Industrial Safety Engineering
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Lecture – 51
Occupational Health and Safety Management (OH&SMS) and OHSAS 18001- Part 1

Hello everybody, very good day today. I am please to introduce Professor O Bala Krishna who will be taking next 5 lectures. Professor Bala Krishna joined the Department of Industrial and Systems Engineering, I I T Kharagpur as visiting professor in the year 2017. He is well known expert in the area of Safety Engineering, Occupational Safety and Health apart from maintenance operations related to steel manufacturing.

He worked for 36 years at various important top level positions in Tata steel. After retirement from Tata steel he joined DuPont Sustainability Solution as independent consultant and then after that he joined our department and really we are I am extremely happy to have Professor O B Krishna with our department and he kindly agreed to take 5 lectures on very important topic.

So, he will be teaching you Occupational Safety and Health Management systems 18001. Then the entire is what is that management system and then he will talk about the performance metrics or performance measures related to occupational safety and health management and he will continue and if time permits he will also discuss something related to energy isolation.

So, I welcome Professor Krishna. So, you please listen to him and I am sure that you will be really benefited and any questions related to this particularly safety in industrial safety engineering, any practical issues you can put in the discussion forum and he will be happy to answer all those questions and any other questions what or what are the topics I have taught to you if there are any practical issues particularly or in general other issues you may also put in the discussion forum. So, definitely he is Professor Krishna and myself jointly will answer all those questions. So, once again I welcome to Professor Krishna, thank you professor Krishna for joining, thank you very much, please listen to Professor Krishna.

Hello viewers. As Professor Maiti introduce me I will be taking a few topics with you. Before that just I want to tell you I have the experience of implementing designing implementing safety management systems in not less than 25, 26 industries across the world including Tata steel. So, this first lecture which I am taking is on the introduction to OHSAS 18001.

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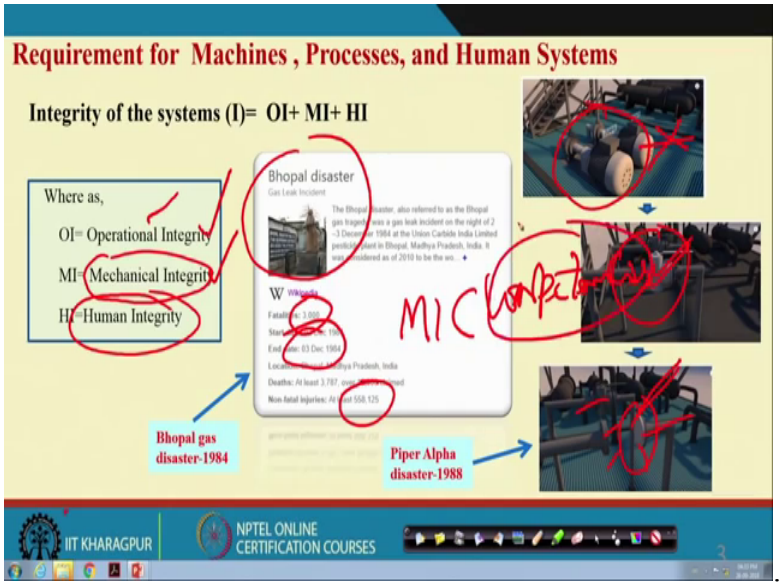

You agree for any machine, processes, systems, equipment, the fundamental requirement is you should have three integrities. One is Operational Integrity, other is Mechanical Integrity, the third is Human Integrity.

What is this operational integrity? What is this integrity at all? The definition of integrity is the things if they work as per your design as per your requirement it is called integrity. So, whatever is designed you should work in that passion that is called integrity. So, operational integrity means the operations of the equipment or processes behave the way I have designed, the way the designer has designed that is called operational integrity. Let us take some examples of operational integrity.

You heard of Bhopal disaster, which happened in 1984 in Tata in India, which is one of the major disasters of the industries, it happened on December 84 many people died around 3000 people died. Many people are non fatal injuries about more than 6 lakhs. We cannot forget it. Why this happened, what is the reason for this happening? The MIC gas has leaked. Why MIC gas has leaked? People say water has entered into the MIC

campus and there is violent reactions. Why water entered? Somewhere operational requirements have failed; the designer never wanted water to enter into that. Designer never wanted violent reactions happening in the chamber, but it happened because of various reasons. So, it has lost operational integrity which no operations manager, nobody wants.

Second is mechanical integrity. Have you heard of Piper Alpha? It is under British government 1988, Piper Alpha is a oil platform; 1988 there was major disaster in the Piper Alpha platform and the whole platform vanished, many people died around 120 people died or more than that. In the platforms normally oil platforms, families also recite family members also died.

It happened for small purpose. What happened actually in the Piper Alpha? There were two pumps. They have to pump out the liquid gasoline or liquid petroleum products, one of the pump has got problem in the delivery lines where the pressure releasing valve is there. So, they wanted to changes, hence one line they want to shut down. It was taken for the shut down and have taken out this valve is a gap and they have put the flange here and tightened. Pipe is electrically put off, the motor is electrically put off.

In the next day in the night the other pump which giving problem. So, they thought about the second pump they never knew it was on shutdown and they started it. The moment they started this flange if this tightened properly, The centrifugal pump would have keep on rotating nothing would have happened, but the people have would not tightened properly they have tightened with loose looseness. As a result, the vapors came out from the flange and it caught fire and the whole platform went off.

What do you call it? Mechanically it was not tightened. The mechanical integrity the people have not provided. Of course, there are operational integrity problems. The equipments which you have designed, it should perform the way you want. Finally, operation integrity; people have to behave the way they are supposed to behave, people should have competencies to run the machines, to run the processes they have proper training and finally, they have to implement it, they have to follow it. If they do not do it we call it failure of human integrity.

When the operation integrity, mechanical integrity, human integrity which ensure we say the integrity of the system is ensured. It is very easy to tell, but lot of problems in this.

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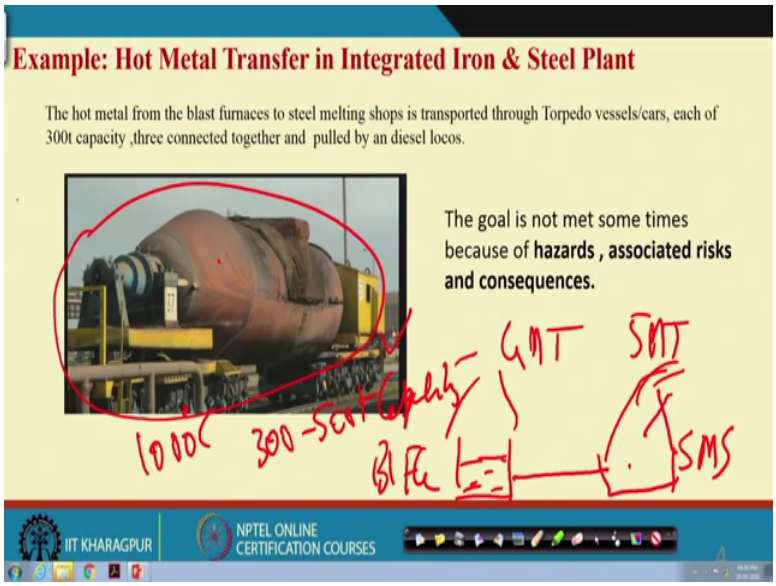

Let us look at this is in a steel industry. I am giving you an example. In a steel industry, integrated steel plant say which runs with which runs having capacity of 4 million tons, 5 million tons or 6 million tons. They produce 10000, 20000 tons per day is a blast furnace where iron is produced that iron will go to steel melting shops for making it steel. So, iron will go to steel melting shops this is steel melting shops this is blast furnace iron. When this metal is made it is sent to steel melting shops with a car called torpedo ladle car, which will have say 300 to so, 500 ton capacity. At a temperature of say 1000 degree centigrade; it is a refractory line torpedo car. This to deliver properly hot metal to steel melting shops.

The whole equipment should have mechanical integrity, the vessels should not fail, the trivial should not fail, the axle should not fail. If it fails what will happen with 300 400 tons of hot metal with more than 100 degree centigrade. And there is an operator would who takes it operate has to take properly. If it has if it runs at very high speed, maybe at the junctions at the curvatures it may it may get delay very difficult to the delay. So, operation integrity, mechanical integrity, human integrity, operations means when what are the major operations in this?

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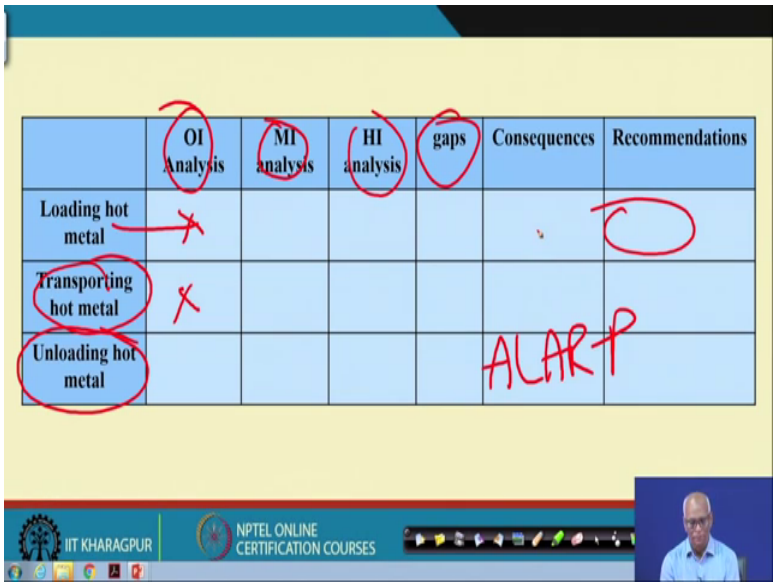

One is putting the hot metal in that in the torpedo ladle; this is putting the hot metal in the torpedo ladle; second transporting hot metal to steel melting shop, third unloading steel metal unloading hot metal or iron which is very hot in the steel melt shop. So, we (Refer Time: 14:56) like it we can analyze what are the operation integrity in this, what is the operational integrity problems in this, you can do analysis, you can do mechanical integrity analysis, you can do human integrity analysis. If you have to ensure the integrity is there if there is any gap you have to see what is the consequence.

So, if it is ALARP level as low practically possible reasonably practicable as low as reasonably practicable if it is at low level then you can leave it. Otherwise, you should have recommendations how to bring the integrity back. This is one of the example of steel melting shop.

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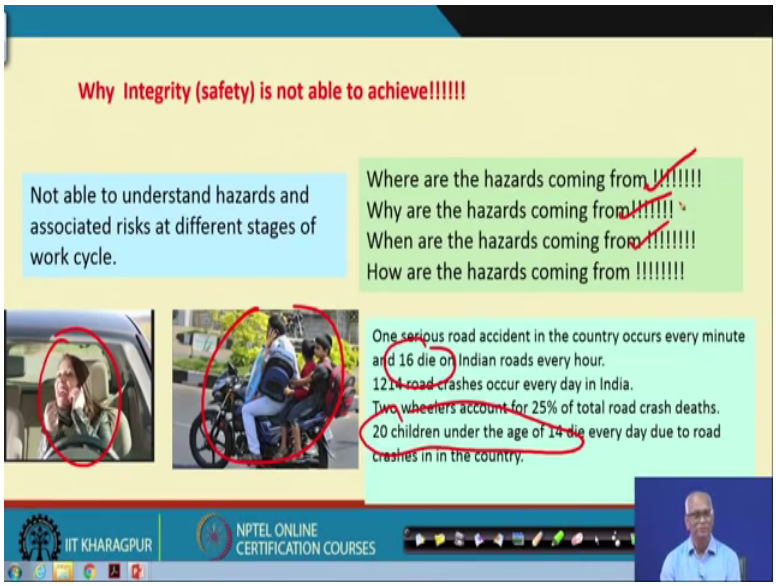

Why cannot we achieve this integrity? Why because we do not know what is the hazard. Look at this. He is carrying two children to school. Why? To give prosperity to them. What is he doing? Talking in mobile phone not putting helmets overloading, he does know he does not know the hazard. What is the consequence? If he fall down what is going to happen to him to his children, while talking mobile if he hits anybody what will happen? He is not able to understand the hazard, hazard is potential to harm, risk amount it can harm and the consequence. See here. Why this things happen? When every minute we have one serious incident happening in India, 16 people die on the roads every hour.

So, even 21 children under the age of 14 die every day still we do it. Why people do it? Why they are not able to understand the hazards? Where are the hazards coming from? Why are the hazards coming from? When are the hazards coming from? And how are the hazards coming from? If you understand this properly people will not do it, people are not doing intentionally, people do innocently that is the whole issue.

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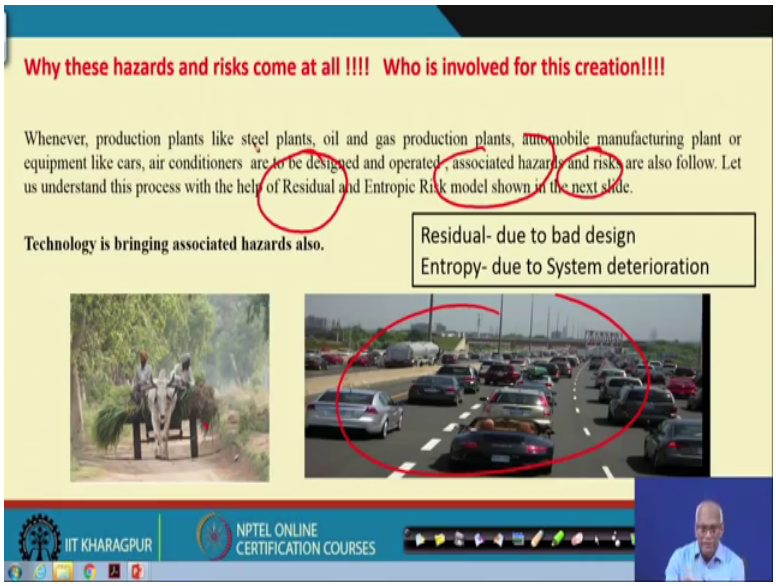

These hazards are not created by others, we have created. As Einstein says when we have designed the world this world by us, we thought everybody will happen as we think as we design, but it will not happen. If the hazard is more if that opens out the consequences more look at this.

This is a Bullock cart. In the bullock cart hazard it goes at slow speed there is no mechanical machines in this. Even anything happens in this the risk will be very less, it is also we have designed, we want speed, we want more speed, we want more comfort. So, we have designed big roads we have designed many cars running at very high speeds. These speed that technology also brought associated hazard and risks in whole of its life cycle that has to be understood.

There are two types of risks; one is residual risk. What is residual risk? While designing the equipment unknowingly 90 percent of the time unknowingly not able to see the hazard and the risk people leave some hazard, that is the residual hazard which will be converted into risk. When it comes to operation when you put the equipment in service if any deterioration happens then the entropy this will come, entropy hazard will come will talk of these things detailed.

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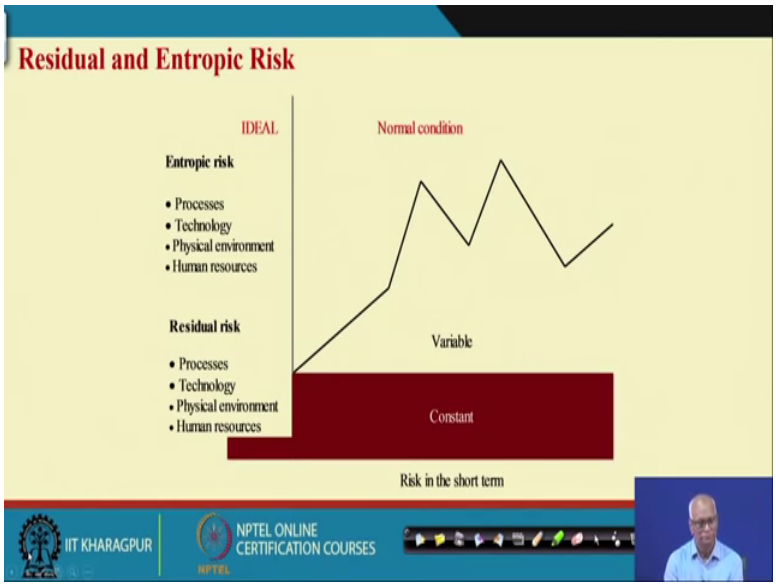

So, we said one is residual risk other is entropic risk. What do you mean by residual risk? As a designer you have to design processes, you have to bring technology what technology you are bringing. Is it a two wheeler with electric power, two wheeler with diesel power, two wheeler with petrol power or gas power, what technology you are using? Physical environment how is the physical environment? Temperature, wind the whole of physical environment around where you are working? In the industries if you work if it is the hot environment then the design should be different. If it is cold environment human resources that designer has to think what are the human resources required, what are the competent is competencies required, for running the equipments, for running the processes, for doing the maintenance and that should be given.

So, while designing on the drawing board designer should see all these things are fulfill. They should understand hazard in all these processes, technology, environment and human resources. If this is not done what will be the hazard? The total hazard of this and associated risk should be as low as reasonably practicable that we will call ALARP.

So, this is as low as practicably possible. If you want to make it 0, it is not possible, it will cost more money, it will cost sophisticated technology. Hence, which in the tolerance we have to bring, but the designers normally do not have knowledge that knowledge of hazards and the risk and they leave this much; this is called residual risk. Residual risk is coming from the design or coming from the manufacturing you have to

live with that in a process very hazardous process. If you put a risk of high level managing it very difficult.

The residual risk let me give you one example; you must have seen tracks railway tracks about 70000 kilo meters tracks are there in India. Many places you see roads crossing it; this is called unmanned crossings. What will happen? The rule is trains will have first authority to go by knowingly unknowingly many people keep crossing many buses keep crossing and trains will be hitting. Why it happening? You have introduced a residual risk, if you put in under pass or overpass this residual risk will be 0, without putting it you are forcing people we are forcing people to follow rules that is called entropic risk.

So, the moment you put a flyover it will cost more money, it will cost more place that is why flyovers are normally not built. It takes years and years I seen in I I T Kharagpur near I I T, a flyover built say after 65 years in detail so, many people died. So, that is called residual risk.

What is entropic risk? When the systems degrade, when the processes degrade, when the technology degrade, when the environment degrade or when the human resources degrade then the risk will be increasing and there are chances of becoming meeting with the accidents. When the risk increases very high then people will get down may now the risk is very high let me let me bring it back. They keep on bringing down going up bringing down going up, this is call entropic risk ok.

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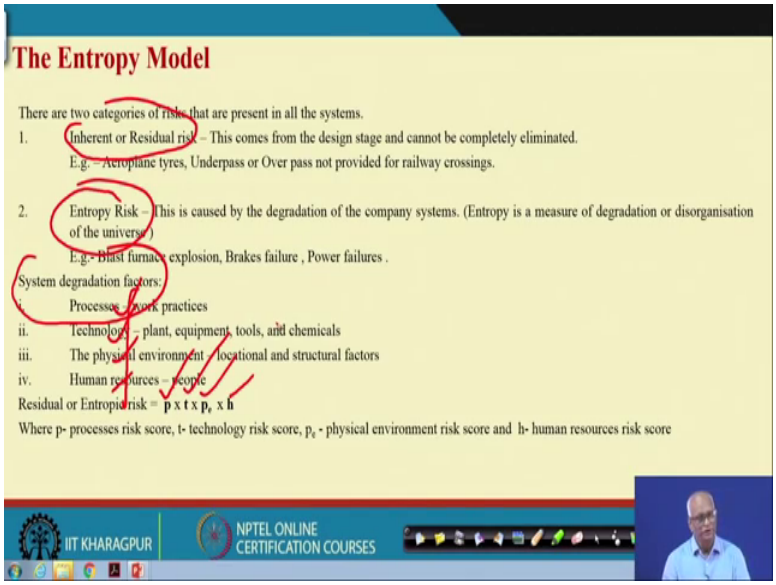

So, what we talked? There are two types of risks. One is inherent or residual risk. I talked the example of railway crossings then we talked about the entropic risk. Suppose a vehicle while going the brakes fail, we call it entropic risk or the example which I shown piper alpha they are all entropic risk.

So, when the system degradation happens in all these three all these four factors the entropic risk come. So, residual or entropic risk is the multiplication of the processes risk, the technology risk or the environment risk and the human risk; multiplication of all these four is the entropic risk.

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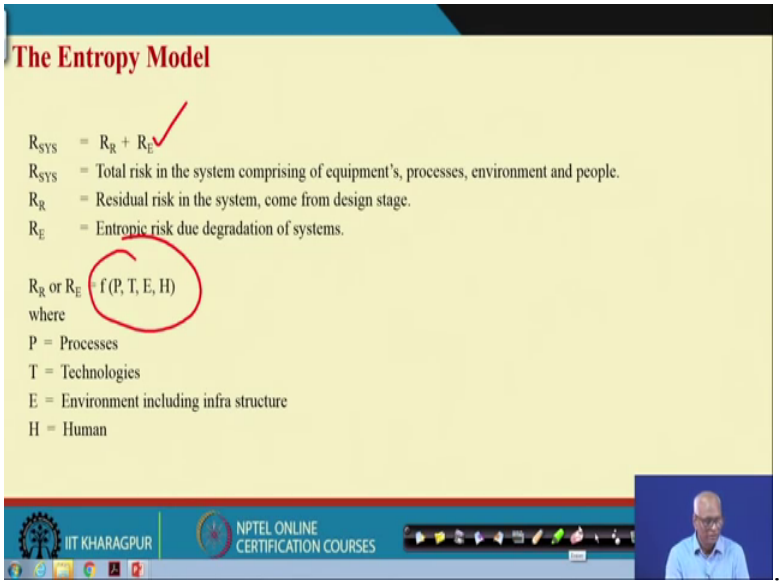

So, if R R is the residual risk, R E is the entropic risk, the system is total system risk is R R plus R E because of these four factors is the edition of these two risk. So, we have to see that these two risks are within the tolerable limit.

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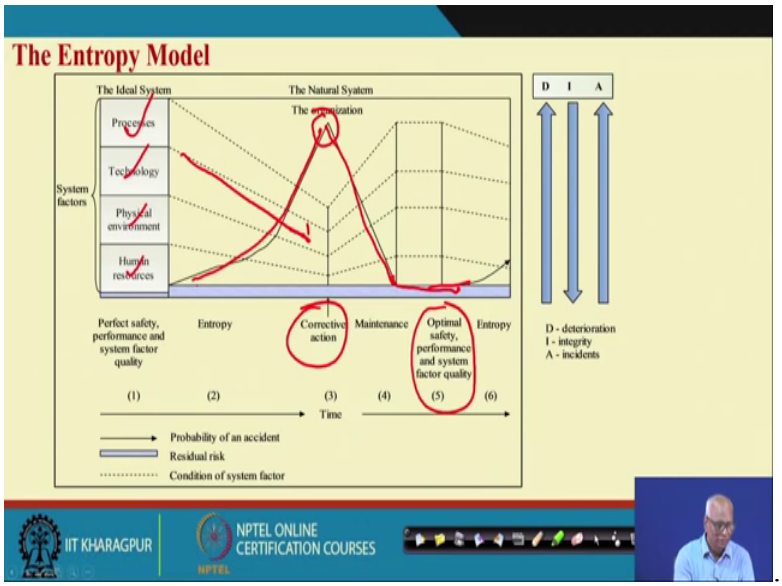

So, telling little more there are processes, technology, physical and human. If the integrity loses reduces then the deterioration the deterioration when the deterioration keep happening then the integrity will come down.

Why deterioration system deterioration happens you all know because of the maintenance problems, operation problems. So, when it goes to the alarming level then you take action it will come down. If we hold it, it is good then it will go little up. So, you do corrective action here. This is the optimal level as the time goes then the incident will not happen come down. Then what you have to do? You have to do.

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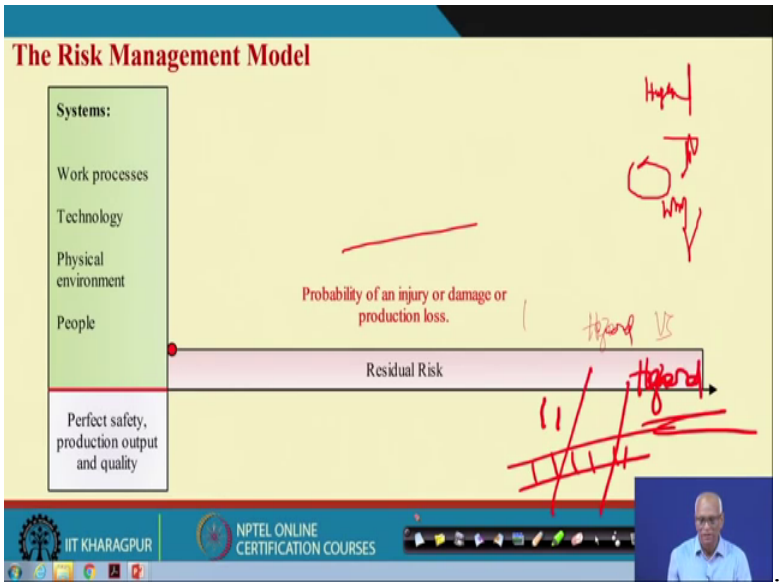

Let us you have it moves.

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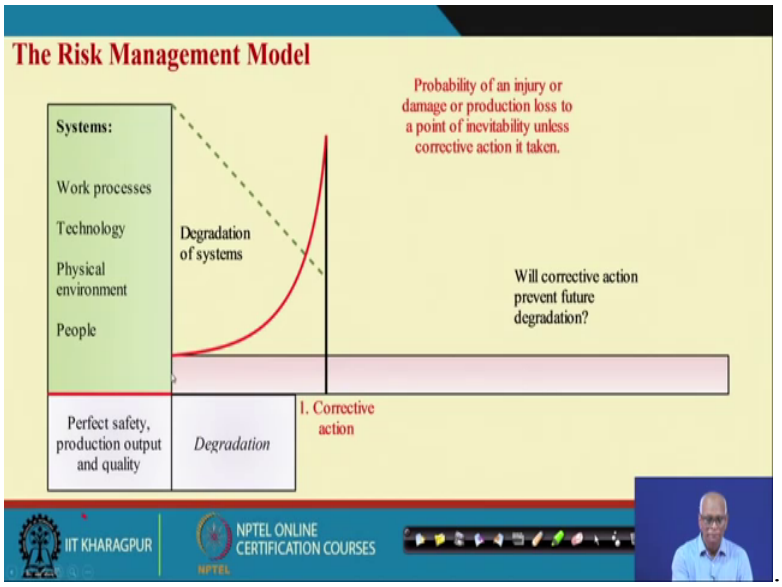

Initially when the degradation happens the incidents the risk increases the integrity reduces.

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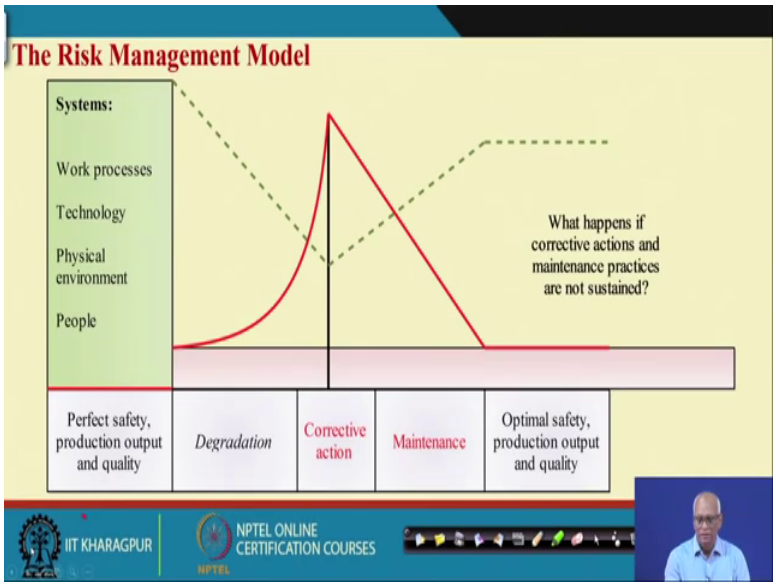

You take action by proper maintenance. Then you try to maintain it.

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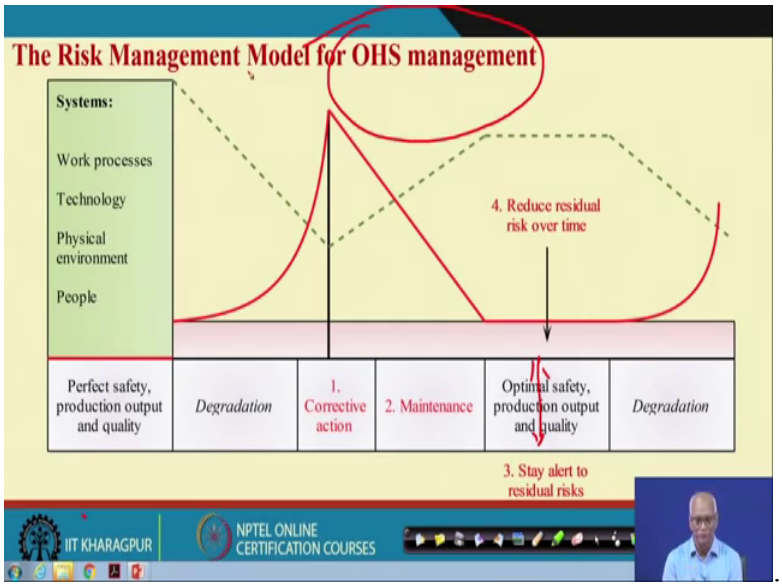

Finally, if again degradation happens it goes like this. Normally, you have to when it comes here you should hold it here and you should try to reduce the residual risk, that should be the risk management model for occupational health and safety management. We have to if there is any first you have to enters the residual risk then you have to enters the first you have enters the entropic risk then you have to enters the residual risk

and hold it at the ALARP level that is the purpose of the occupational health management system everybody would like to do this.

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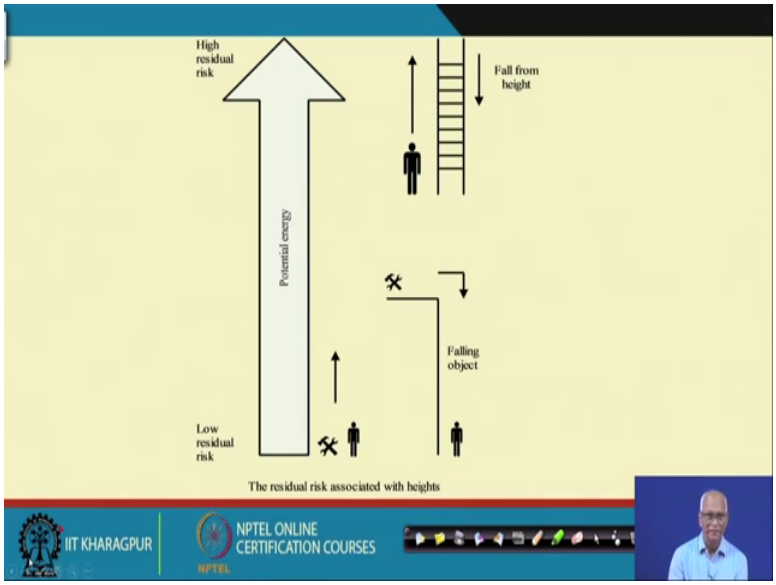

These are some examples, how the residual risk is introduced. If you put people working at height you are introducing residual risk. If you reduce the height in the design then the residual risk will be less.

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There are four systems for doing the effective risk management. One is implement maintenance practices to prevent entropic risk. So, that degradation will not happen. When you maintain properly when the entropic risk comes to the very low level then you start working on the residual risk. You both residual and entropic risk are normal whenever you have to any gradation happens if you keep working then that is called effective risk management. Thank you this is what did we discuss.

We have discussed how the hazard will come, who are responsible. Initially the designers because lack of competencies, lack of knowledge's, lack of perceptions. The later entropic risk will come because of the operation people, operation degradation, maintenance degradation, human resources degradation, people have retired, you are not recruited the skilled people, where the entropic risks are maintained example like Tata steel. After 100 years it looks new, it looks young because entropic risks are manage very well. The managing entropic risk, human risk, entropic risk and residual risk throughout the life cycle from design through throw out that is called OHAS management.

Thank you.