Health, Safety and Environmental Management in Offshore and Petroleum Engineering

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Module - 02
Operational Safety
Lecture - 07
Financing Risk

Friends, let us continue with the lectures on HSE practices in Offshore and Petroleum Engineering under the basis of NPTEL IIT, Madras.

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We are talking about lecture 7 module 2; module 2 is focusing on operational safety. Today in the seventh lecture, we are going to talk about financing risk. The question which has been answered in the previous lectures can be recollected slightly risk should be associated in economic terms to get the real meaning or value of risk. So, decode the real value of risk assessment, it is essential that risk should be connected to the economic terms. Therefore, it becomes important to quantify risk.

So, risk need to be quantified, one can use statistical tools to estimate probable risk analysis, but just not effective because their own address the economic issues behind the feeling or the real value of risk assessment. So, risk need to be quantified we agree that risk estimates are attractive only if consequences and economic perspective are also

addressed in the analysis. So, we can make a statement like this to make risk analysis or risk estimates more attractive, but if you look at the consequences you can understand that is still for consequences alone, you see that it will still remain as a statistical number.

So, consequences alone can still remain as a statistical number. We will not be able to get back the original value of risk assessment, if you do not attach the economic consequences or economic importance to the risk analysis. So, one is now interested to know what are those methods which can be addressed by economic loss or estimate the loss. So, one is interested in the financial implication of risk assessment because it should be reflected in the company's balance sheet for risk estimates and so on and so forth, having said this one can clearly criticize.

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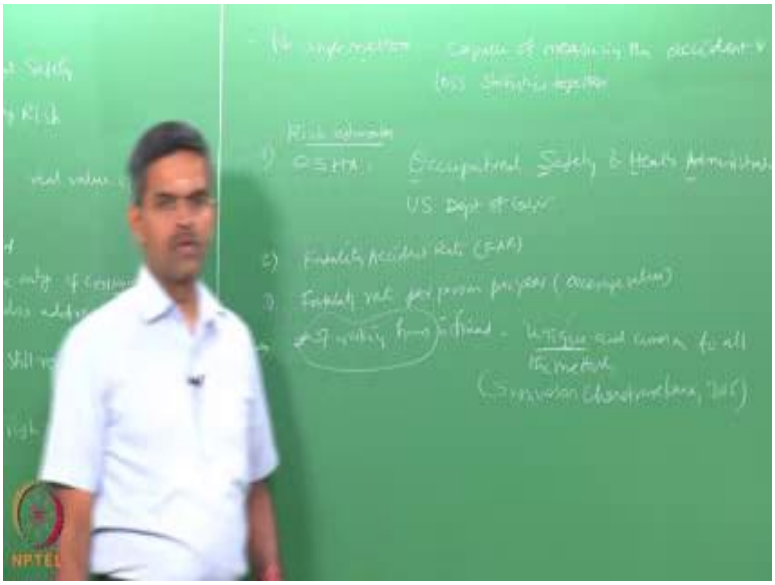

There is no single method which is capable of measuring the accidents and loss statistics together, essentially in the literature there are three commonly referred methods used for risk estimates. One is suggested by let say, risk estimates or suggested by three different agencies one is OSHA, which we will call Occupational Safety and Health Administration, US Department of Labor. So, they also suggest methods for risk estimates.

The other method as we saw briefly in the previous lecture is a fatality accident rate, which is also used to measure risk. The third could be fatality rate per person per year. So, this is basically an average value, all the above methods report the number of

accidents and or fatalities for fixed number of working hours that is very, very important. So, in all the above three methods as you see here the number of working hours is fixed.

So, depending upon the number of working hours a person is exposed to risk is what the denominator means, the number of working hours during the specific period which is unique and of course, common to all the methods unique in sense, the risk analysis in offshore and oil gas industries is using this specific dialogue that the number of working hours during which the person will be exposed is fixed may be 8 hours, 6 hours, it is fixed depending upon this standards that is the uniqueness and incidentally. This uniqueness remains common in all the three methods suggested by international regulatory authorities as seen from Srinivasan Chandrasekaran, 2015.

Now, we are heading towards understanding risk in terms of economic perspective Frank and Morgan gave a method called LRA.

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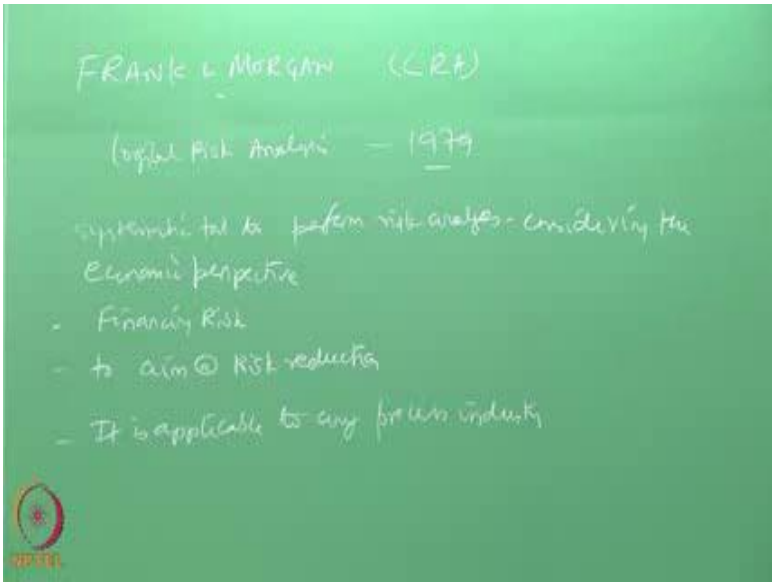

That is called logical risk analysis suggested by Frank and Morgan in the year 1979. This is a systematic tool to perform risk analysis considering the economic perspective. Ultimately, one can look at a term called financing risk as addressed and stated by Frank and Morgan in the original paper.

The objective of the scheme is to aim risk reduction that is the objective of the whole exercise. Interestingly, Frank and Morgan advised this model to applicable to any

process industry. Therefore, oil and gas industry can be very well used as an applicant of this particular method. Now, before applying this method for an example problem which targets risk reduction, let us try to understand certain basic things in the administrative perspective of the whole problem. For example, I am interested in aiming at the risk reduction of the entire plant. So, I am going to apply this method or model.

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For a process plant, the process plant may be a refinery which is on the down steam side may be refining crude oil. The plant has got various sections; we can also call them as departments. Let us say, Department A, which is assigned with receiving crude oil. So, inventory stores, etcetera. Department B can be the processing sector, Department C could be the electromechanical control systems, etcetera.

So, one can divide the plant into n number of departments. They can be separated depending upon their functional application related to a specific plant. So, this is very easy and very simple. They serve every industry actually works, we need not to be separate them, they are already separately located isolated interconnected by pipe lines or by some flow charge, etcetera. So, there are interconnection between them; however, each one of them is also capable of operating independently. So, let us have a plant where such logistical arrangements to exist. So, Frank and Morgan method has actually 6 steps to compute risk analysis.

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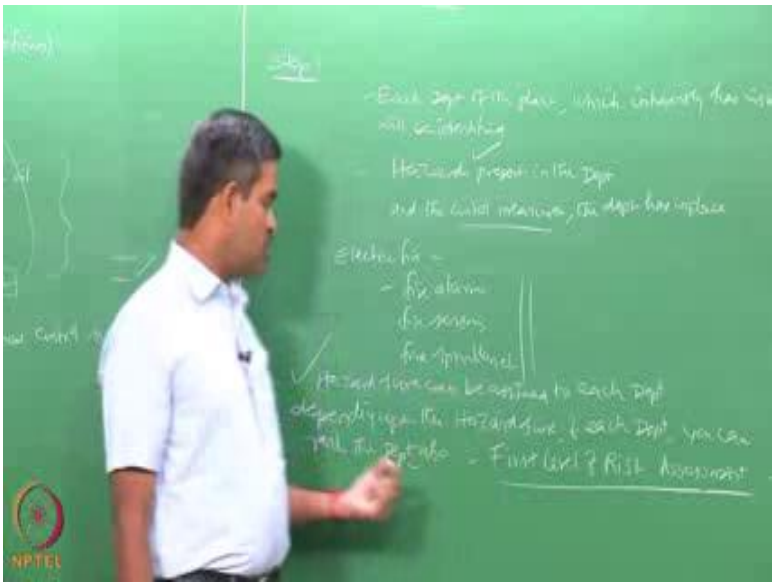

So, there are 6 steps to compute risk analysis are to perform risk analysis of a given process department. In step number 1, what we actually do is each department of a plant or the industry which inherently has risk will be identified, what does it mean is each department will have inherently some risk present, the hazard scenario would be there. It is people should identify the hazard scenario and try to look at the probability of the hazard scenario getting ripe and or getting matured to become a risk, which is non-acceptable as per the standards of safety of the company.

So, each department will be associated with the specific risk, which needs to be first identified. So, to do this you need to identify the hazards present in the department and the control measures the departments follow. I can give a simple example; let us say there can be a possibility of electric fire which is a hazard. However, there are fire alarms, fire sensors, fire sprinklers, etcetera located in the department which can all be countered for control measures.

So, every department you can easily identify various hazards present in the department and the control measures available to counteract these hazards before they get matured to become a risk. Now, the question is if you do not have any free idea that is an experience about identifying a hazard and the corresponding control measure because I have to convert both of them into equality quantitative numbers mathematically. So, I have no

clue, let say I have no experience I have not disturbed the department earlier, how do we go about it?

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Interestingly, if you look at the screen, you will say that the hazard groups and hazards scores for each group are suggested by Frank and Morgan. As a proposition, if you look at the table very clearly, here one can see let say, in the hazard group the first group can be fire and explosion potential, wherever there are fire and explosion potential present in the department. You can try to look at large inventory of flammables present in the department. Let us see you got a stock of cylinders, etcetera if you notice there is a large inventory of in flammables present in the department then you assign a score of hazard to this group as took.

Similarly, flammables generally distributed in the department, flammables normally in the vapor phase rather than liquid phase systems operated routinely or open routinely flammables having low flash point, etcetera. So, each one of them is grouped in such a manner and for each one of them you get assigned a specific rating depending upon some pre accepted pre inspected models. So, this suggested by Frank and Morgan as a suggestive tool; however, one can also prepared this table on his own experience or based on the inventory in expert expertise what people have in their own industry.

So, this table can be also prepared by you by conducting periodic inspection gaining experience or including experience professionals in the team and one can prepared this

what we call hazard grouping and hazard score. So, the grouping is fire and explosion potential complexity of the process and so on. These all are grouping what you see in the bold letters here and against each group what are the possible hazards present what could be the corresponding hazard score for each level of hazard and the value of this total hazard is can be normally given in this group. So, this group can have total, if all of them are present this group can have a total hazard score as 10, if all of them are present if a few of them are present you can sum them up.

Let say you have large inventory present; you have systems opened routinely allowing flammable air mixture. You also have flammables having low flash point present in your inventory. In that case, your hazard score for this group could be 1 plus 2, 3 plus 2, 5. So, again is the score of 10, you can assign a score of 5 as a hazard score for this particular group. Similarly, one can also see the remaining groups. So, for each group you can calculate the hazard score then you can add all the hazard scores for this specific group for this specific plant.

So, it is very easy that hazard score. So, hazard score can be assigned to each department. So, even though do not have an experience when used the table or the chart given by the Frank and Morgan directly, or if an experienced person you would always generate or love to generate their own table and the hazard scores depending upon the experience and expertise and the case studies whatever encountered in their past resent past in the industry. So, for every department one can easily identify and assign a hazard score. So, you can group them each group you can give a number can sum all of them and give a single hazard score for all the groups present in the specific department.

So, you will do this for each department for example, if your plant has 3 departments; A, B, C for each department what are the possible hazard groups present for each group, what is the score? What is the total score? You can always compute this and assigned this hazard score to the department A, similarly for department B, for department C independently. The next issue is about the control score. So, this is another if you look at the screen now.

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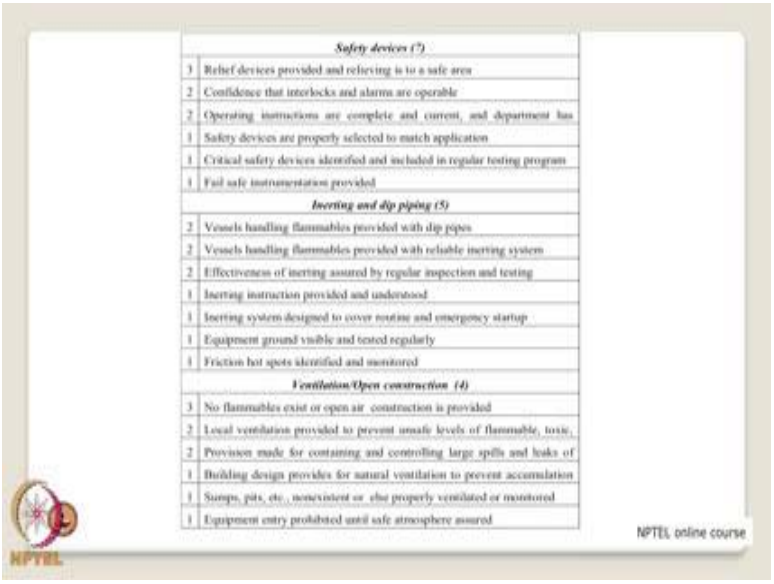

You will see the remaining hazard groups like safety devices, inverting and piping, ventilation and open construction, each one of them will have different sub groups present in them each; one of the sub groups will have a relevant an appropriate hazard score you can always identify the respective hazard score for each group, sum them all together to act their hazard score from the department as just now we said, similarly accessibility under separation. So, all of them will have a specific hazard score.

The moment you assign a hazard score. So, depending upon the hazard level of present in each department you can always rank the department. So, depending upon the hazard level you can rank the department also, it means the department which has the maximum hazardous score will always likely to contribute for the risk of the entire plant in total. So, that department is at high risk. So, you can rank the department amongst A, B, C if the hazard score of department A is higher than that of B and C, one can always say department A is at an higher risk compared to B and C because we assume that the hazard present in the plant A in the department A of the plant is likely to mature to become a risk.

This is what we call as first level of risk assessment. Interestingly, in the first level of risk assessment itself as suggested by Frank and Morgan, one can see here the inventory the machinery in equipments, the people involved the type of operation the electrical and chemical processes involved all are accounted in looking forward for the hazard

contributed from each group. So, friends it is not only accounting for the people working or getting exposed to the risk or the hazard situation, it also includes the value of the whole process line in terms of equipments, etcetera.

So, hazard scores are associated depending upon the commercial value of the whole process which indirectly accounted in terms of hazard score and therefore, that hazard score will always rank the department depending upon which department gets the maximum hazard scores first. So, one actually need a check list to prepare a hazard score. I showed a check list given by suggested by Frank and Morgan based on which your hazard scores can be prepared one can also prepare a check list on their own. So, that you can always assign hazard scores depending upon the type of operation practiced in this specific department, and the score can be also associated in terms of numbers related to the economical importance of this specific department and the specific sub group within the group of the department. So, we can always account indirectly the economic perspective even and the hazard assessment level itself which we call as first level of risk assessment.

As I said, risk will always be a matured outcome of a hazard. These are always happened only when the controlled measures present in the department are not effective. So, to understand whether the hazard situation present in the department will always materialize to become a risk, one should also look at the controlled measures what the department has inbuilt in the design. So, that can this controlled the hazard situation or not. So, one should look for controlled scores of each department. So, maintain the controlled scores again you need to have a check list control scores need to be computed for each department.

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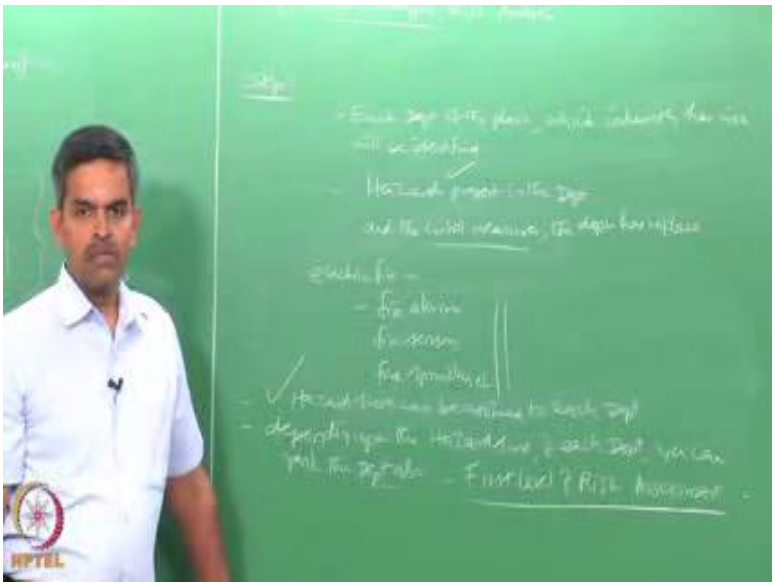

Obviously, one can depend on check list which either you have or refer to Frank and Morgan. So, Frank and Morgan also have given the different control scores for each department or each process. So, depending upon the method by which you prepared the hazard score. Similarly, one can prepare the control scores also. Now, for each department one has calculated the hazard score the control score for understanding. Let us say, hazard score is nothing, but the sum of hazard weightage of each sub group within a group for each department. So, hazard score is prepared for each department.

Similarly, control score is also a sum of control measures present in each department for example, let us look into various control measures a department or a plant can have the plant can have siren system. The plant can have automatic shutdown system of the process line. The plant can have smoke detectors, the plant can also have let say, automatic sprinkler systems all this control measures independently evaluated will have weightage. You can add all of them and you say the control score of my department is also. So, you have a control score in terms of a number you also have a hazard score in terms of a number both are numeric values. Now, I have to determining the hazard score and control score of each department risk index can be calculated.

Risk index given by RI is nothing, but the control score minus the hazard score, ladies and gentleman please pay attention to this particular equation, risk index it is not the difference between control score and hazard score. It is always control score minus

hazard score. It means risk index can be positive, if the controlled measures are far better compared hazard scenario present in the department risk index can be negative. It indicates that the control measures present in the department are very inferior compared to the hazard scenario identified by you, for the department risk index can also be numerically 0. It means the control score numerically exactly is equal to the hazard score.

So, this risk index will always indicate which department has a poor control measures, whereas the first level of risk assessment indicated which department has highest hazard present in the whole plant. Now, you are gradually converging towards the statement of concluding amongst the 7 or 8 or 3 or 4 departments present in the given process plant which department within the plant initiates risk, which department within the plant can initiate risk, which department has a more likelihood of initiating risk, which department actually initiates or capable of initiating risk. The risk index and first level of risk assessment or the hazard score will be able to clearly tell you in mathematical terms amongst the given department, which department is to be focused towards safety assurance.

So, friends it is very interesting method and very elaborates which can be applied to any process industry. Now, the catch in the whole discussion here in the step 1 is the risk index and risk assessment. At the first level all depends on what we call as the inspection or a routine table. So, we need to conduct detailed inspections based on our experience in expertise of various people working in different departments we have got prepared this tables suggested by Frank and Morgan. So, you have got a group, the hazards situations present in any process plant depending upon previous exteriors accidents assign any score to each one of the possible hazard scenarios, make a total score subdivide them into different groups make a different group and keep it ready, and this can be as elaborate as detailed as per your choice.

So, your first job as a risk assessor or an offshore engineer is to make a site inspection to any process plant and note down the various hazardous scenarios present in the plant, group them, sub group them, give a number to them and prepare an elaborate list discussed deliberate with the employees and employer and tries to freeze it out and have an unique list with you, which itself is a very interesting and very herculean task. Of

course, interestingly every process industries do have such lists, if they are serious enough to implement assure a safety assurance in the whole process.

So, friends in this lecture we discussed about the risk assessment method which started with financing risk. We will continue with the same method in the next class as well and solve an example. So, we have understood that how risk is getting quantified in terms of hazard at the first level, in terms of risk at the second level both occurring at the first step itself on the Frank and Morgan, financing risk analysis or method.

This is one of the interesting tool which can be easily applied to any process industry has suggested by Frank and Morgan and it is this method is as early has been available in the literature since eighties. So, risk analysis, friends is not yesterdays business people have been sensitized with risk in hazard for the past 30-40 years. So, accidents do happen, accidents happened, will happen, continue to happen even with all this methods because accidents can be only prevented if safety and risk are realized and sensitized as in experience. So, it is a culture. So, safety is a culture, it is not a practice not an education.

So, we will discuss this method in detail in the next lecture as well. We will also solve an example, will tell you and it is an experience we will diagnose the example very clearly and show you how this method can be very easily useful and very interestingly derivable, and applicable to draw conclusions based on the scenario present within the department of a plant.

Thank you very much.