Health, Safety and Environmental Management in Petroleum and offshore Engineering

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Module No. # 02

Lecture No. # 07

Hazard Assessment and Accident Scenario

So, this is a last lecture, what we have in module - 2, Hazard Assessment and Accident Scenario.

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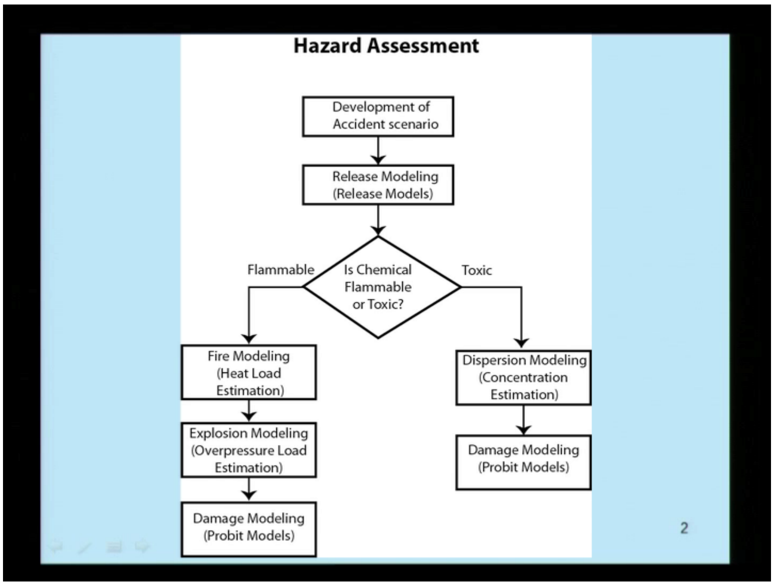

When we talk about hazard assessment, the simple flowchart explains you, how actually the hazard assessment is carried out? You have to discuss and understand the development of accident scenario. Then discuss about the different kinds of release models which we have explained in detail. Then you say, if the released chemical is flammable or toxic, if it is flammable, then discuss about the fire modeling, which we call heat load estimation. Then discuss and arrive at the explosion models, which we call overpressure load estimation. And then we estimate the damage using the probit models. If the chemical release is happening, which is toxic in nature, then discuss about the dispersion model; which will give me the concentration estimation of the dispersed vapor cloud. Then again estimate the damage, what we call from the probit model. So, in both the cases for hazard assessment, probit models are being used commonly in the literature.

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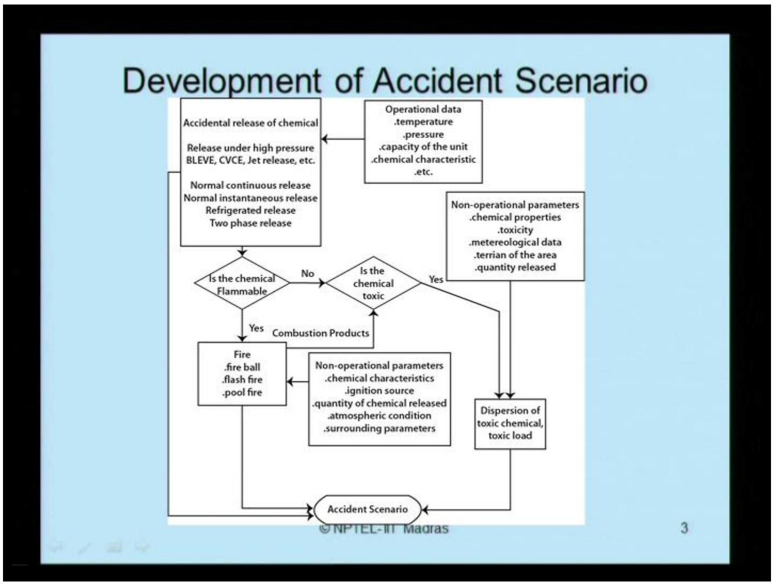

If you look at the development of accident scenario, the accidental release of chemical, which releases under high pressure like, for example, BLEVE, CVCE, jet release etcetera are possible. There can be a normal continuous release; there can be a normal instantaneous release; there can be a refrigerator release; there can be a two phase release. They are all dependant on the operational data like temperature, pressure, capacity of the unit, chemical characteristics etcetera. Once they create or become a scenario for an accident then they release a chemical.

Is the chemical flammable or not? If the chemical is flammable then it can cause fire; that can be a fire ball; that can be a flash fire; that can be a pool fire. If it is not a chemical flammable then is the chemical toxic? If the chemical is toxic discuss about the dispersion models, if it is nontoxic then you have to look on to the combustion product, which are obtained from the fire release or flammable release. Now, the factors affecting this can be non-operational parameters like the chemical characteristics, the source of ignition, the quantity of chemical released the atmospheric condition and the surrounding parameters. So, both of them put together flammable or nontoxic or toxic put together will discuss what we call an accident scenario. So, the operational data with the present of certain situation, with certain present of non-operational parameters can lead to what we call as an accident scenario. This is what we called development of accident scenario.

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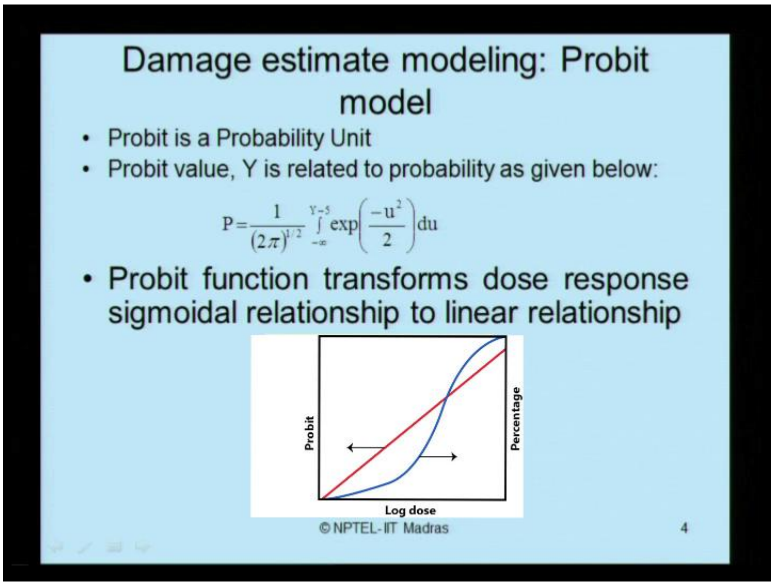

Now, we have seen for estimating the accident scenario; we look for the damage estimates. Probit model is seen as one of the common model, which is being used in the literature. Probit stands for probability unit; that is why it is called probit. The probit value, y is related to probability as given below. The probit function actually transforms the dose response relationship to a linear relationship; that is what actually the probit function does.

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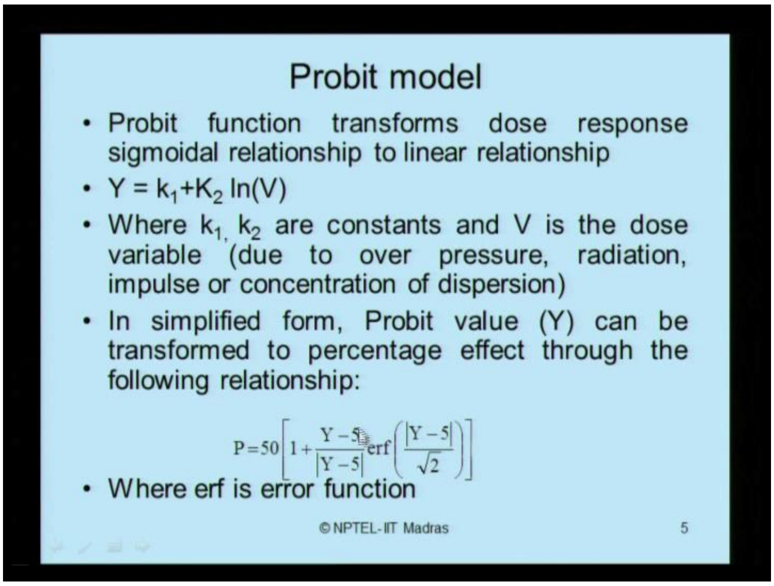

Probit function transforms the relationship to linear. Where Y is a probit value is given by k 1 plus k 2 natural algorithm of V, where k 1, k 2 are constants and V is the dose variable, which can depend on over pressure, radiation, impulse or concentration of dispersion depending upon what kind of release is that. In a simplified form, probit value Y can be transformed to percentage effect through the following relationship also. In this case err is, what we call as an error function.

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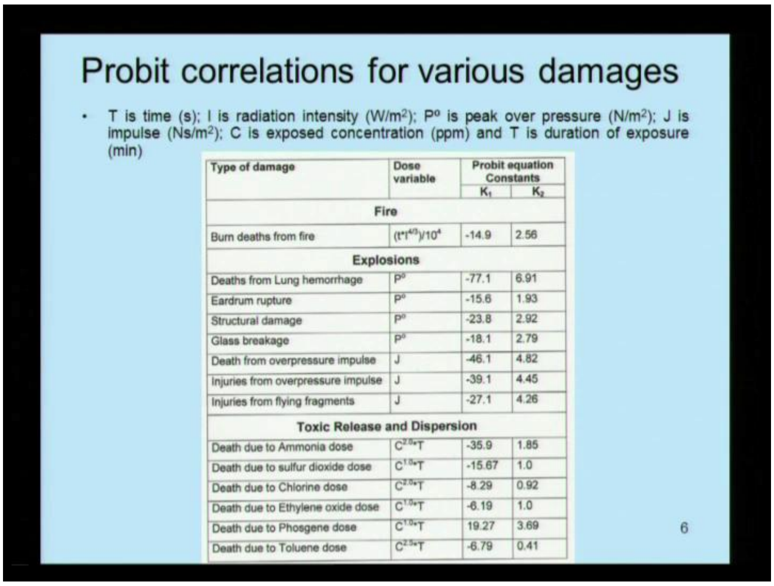

Type of damage	Dose variable	Probit equation Constants	
		K_1	K_2
Fire			
Burn deaths from fire	$(t^*I^{4/3})/10^4$	-14.9	2.56
Explosions			
Deaths from Lung hemorrhage	P^o	-77.1	6.91
Eardrum rupture	P^o	-15.6	1.93
Structural damage	P^o	-23.8	2.92
Glass breakage	P^o	-18.1	2.79
Death from overpressure impulse	J	-46.1	4.82
Injuries from overpressure impulse	J	-39.1	4.45
Injuries from flying fragments	J	-27.1	4.26
Toxic Release and Dispersion			
Death due to Ammonia dose	$C^{2.0}*T$	-35.9	1.85
Death due to sulfur dioxide dose	$C^{1.0}*T$	-15.67	1.0
Death due to Chlorine dose	$C^{2.0}*T$	-8.29	0.92
Death due to Ethylene oxide dose	$C^{1.0}*T$	-6.19	1.0
Death due to Phosgene dose	$C^{1.0}*T$	19.27	3.69
Death due to Toluene dose	$C^{2.5}*T$	-6.79	0.41

Now, the probit correlations for various damages to estimate k 1 and k 2 are given for fire explosions and toxic release models from this table. So, the type of damage and the value, the dose variable and the probit equation constants k 1 and k 2 are available in the tabular form here. In this case T is time in seconds; I is the radiation intensity which you see here in watts per square meter. P naught is peak over pressure in Newton per square meter, is what we see here. J is impulse in Newton second per square meter, what you see here. C is exposed concentration in parts per million, what you see here. And T is the duration of exposure in minutes. So, this is time in seconds whereas, this capital T is duration of exposure in minutes. So, if you know these values substitute in this equations and try to get those variable for different kinds of dispersions.

And from this, try to get to your probit equation constants k 1 and k 2, which can be subsequently used to estimate y what you see from the previous equation, if you know the volume of dispersion.

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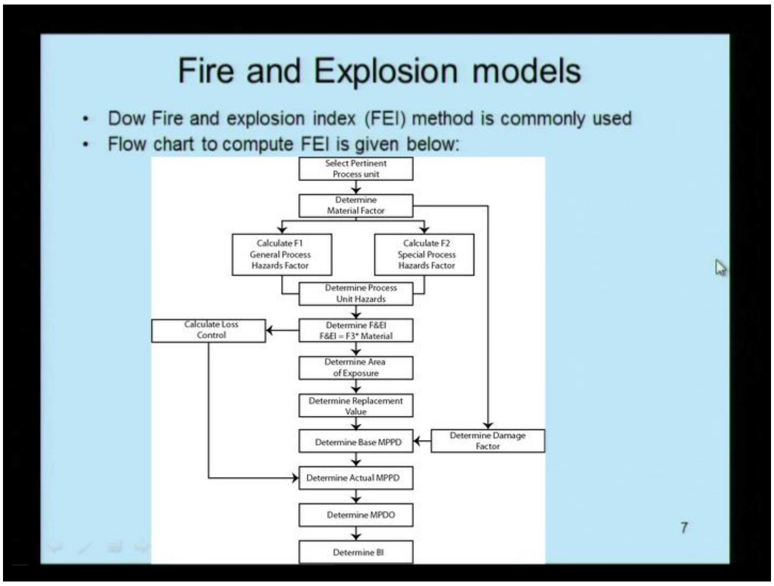

For fire and explosion models select the pertinent process units, where you are examining, determine the material factor. Calculate F 1 and F 2; F 1 is what we called as hazards factor general process F 2 is called hazard factor for special process. Then determine the process unit hazards determine F and EI. Then determine the area of the exposure. Determine replacement values; determine the MPPD and so on and ultimately determine what we call damage factor.

The Dow and fire explosion index method is commonly used for fire and explosion models. Flowchart to compute FEI is what is shown here.

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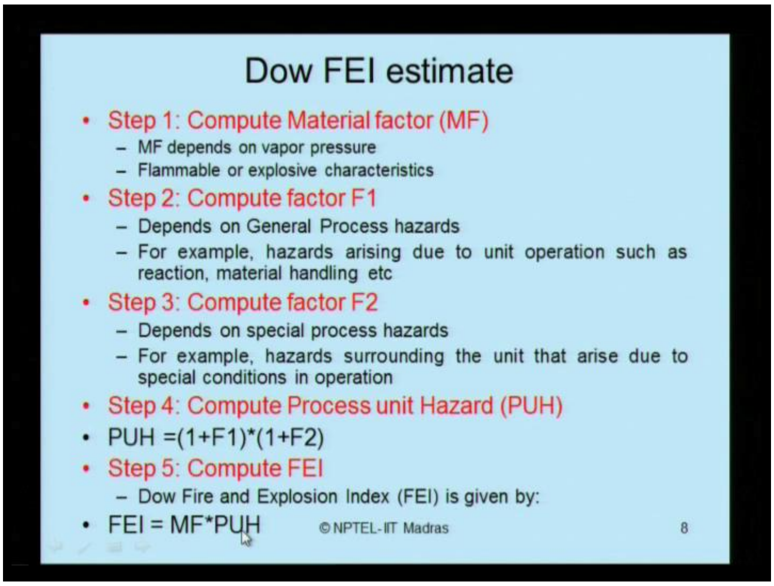

Now, Dow FEI estimate based upon different steps. It is a compute the material factor depends on over pressure and explosive characteristics. Compute the factor F 1, which depends upon the general process hazards, for example, hazards arising due to unit operation such as reaction, material handling etcetera. Step number three: Compute factor two, which depends on special process hazards, for example, hazards surrounding the unit that arise due to special conditions in operation. Ultimately in step number four: Compute process unique hazard – PUH. PUH is given as 1 plus F 1 star 1 plus F 2, where F 1 and F 2 are the factors computed in above steps two and three. And compute Dow fire explosion index, which is given by material factor into PUH. Material factor is what we compute from step number one.

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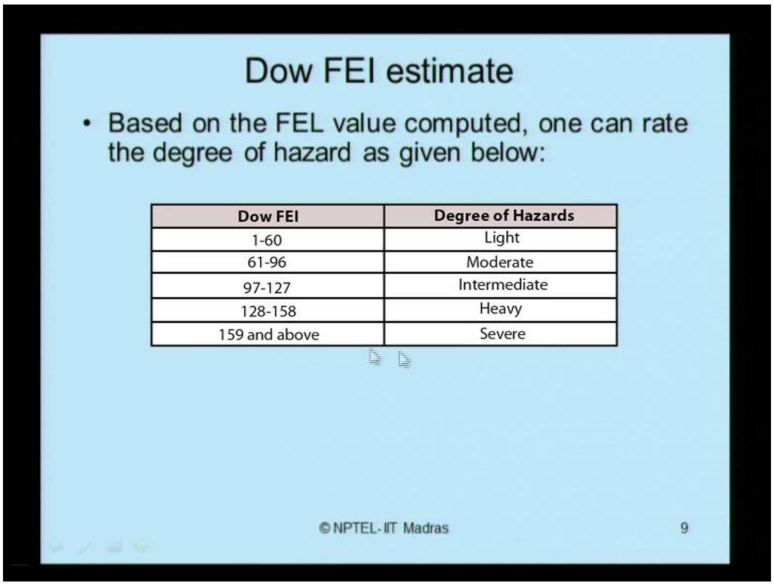

Now, if your FEI is based upon the value is given below then the degree of hazards can be also classified from the table. If the FEI is lying from1 to 60, for example, the degree of hazard arising from the fire and explosion index is light. Otherwise, if it is more than 159, it is considered to be severe.

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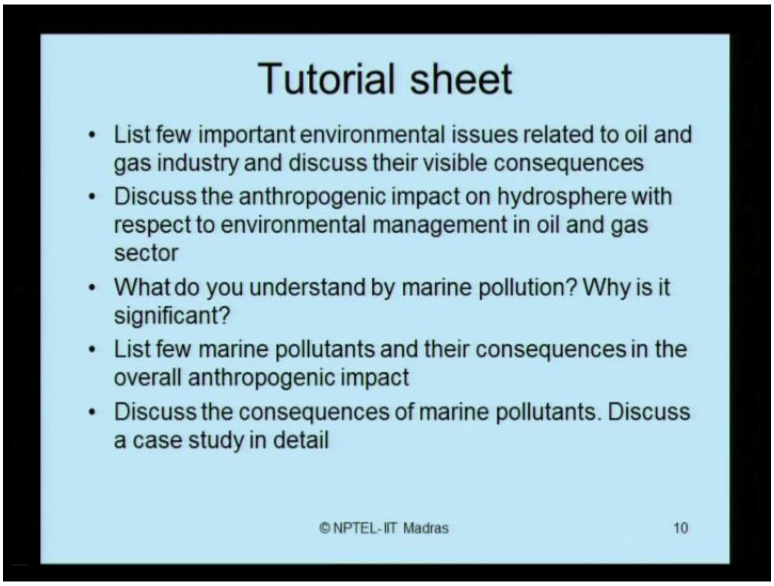

Ladies and gentlemen, this is a tutorial sheet what we have for module-2. This is based upon the questions are arrived based on the lectures given in module-2. List few important environmental issues related to oil and gas industry, discuss their visible consequences. Discuss their anthropogenic impact on hydrosphere with respect to environmental management in oil and gas sector. What do you understand by marine pollution? Why is it significant? List few marine pollutants and their consequences in the overall anthropogenic impact. Discuss the consequences of marine pollutants. Discuss a case study in detail

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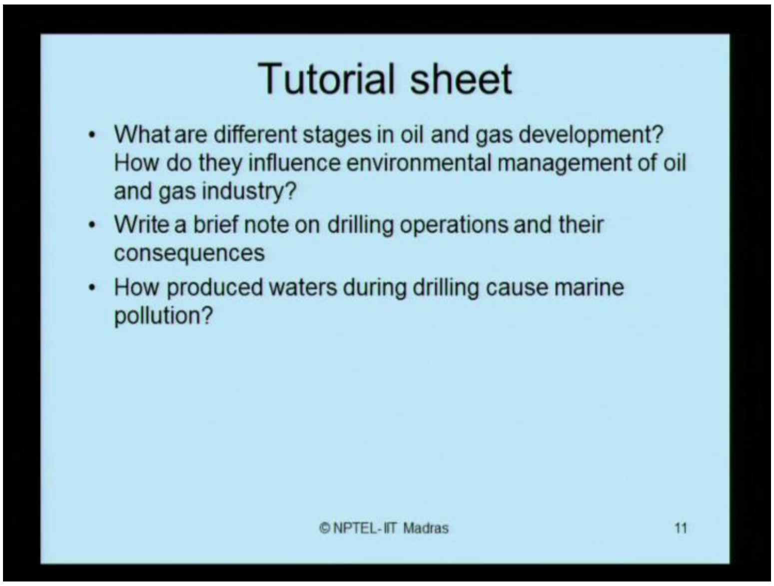

What are different stages in oil and gas development? How do they influence environmental management of oil and gas industry? Write a brief note on drilling operations and check their consequences. How the produced waters during drilling can cause marine pollution?

Thank you.