter a seismic event; the failure of the platform resulted in or let say caused in a seismic event equivalent to 3.0 magnitude on the Richter scale.

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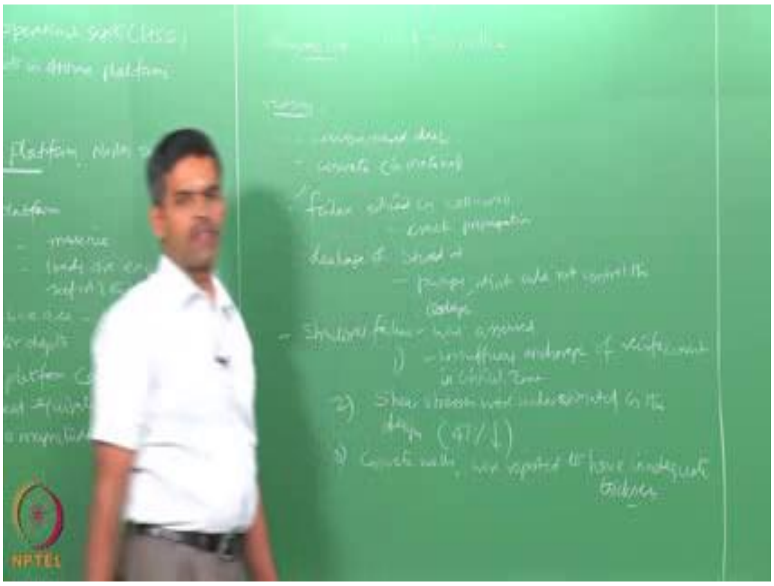

Now, interestingly the economic loss of the failure which we have more keen on risk analysis is about US Dollar 700 million that is estimate loss of this failure.

Friends look the screen now.

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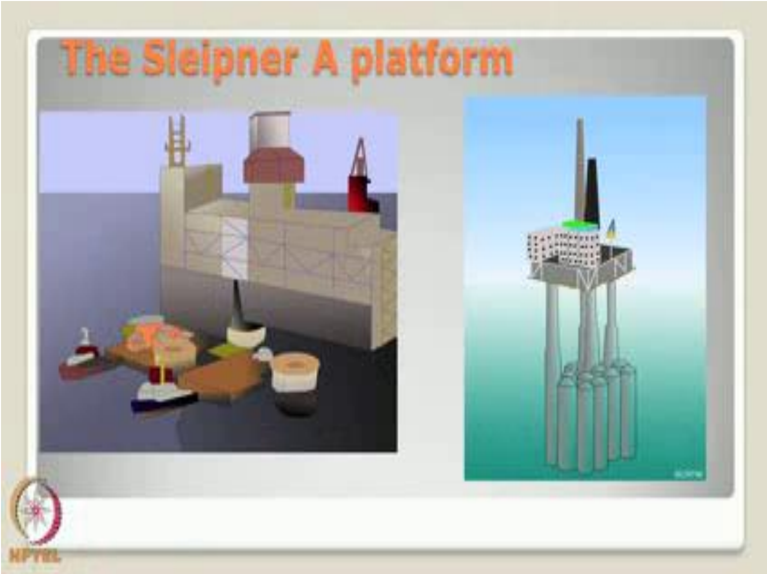

It is actually captured view indicator graphically about the sleipner A platform nocsey. The right side actually the platform what you see, the left side actually the scenario were the platform was about to get attendant for risk operations. Now let us see reasons for failure, what happen to them, the diagnoses. Interestingly we all know it is cell cellular or (Refer Time: 03:41) based design, essentially a system is concrete in material concrete as variability in fact it has better characteristic steal in terms of carotion system. However, there has been failure notice in cell valve of the (Refer Time: 04:15) this resulted in crack propagation. To the original failure is from the crack started from the cell valve this resulted leakage of the stored oil.

Say interestingly people try to use pumps which could not actually control the leakage. The basic reason for structural failure was assessed due to insufficient anchorage that is one reason. Anchorage reinforcement in critical zones, you know anchorage very important check to be done for reinforcement concert design especially in critical zones were the bending bars over lapped; it is also seen that is first reason. The second reason was the shear stresses are under estimated design. It is very serious to know that the under estimate was about 47 percent low, so it is a phenomenally big over site in the design. The third reason was the concrete walls use for the (Refer Time: 06:18) cells there reported to have in adequate thickness.

So, if you look at the diagnoses or look at the conclusion summary of the particular figure let say the summary.

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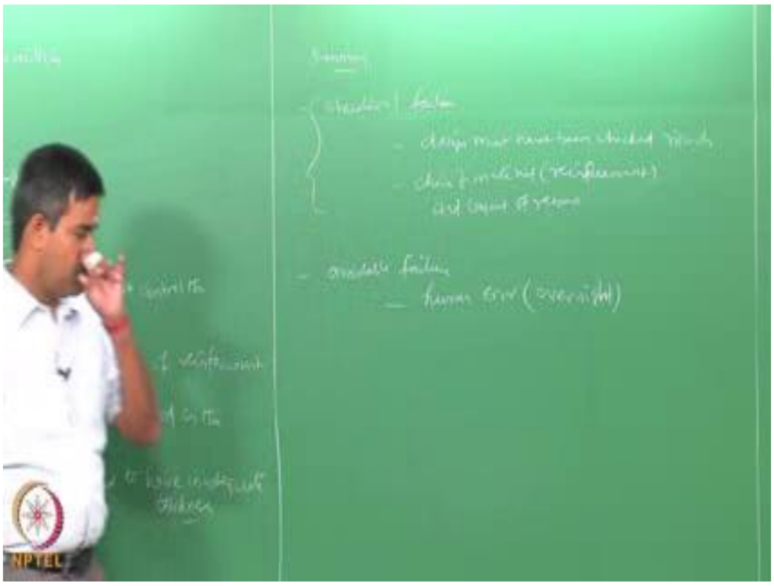

What we learned from this kind of accident, essentially the failures and structural failure. So, it is better that design must have been checked regressively which have not than in the case. The secondary could be even choice material in fact for reinforcing bars. And let say layout or reveres could also be reason there will have diagnoses. This is an avoidable failure; failure would have been avoided.

So, I would be associate this to human error. Instead of saving error we can even say error over sight. Even though you do lot of check during the primary design stages however there can some over sight which can lead to this kind of problems. So, this is a classical example where a structural design failure can cause a serious economic loss to the platform.

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The second example what will discuss is thunder horse platform. Thunder horse platforms are a production platform located in missions canyon block south east of New Orleans. Because to know the economic prospective it interesting that we should know the investment also. The construction cost is approximately about US Dollar 5 billion. The service life of the platform estimated originally is close to about 25 years. The (Refer Time: 09:46) of the platform is constructed in 2004, that is a period of construction. And interestingly if you look at in 2005 the platform was subjected to Hurricane Dennis, so the platform was evacuated; no fatal reports on any personal platform they were all same. Have to the Hurricane passed the platform was inspected and assessment reports did not mention any damage, so no damage after passage of Hurricane.

So, friends here are examples which contradict the whole idea that the design failure is very common. So, it is a very uncommon phenomena which happened in earlier failure case what we are discussed. In this case even though a Hurricane of a very high intensity or a magnitude passes the platform, there were no fatal reports the platform was evacuated successfully and the platform had no structural damage even after passage of the Hurricane. The hell of the platform was perfectly integral. Interestingly the issue was very critical here.

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An incorrect plumbing line allowed water to flow freely which actually tipped of the platform. So, it is very important here that hazard analysis on the design and functional aspect is important, because a minor details such like plumbing pipeline can also cause a damage to the platform even though the platform sustained and Hurricane of a very high magnitude. You see that interesting part is a small component or a very minor mistake in the whole layout could tip up the platform, however the platform sustain a very huge magnitude of Hurricane Dennis without any structural damage.

So, hazard analysis or hazard evaluation or system requirements in a given design of off structures where even minor details must looked into so that nothing is over sight, nothing is left over and notice so that all factors put together should be checked for all possible perceived divisions in the whole function of the platform or the design. There was a design failure which was responsible for the first case of case study of accident is not there in the second case study, but very a minor mistake made by the pipeline plumbing has caused tipping of the platform. However, interestingly the platform was then rehabilitated substantively after about a month of the Hurricane Dennis it was repaired and substantively Hurricane Katrina pass the platform and the platform did not cause any damage, and no structural damage was report.

So, all the time one cannot say that the design office could have an over sighted in the detailing reinforcement, checking of shear, checking encourage rebars, retaining of structural layout of bars, etcetera. All time does not happen but as a rare case in the first case study what we just now saw there was a design (Refer Time: 14:33) over sight which cosseted the platform over 700 billion US Dollars. However, the structural design can be as integral as it is which has passed two Hurricanes; Hurricane Dennis and Hurricane Katrina successfully without any structural damage, but a small mistake like plumbing pipeline could cause the tipping of the platform as you see in this photograph. I request you look at the screen now.

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There is over topping thunder horse platform shown graphically here, this what actually happened to the platform schematically. The platform was over toppled because of the allowance of water following freely from a plumbing pipeline. How was the structural integrity was wonderful for the platform which with stood two Hurricanes; Hurricane Dennis and Hurricane Katrina successfully even after rehabilitation.

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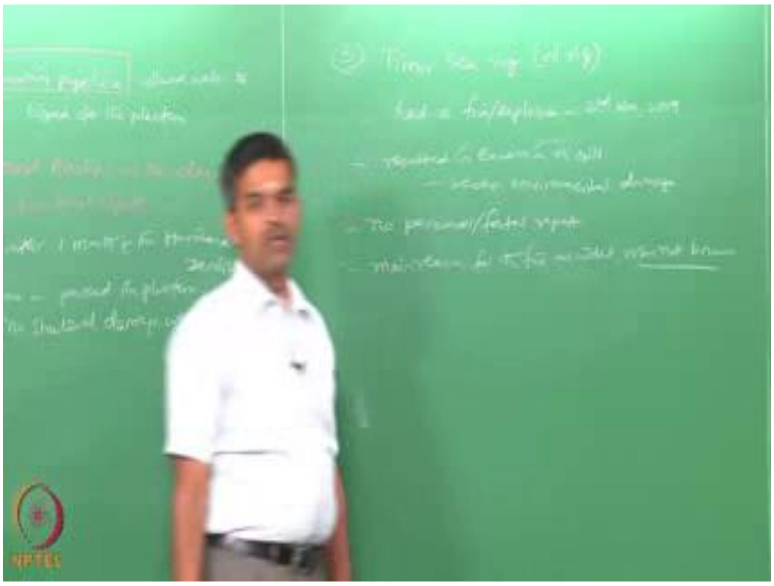

The third case study what will see now is Timor Sea rig which oil rig. Timor Sea rig actually cause fire, happened on 2nd November 2009, resulted in excessive oil spill, caused severe environmental damage, no personnel injury during accident they were all safe. But the main reason for the fire accident interestingly friends, was not known.

So, if you look at the screen now.

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Interestingly you can see the graphical image captured of the Timor Sea oil rig which is showing the fumes being escaped from the top side of the platform, which is indicative way of the fire explosion which happened in the oil rig on 2009.

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Fourth case study; is the Bombay high North in offshore Mumbai located in Mumbai

India. The platform had fire accident reported on July 27 2005. Interestingly the Bombay high North which we call as BHN, BHN was completely gutted to molten metal in less than 2 hours. Very interestingly the whole infrastructure was completely reduced to molten metal. Of course, the platform was later repaired and retrofitted and made functional that is a different story, but however there was fire accident which could even catastrophically damage the whole platform which was very effectively functional in India.

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Friends if you look at the screen you will see the damage view of the BHN platform which is gutted because of fire accident happened on 2005, July 27. So, what do we learn from these events.

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It is very important and common to note that the reason for accident in most of the cases is not known. So, which lives an idea that oil production exploration processing is a hazardous process, cannot be risk free. Accidents are unexpected so risk because economic value is associated is very high. Second reason could be even the post accidents studies which has been conducted on these and reported in the literature for example, Pray et al 2010 shows that there are set of complex reasons for these accidents.

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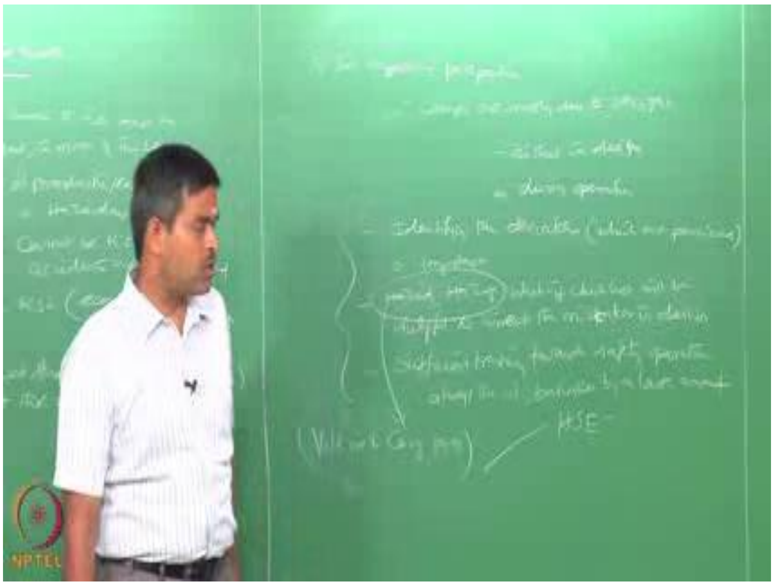

In engineering prospective, if I try to diagnose this accident one can easily understand that the cause mostly due to over sight. Now over sight was either in the design or during operation, which resulted in serious accidents. Therefore, identifying the deviations which are perceived from the design intend in any working plant is important. So, hazid which is giving me the hazard identification, hazap which gives me hazards during operation of the plant; what if check list will be helpful to correct the mistake in the design before these design mistake become very expensive as in the cases we reported.

Substantively, sufficient training towards safety operations could always save the platform or save the oil business by a large amount. So, HSE practices are very important and become mandatory really to learn as a very throw tool from check accidents. So of course, as summarize by Valerie and Carry in 1991 HSE practices and hazid in hazard studies are very useful in revisiting either design problems or the problem during operation in any process plan or any structural problems like this which could say lot of damages from happening, so that is important. Therefore hazard evaluation, risk analysis is vital as per a offshore industry concerned which is repeatedly proven by catteries as we just now discussed during accidents.

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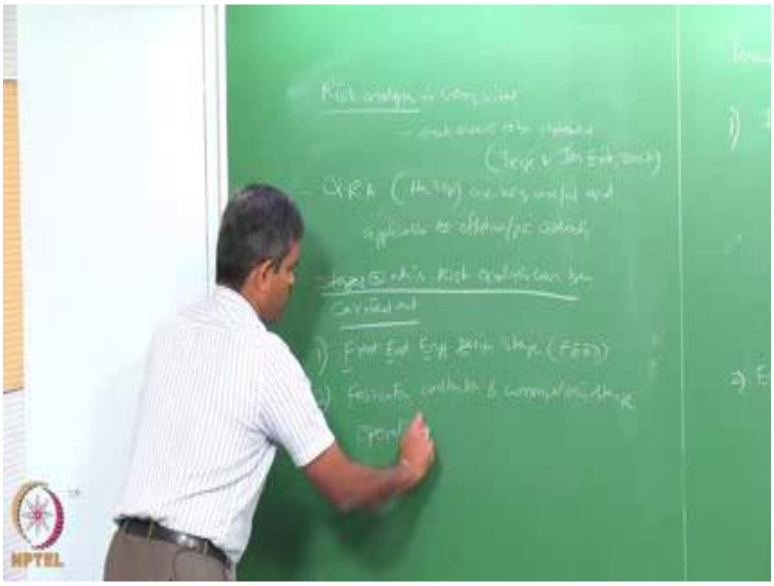

Therefore, one can say risk analysis is very vital because we do not want such events to be repeated. So, risk analysis tools should be handled very carefully to have successful outcome as told by Teeje and Jan Erik in 2007. Also QRA tools both qualitative and quantitative be very specific hazap tools are very useful and applicable to offshore and petroleum engineering industry.

Now the question is once we agree that risk analysis is important and the vital tool let us see at what stages one can do risk analysis. Risk analysis can be carried out at different stages, the first and for most stage where people should do risk analysis it can be done at front end engineering design stage itself what we call as feed front end engineering design stage itself. One can also do risk analysis during fabrication construction and commissioning stage. One can also do risk analysis during operational stage as just now we have been seen there is examples like hazard etcetera.

Having said this let us see how we go about further with hazard evaluation and control.

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We all know that every type of hazard is associated with some risk that is very clear. So, every type of hazard is associated with some risk, because every hazard happening in oil and gas industry has a financial implication therefore risk is very important and closely connected to hazard analysis, because this has a potential of financial loss that is where it becomes very important for us economic prospective.

It also has very serious consequences; therefore every type of hazard in offshore industry actually is associated with some type of risk. It is important therefore to analyze the following; one this seriousness or consequences, the economic prospective of the risk involved, the environmental damage caused by the degree of risk, both in terms of operational in terms of strategic and economic prospective. Therefore, hazard evaluation has to be planned.

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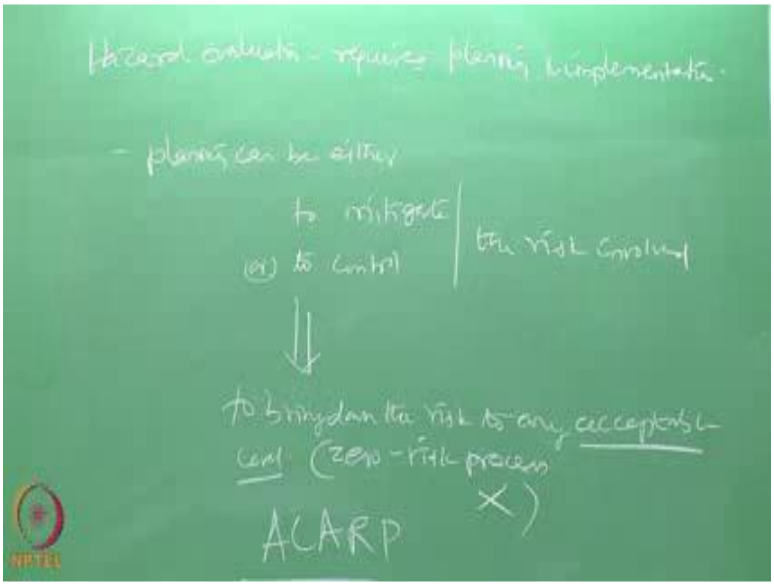

Planning and subsequent implementation; planning can be either made to mitigate or to control the risk involved. The movement I said control or mitigate the objective is to bring down the risk to any acceptable level. Please understand offshore business cannot have a zero risk process; it is not a zero risk process. We cannot bring down the risk to zero level. We can always try to or attempt to bring the risk to an acceptable level what we call as, As Low As Reasonably practical. Therefore, hazard evaluation should lead to risk reduction to an ALARP level which can be done in any stage in a process plan.

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If you want to do a QRA during a design stage, let us say hazard can be effectively done when you got a plant or process unit in operation because hazard actually perceives the hazards why the system is functional. But you want to actually evaluate the hazards in the design stage itself then one can do what is call failure mode and effect analysis what we call FMEA. There are two kinds of FMEA you can do; one is what we call design FMEA, other is called process FMEA. You can also do failure mode effect analysis for a given process in place can also do it at the design stage both FMEA can do. In the FMEA you can also add one more quality to a study by identifying the criticality in the design so we call that as failure mode effect and criticality analysis; FMECA. So, one can do FMECA during operation.

Subsequently, if the plant is in process or the process line or the production line is functional then one can do a hazop study, initially one will do hazid study. To identify the hazards one can also do quickly a check list method or a what if analysis to check the hazards present in the system. And subsequently one can do a detail hazop study which can evaluate the consequences and probability of occurrence of undesired events.

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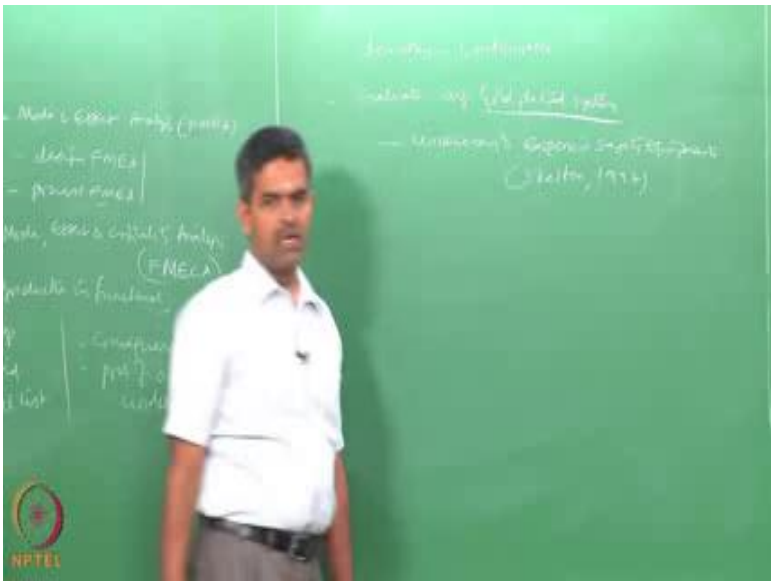

So, friends in hazard analysis whatever deviations you perceive in the design stage itself or all undesirable. So, hazard analysis or hazard evaluation in general gives a very good foresight about the perceived deviations from the original objective of the problem which can be very useful tool for identifying the unnecessary expenditure involved in the whole design. We already saw in the previous lectures by doing a hazard analysis one can also evaluate any gold plated system.

A gold plated system is that one where the probabilities in minimum consequence are noticed, but however it also indicates me that a gold plated system is delta with unnecessary and expensive set equipments. So, it has got unnecessary and safety and expensive safety equipments in place which can be also reduced so investment cause can be diverted to other necessary segments of the plant which requires more safety assessment or assurance.

So Skelton, 1997 clearly highlights how a gold plated system can be straightly compromised to redirect the investment from this particular system design to that of the one which is requires more safety assurance. Hazard evaluation, therefore is a simple way of evacuating hazard and identifying the total consequences associated with the hazard and the likelihood of those consequence which will occur when the hazard is formed. So, hazard evaluation can be done interestingly by a matrix as see in the screen now.

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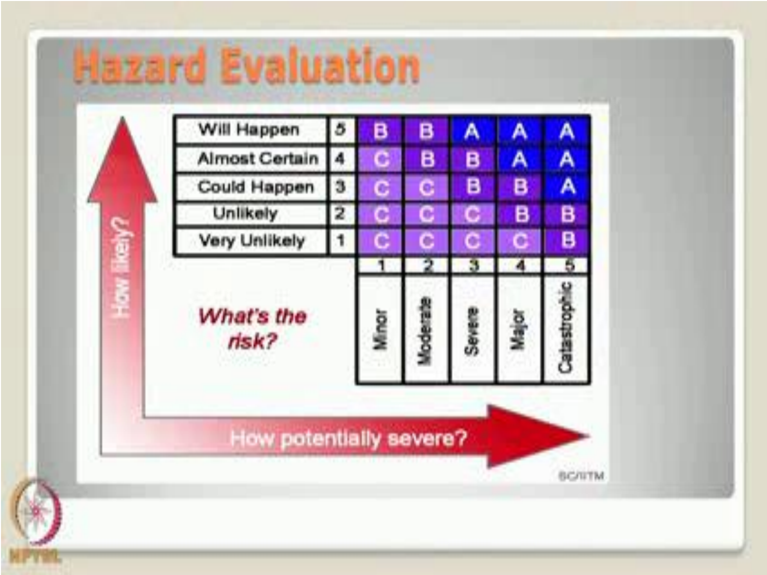

The screen shows a matrix which explains how potentially they are severe, how likely they can occur; if they will happen we have a scale of 5, if they are very likely we have a scale of 1.If the potential severity is catastrophic you have a scale of 5, if the potential severity is very minor or unnoticeable you have scale of 1. So, you form a matrix and you classify them in an alphabetic rotation varying from A, B, C as you see from the matrix here. For example, any potential severity which is minor but will definitely likely to happen may be classified as B. Any catastrophic severity which may be very unlikely is also classified as B.

So, one can see here the band of the B is undesirable, of course A are acceptable and C is also acceptable of course with some correction measures. So, hazard evaluation can be easily done in a qualitative scale, can be converted into an understanding like this in terms its severity equivalence and likelihood of occurrence which is also a form of risk analysis. So, indirectly hazard can be also converted to risk analysis in terms of evaluation chart as shown in the screen now.

Hazards can be also classified as class C, B and A as you see here; class C refers to relatively lesser risk, whereas class B refers to higher serious risk and class A refers to in tolerable risk as seen hazards evaluation chart. This implies that the work should be immediately stopped and the risk analysis should be carried out and the corrections measured measurements should be taken in the given system. So, if you look at the screen back again you will easily see; catastrophic damage which certainly going to happen is classified as A and so on which is undesirable.

So, hazard classification goes in a group A, B, C; A is in tolerable and acceptable, Be is posing serious risk which means immediate should be taken to control risk, whereas C is relatively lesser risk. The class into which the hazards fall is basis for deciding how you prioritize the plans of hazard analysis.

Friends, in this lecture we have understood how to do a hazard evaluation. We have understood what are important steps we learn from accident and analysis, and we also said how hazards and risk can be inter connected and hazard evaluation is very important in oil business.

Thank you very much.