Risk and Reliability of Offshore Structures
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Module - 03
Risk assessment and Reliability applications
Lecture - 07
Risk assessment

Welcome friends to the 7th Lecture in Module 3.

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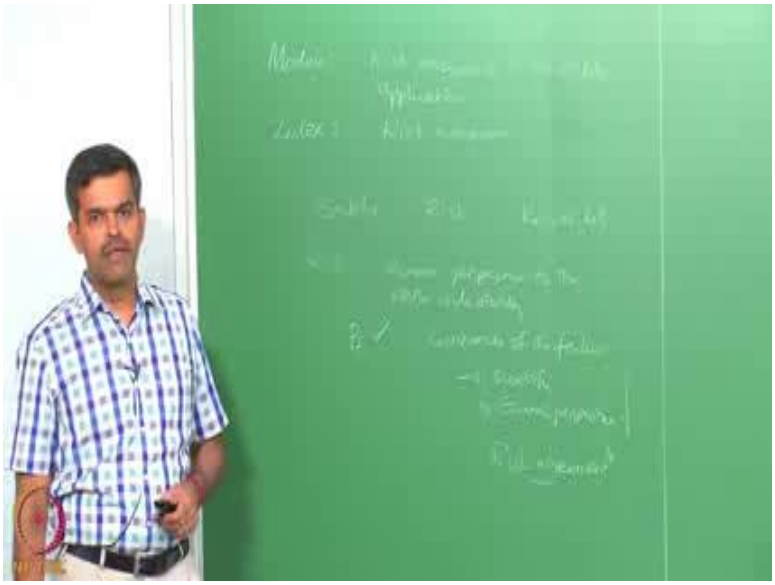

Module-3 in this course is focusing on Risk assessment and Reliability applications; this is the 7th Lecture where we will talk about Risk assessment in general terms. In the earlier lectures of module-1 we have already compared categorically three issues; safety, risk, and reliability. Flip back to a exclusive an explicit definitions of all these three terms related to offshore engineering, in general you will be able to certainly recall that reliability is more or less a general application in terms of scientific method of estimating the probability of failure which is the consequence of failure. Safety is more or less a scheme or a system which identifies the reasons and the pros and cons of a given structural system under the given conditions. We just not talk about probability of failure, but talks about whether system is safe or not.

We have also seen some examples where we understood the Mathew stability analysis which challenges safety operation of the platform. Estimation of fatigue life which estimates the reliability perspective of stress concentration factors of a tubular joint etcetera. We also said in the earlier lectures that risk generally gives a financial perspective to the whole issue. So, risk gives the economic perspective as well to the whole understand. On the other hand risk can be in extension of reliability study. If we know the probability of failure, if you also know the consequences of the failure, and if we are able to relate this consequences both in scientific and economic perspective then one can say I can extend this study for risk assessment.

If you ask me a counter question to really know the risk assessment do we have to follow the reliability path, the answer is no. One can also do risk assessment directly without following a detailed investigation through what we call reliability path, it is not required. Then basically, how do we actually classify risk assessment, why risk assessment is important for offshore engineering or offshore structures, in general how do we do them.

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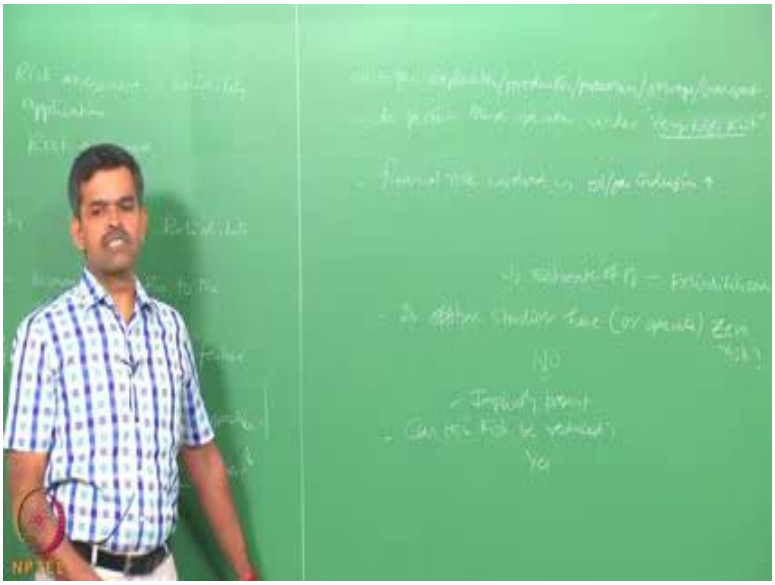

We all know that offshore structures which are essentially constructed for oil and gas exploration and production transport etcetera are various purposes do perform these operations under very high risk. So, I can make this statement very confidently saying

that the risk involved in this set of operations are relatively high in comparison to any other process industry which does parallel extent of business.

On the other hand to be very specific the financial risk involved oil gas industries are very high. This may be due to many factors out of which uncertainties in estimating performance of probability of failure are also one of the reasons. There are many reasons one amongst the reason could be estimate of probability of failure based on thorough reliability analysis. So the question asked is, do offshore structures have zero risk? If we ask this question to me which you will also like to answer later the answer is big no. Risk is implicitly present is inherently inbuilt in the system, you cannot isolate risk from offshore structures ever it will always be there; it can arise from the environment, it can arise from the production methodology, the processing techniques, from the sea states, from the type of platform used, from the method of construction, method of commissioning and decommissioning, there can be many issues.

So, risk cannot be separated from offshore structure engineering as such. So these industries do not operate at zero risk. The next question could be, can this risk be reduced? The answer is yes, we can. Then what should be the prerequisite to know risk reduction. Prerequisite to know risk reduction is you must know what the risk is.

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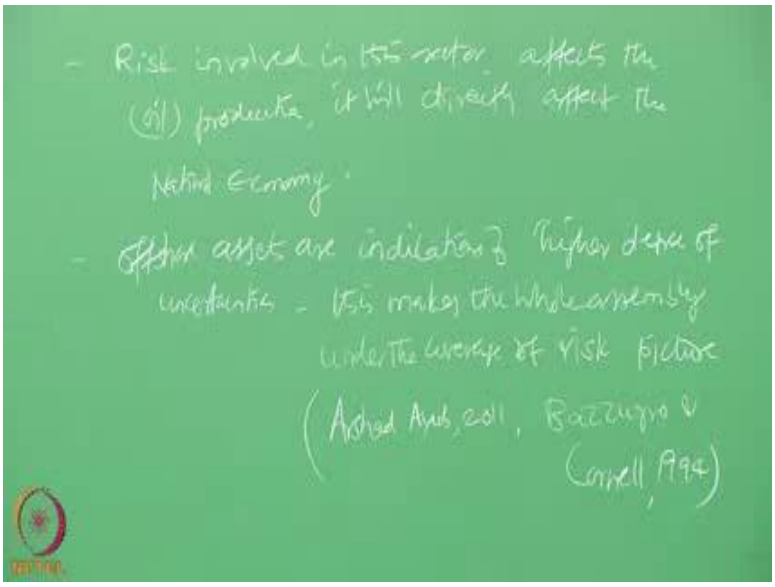

So, the prerequisite is risk assessment. Several operations like; drilling, processing, and supplying or transporting oil to the downstream units for commercial use of the product embarrasses risk. Friends it is also important to know that the physical growth or the deficit index of any nation's economy is controlled by oil price tools that are important.

Therefore, if the risk involved in this sector affects the production it will indirectly or it will even directly affect the nation's economy. So, it is very necessary that while estimating the probability of failure or reliability of a given structural system which is used for this kind of operations parallely one should also look at this in the economic perspective as well. What I mean to say is, one should also estimate risk involved in the whole exercise. Obviously, one will now able to clearly understand reliability can be applied to structural systems; as such risk cannot be directly applied to structural system, risk can be only applied to system in operation.

The system will have a value, system will have to perform the intended function, and failure of the intended function on demand is window of reliability; the consequences caused because of it is failure in economic perspective is risk. So, risk will more or less touch the performance level of the offshore structure rather reliability would touch the design level or the geometric form level itself in offshore structure system. So, risk can be in higher end use of failure assessment of consequences assessment compared to reliability. One is of course scientific, and one is of course scientific plus economic perspective.

It is therefore necessary to understand the risks involved in oil gas industry in detail, so that efficiency of such industries can be improved and can be examined with more confidence. In addition offshore platforms in general and other installations present in offshore platform are entangled by higher degree of uncertainties, so result of which this makes the whole assembly under the coverage of risk picture; Arshad Ayub 2011, Bazzurn Carnell 1994.

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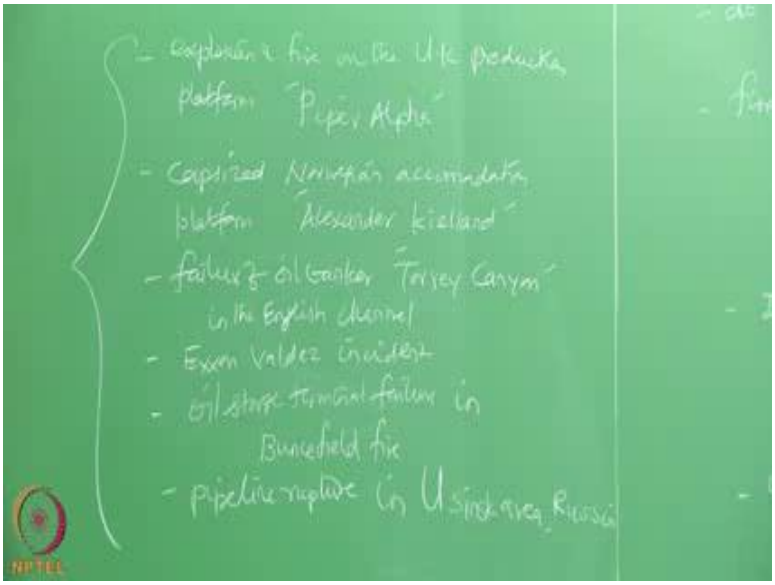

Offshore structures or offshore installations also involved risks of major accidents, which have been demonstrated by evidences in the literature. There can be many examples; explosion and fire on the UK production platform, Piper Alpha. The cap sized non region accommodation platform, Alexander Kielland. Failure of oil tanker, 'Torrey Canyon' in the English Channel; Exxon Valdez incident; oil storage terminal failure in Buncefield Fire; pipeline rupture in Usinsk area Russia are classical examples where there is a high degree of risk involved in the offshore installations which can result in major accidents.

Major accidents represent the ultimate most disastrous way in which a set of offshore platform can be tossed off. Accidents cause death, suffering, pollution the environment, and disruption of the business. As these values of incidents are very high they are so dramatic in nature they also attract attention from the news media and linker in the public memory for longer time causing concern about the safety.

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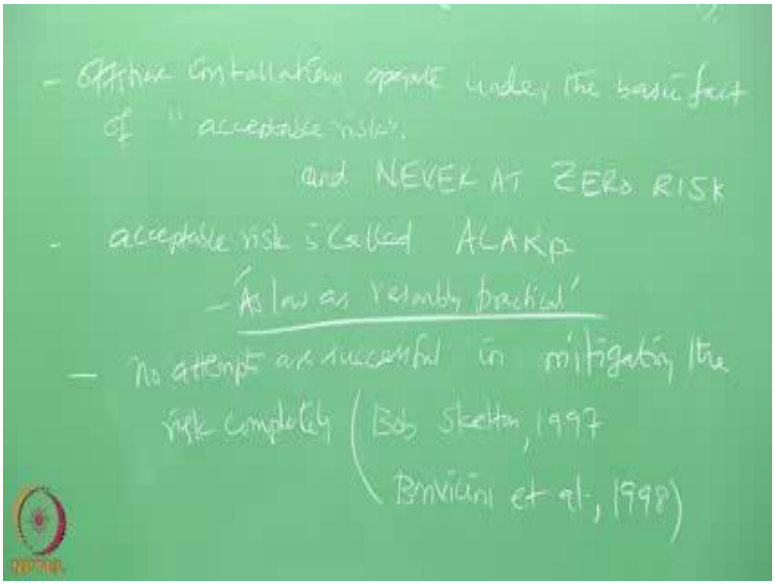

Now, interestingly accidents happened on offshore installations post concern about societal safety and economic stability. Interestingly in both cases indirectly risk is accounted. Therefore friends to understand the risk involved in offshore installation it is necessary and vital to understand the basic fact that oil industries operate and the bracket of what is call acceptable risk. So, offshore installations operate under the basic fact of acceptable risk and never at zero risk.

All the time efforts are made only to bring down the level of risk to a specific level call ALARP. The acceptable level of risk is called ALARP this says as low as reasonably practical. But offshore industries installations do not attempt to mitigate it completely, no attempts are successful in mitigating the risk completely.

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Therefore one interesting question comes in mind is why such attempts are not made. The answer is very interesting; risk mitigation is one of the most expensive schemes in any industrial investment. As oil companies are competitive in limiting the production cost that the constraint for the oil companies is to limit in the production cost. Therefore, investment towards risk mitigation to make it zero level is too far an imaginative process. Unless otherwise methods for optimizing the production cost do not become prevalent in this industry.

Let us now look into few terminologies it is very important risk assessment, let us see what an accident is. It is a specific unplanned event or sequence of units that has undesirable consequences. Then what is that hazard where as risk and hazard cannot be separated, they paired of always is a characteristic of a system or a process that represents a potential for an accident causing damage to people, property, and environment.

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Then what is risk? Is a measure potential, economic loss or human injury in terms of probability of the loss or injury and the magnitude and it is consequences if occurs. Explosion is the sudden release of energy accompanied by a blast wave, fire is a process of combustion which is characterized by heat or smoke or flame or the combination of this.

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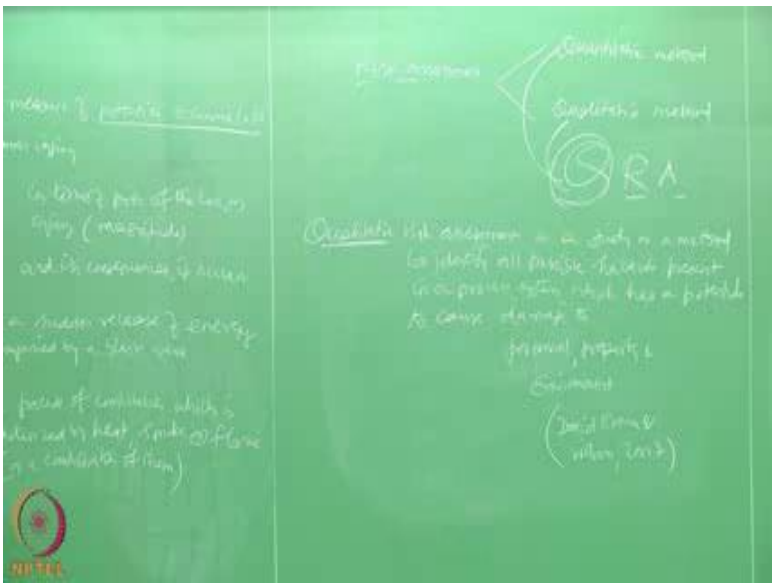

Now, friends risk assessment can be done in two ways; one can be quantitative method, other can be qualitative method. Unfortunately both are referred as Q R A; R A stands for risk assessment, Q either stands for qualitative or for quantitative unfortunately they are referred by the same name. Therefore, we need to give more detailed explanations of risk assessment when it is quantitative or qualitative.

Now the qualitative risk assessment is a study or a method to identify all possible hazards present in a process system that which has a potential to cause damage to personal property and environment, David Nown and William.

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There are various qualitative studies which can be carried out for risk assessment to ensure or to assess safety about the process. Namely primarily used to assess safety of the process, safety audit, preliminary hazard analysis what we call PHA. Hazard an operability studies which we call as hazop. Failure mode and effect analysis which we call as FMEA or FMECA, where C stands for failure mode and effect criticality analysis, these are all lists of qualitative studies which can generally carried out to assess safety of a given process which are called set of QRA studies.

When I talk about quantitative methods it has a mathematical approach, it is used to

predict the risk of failure, it also suggests in fact should suggest means to minimize them. That is the classical definition which is given by various researches in 2006 and 2012.

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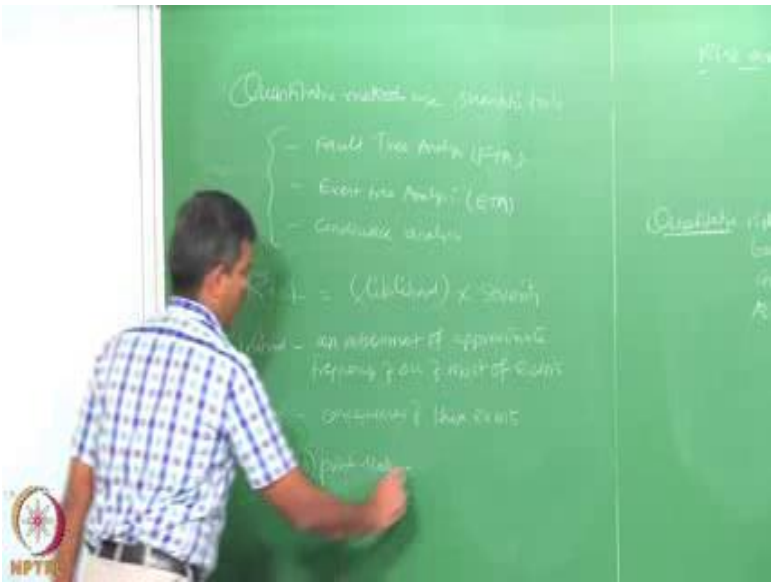

Quantitative methods scientific tools, there are different types fault tree analysis, event tree analysis, consequence analysis. Now, we already said risk is actually a product of likelihood of any occurrence of an event and severity. So, likelihood talks about an assessment of approximate frequency of most of the events, whereas severity talks about the consequences of these events; both of them can be expressed on a ten point scale in a relative manner.

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Having said this one can say very clearly that risk is actually a combination of likelihood and severity which will lead to an approximation risk involved for every hazard. So, risk is a combination of likelihood and severity which will lead to an approximate estimate of each hazard present in a given system. Risk level therefore is very important to recommend any actions consider the deviations, where assessment of risk cannot be done with a team there is always a crucial (Refer Time: 34:18) concern therefore the assessment of risk can also be done further in debt may detailed studies which can be recommended by the team where it can be done by a single person.

Ultimately risk should lead to recommending safeguards which are nothing but the control mechanisms or methods which can be used to protect the assets. It can be a combination of hardware instrumentation, operating practices and training modules what we call in general as capacity building. So, risk is more or less overall perspective which is an extended generic form of reliability, where reliability focuses only on failure of a specific system under the given load effects or even combinations if you talk about structural reliability over a specific period of time.

So, you should specify the load effects, the period, the seed states, the structural system and then model all possible uncertainties to really account for the probability of failure of

that system and one minus of this failure would give you in probabilistic terms the risk index beta. But whereas, in risk we are talking about the extension of this in terms of economic perspective and ultimately risk assessment should lead to recommending the safeguard or control mechanisms, which either should be a combination of hardware, instrumentation, operating devices, practices, training modules, etcetera.

So, risk actually is a bigger picture in asset management of offshore industry compared to reliability. Reliability can also be used as a design tool where as risk is used as a performance assessment index. Risk is directly connected to economic perspective reliability is not at all connected to economic perspective, however to recollect level four reliability studies do include economic perspective as well because level four also indicate risk assessment in a given system.

In general net shell one can say risk assessment is going to be a forward step in the direction of economic perspective of asset management and offshore industries where reliability is a prelude for risk assessment. We look into more of the methods in detail in the coming lectures.

Thank you very much.