Industrial Safety Engineering
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Lecture - 25
Safety Function Deployment

Hello everybody. Welcome to another very important lecture, that is a topic is Safety Function Deployment. So, what is safety function deployment? How it is to be applied in industrial situation? And the different steps and finally, the design solutions interventions and in finding out interventions for safety improvement will be discussed. So, see the contents, first we will introduce the SFD that is Safety Function Deployment.

And then the steps to be followed to do it, and we will give one example desulphurizing plant. And then the design principles particularly with reference to the hazard control hierarchy 9 principles, what we have discussed earlier those will be considered here. And then using the this concept and finally, how you will find out the different interventions which we are telling the design solutions and that will be discussed.

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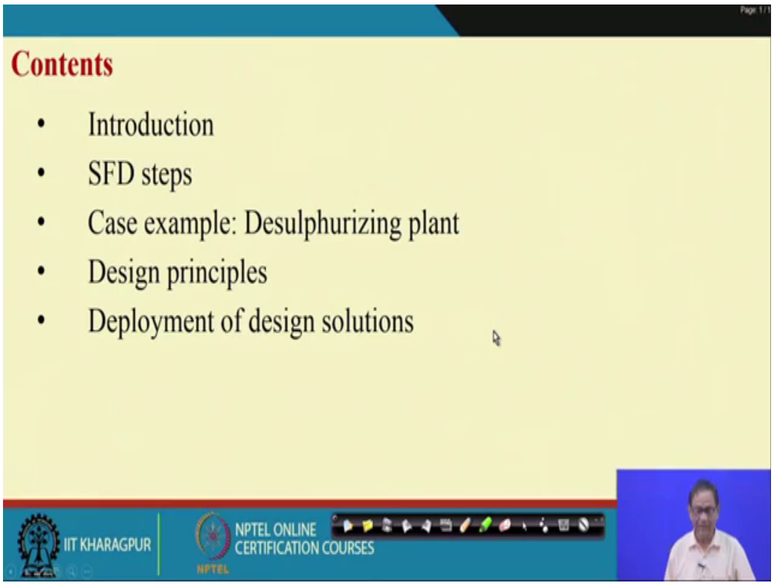

So, it is a little bit lengthy one. So, I am expecting that 45 minutes of time I will be able to complete it.

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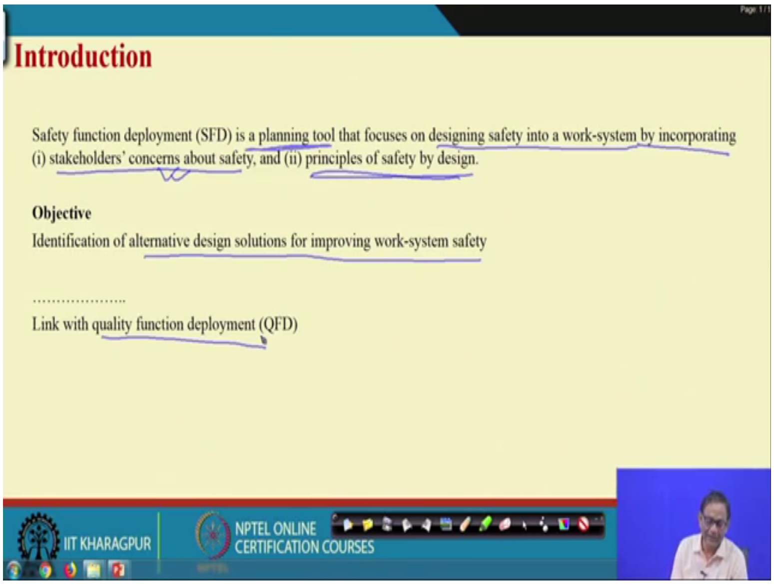

So, what is safety function deployment? Safety function deployment is a planning tool, it is a planning tool that focuses on designing safety into system by incorporating stakeholder concerns about safety and principles of safety by design ok. So, please understand it is a planning tool; that means, this will help you in doing what it will do, it will help you in doing principle safety by design. And here by safety by design means safety by design and redesign that is what we are basically trying to say.

And what it consider? It considers stakeholders concerns about safety. And objective is identification of alternative design solutions for improving of work system safety or other way we can say that system safety where, system is maybe work system maybe your product or maybe your that work place where you are working, but it is a system. So, the concept what we have borrowed that is QFD Quality Function Deployment. Basically, we have you know that quality function deployment is a very, very important topic in quality engineering, this whole purpose is there that how to design quality into the product through QFD.

So, what I have done particularly while developing the safety function deployment, I have taken the concept of QFD into consideration, but not in 1 to 1 or d 2 manner, here we are utilize the risk hazard identification and risk assessment techniques. We have utilize the principle that hazard control hierarchy. And we have also utilize that whatever tools and techniques you have learnt so far. So, one way or other they can be used in this concept.

So, I am not interested to explain you what is QFD, but for the time being let me tell you that QFD is known for quality function deployment; which is a tool that is used to design quality in the product that you are going to produce. So, the detail of quality function deployment can be available. It is available in many standard textbooks you may go through it.

But this concept I have applied in developing safety function deployment, and our primary purpose here is like in QFD design quality into product here also, design safety into the system where people will be working ok. So, I request all of you to go through QFD, because that will give you some more insights what we have developed here. But never the less this is self-sufficient and you will be able to understand.

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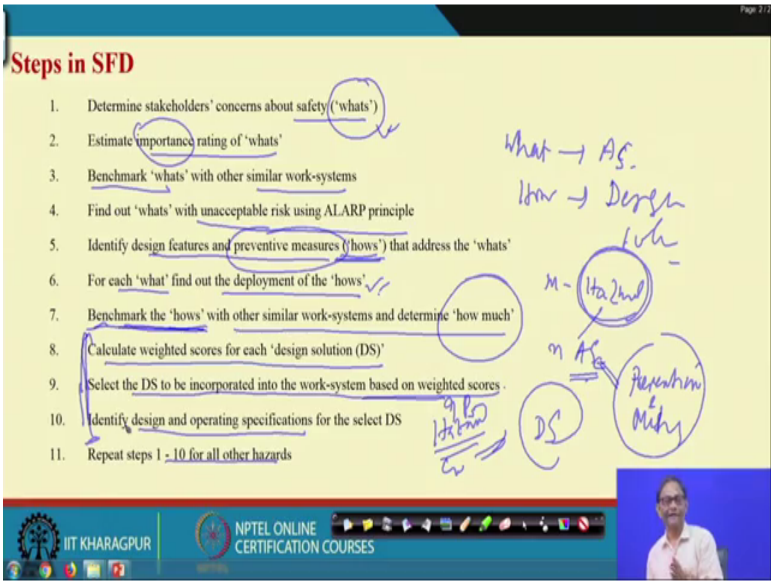

So, first let us explain the steps. So, while explaining the steps, I will try to relate to the previous lectures or the topics what we have covered. But, but for the time being you just think that if you are not getting all the steps together definitely after the end of the class all those steps will be most of the steps will be clear to you. And in may be in the subsequent class also some more steps will be clear to you.

But this is a very, very important topic particularly from blueprint for safety by design point of view. So, our step is determined stakeholder concerns about safety. So, who are the stakeholders? Everybody involved in the work the system; like, the workers or employees, the management. the union, the supplier, everybody who are basically one way or other connected with the system they are stakeholders. So, what is their concern? Concern in QFD terminology, that is what? But in our terminology these are nothing but the accident scenarios.

So, determine stakeholder concern about safety that is what is. What the being an suppose you are the worker, or you are the that is supervisor there, what will be your concern? Definitely you do not want that there will be any accident, no accident scenario is permitted so, that is your concern. Then estimate the importance rating of what is means what? Importance rating of accident scenarios; so, you have seen the risk assessment. So, every accident scenario has risk now, that is the importance. Then benchmark works with similar work systems. So, for a particular accident scenario for example, suppose fire is one accident scenario.

So, now you see that what is the risk of that fire occurring in your system, then you have similar work system in your organization or maybe in other organization, now you check that: what is the risk for fire on that organization. Suppose there is the that there is the emission of gas into the work environment. So, in your system what is the risk of emission, maybe in similar others work system what is the risk of emission, then that is the that you can compare and find out the best managed work system; that is will be the benchmark.

So, what is the need? Need is benchmarking, why? Because you know that whether your risk is the lowest one or it can be reduced further. Then find out what with unacceptable risk using ALARP principles, we have discussed ALARP, there will be acceptable zone, tolerable zone, unacceptable zone. So, you should find out what are the accident scenarios whose risk is under unacceptable zone. So, those things are must be action must be taken immediately. So, you find out those, also find out some which are under tolerable zone. Then identify design features and preventive measure these are basically how's, what do you mean? So, I know what? What is accidents, what is means here accident scenarios, I know what is the risk of every accident scenario.

Now, I have already prioritized with benchmark system whether my the risk of my accident seniors of my systems are more or it is the lowest level or it can be reduced. Then you have used another principle called ALARP. Using ALARP what you are saying that that whether the unacceptable risk accident scenarios are there or not. Then what you required to do? You require to reduce the risk. How do you reduce the risk? That is basically how. What is how in our case what are the design features and preventive measures that you should incorporate into your system so that the risk level will be going down. Then that is means identify design solutions. Then for each what find the deployment of how's.

Suppose you know ok, there are there are 9 design features design principles starting from hazards to last one is the modify the quality of hazard. So, you have to know how many principles are applicable. And now using those principal, how can you find out the design solution that will be that is how's. So, what is equivalent to accident scenario, and how is equivalent to design solution. So, ultimately using our this approach you may find out some solution and it may so happen that better solutions are available in other system.

So, that is why whether yours your solution is the best one or not, that why you require to know the benchmark how's with other similar work system, and determine how much; that means, how much risk can be reduced. So, you have found out how through deployment that through a SFD safety function deployment concept you found out some design solutions. But it means so happen that your design solution is inferior in the sense that, the risk reduction that is possible based on your design solution is not that affective which is already available in some other benchmark work systems.

So, that means, after getting the how's you have to you have to see that what is there in the benchmark. So, that comparison will help you in modifying the design solution and you can go for better design solution. Then what happen? Calculate the weighted square each of the design solution. It may so happen that for a particular scenario, accident scenario or with back calculation for a particular hazard, you will may have get different design solutions because, you have 9 principles. So, you can use a 9 principles together, you may find out a combination of principles will give you one design solution, another combination will another design solution.

So now you may find out that the design solutions are effective, and there are alternative situations available alternative solutions available. So, in that case, select the DS to be incorporated in the work system based on scores. So, that mean you will select which one will be the best design solution that is to be that is to be chosen. So, then identify design and operating, then for that particular solution identify the design and operating specifications. It is a very much is engineering issue.

So, that mean the for that particular solution the constant engineers will see that what will be the design and operating specification for it. Because when you incorporate any design solution, what will happen ultimately it may bring new hazard. At the same time, it may create dependency also. So, there will be problem that is why the expert engineer or design engineers, and the operating people they will be they combining together, they will find out the design operating specification first of all your that design solution may not be accepted by them. When it is accepted what will be the design and operating specification for the DS, DS that is to be identified.

Then repeat this for all other hazards ok. So, let me repeat again, you will be having suppose m number of hazards. This m number of hazards may lead to n number of accidents scenarios. For accident scenario is the concerned it is basically what? Which is concerned for all the people stakeholders, worker will not want the fire will be there. Supervisor will not want this, management will not want this. There should not be explosion. There should be not be fall from height. So, these are all accident scenarios and concern, so that is what. You do you know the risk of every what means every accident scenario. So, you know whether the risk is acceptable or not acceptable. You can compare with similar work system and find out that: what is the risk level there. So, these 2 helps you to understand that that what level of risk can be reduced.

You have to reduce the risk, that risk of accident scenarios and in turn the risk related to hazards, what you required to do? Require to find out some preventive and mitigative measures, prevention and mitigation measures. So, this prevention and mitigation measures we are saying design solutions DS. So, how to identify the design solutions what is to be adopted there? For that purpose, what you are doing? That purpose you are using hazard control hierarchy, that 9 principles 9 piece what given in hazard control hierarchy. So, for every accident scenario and the resulting hazards, you see that what hierarchy is applicable there.

And accordingly find out that which are the what is the best principal design principle that will be used. So, you also find out the alternative other design principal that can be used also. You find a set of design solutions ok. And then once you have a set of design solutions, and if you find out a the set in such a manner that there are multiple sets or multiple design solutions, and which are if you assume that they are equivalent means, any one of them lead ultimately reduce the risk level to that extent for which it is (Refer Time: 15:09). And then you can choose the best one out of the out of the several alternatives. So, the best one selection like from 8 to 8 to 10 these steps we will be discussing in the in the next class.

But this is to be done for all the hazards. Now let us see one after another I will be little faster here. Because you see that the accident scenario risks is nothing but once you identify hazard. Then only you will be able to identify the accident scenarios. And then once you know the accident scenarios, then you will find out the probabilities and get the risk of these things. So, that mean hazard identification is included here, risk assessment included here, risk prioritization with ALARP is also included here.

And these hazard control hierarchy energy control model is also included here. And finally, combining all those things you are going we are going to get the design solutions. Then ranking of design solutions is also included there. It is a very it is a holistic one, and it is really I think it is really a very, very useful on for safety engineers. So, very quickly I have to proceed, but why I will go for go for quickly because, you know hazard identification, you know risk assessment. You know you know hazard energy control model or hazard control hierarchy also. So, what I have to do? How I am mapping the things that is what I have to explain it. So, that is what I am doing now.

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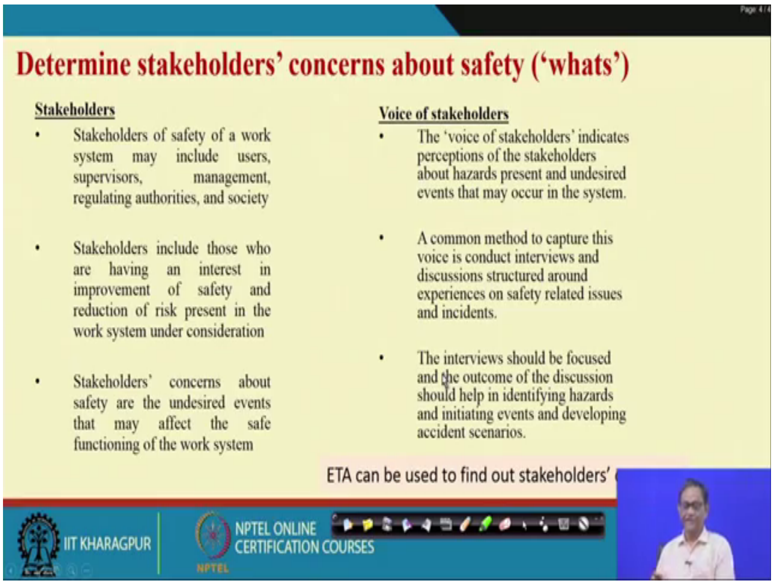

So, I will not explain it further. So, it is basically stakeholders who are stakeholders? And what are the voice of stakeholder? Accident scenarios, and you have seen earlier that event tree is used to find out the accident scenarios given the centre event or top event known. So, this entire top event will come from the hazards.

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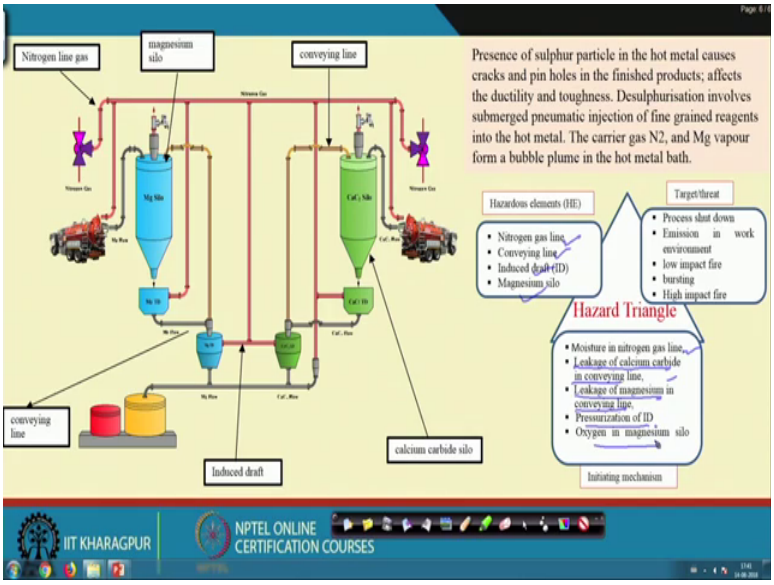

Now, let us consider a case here.

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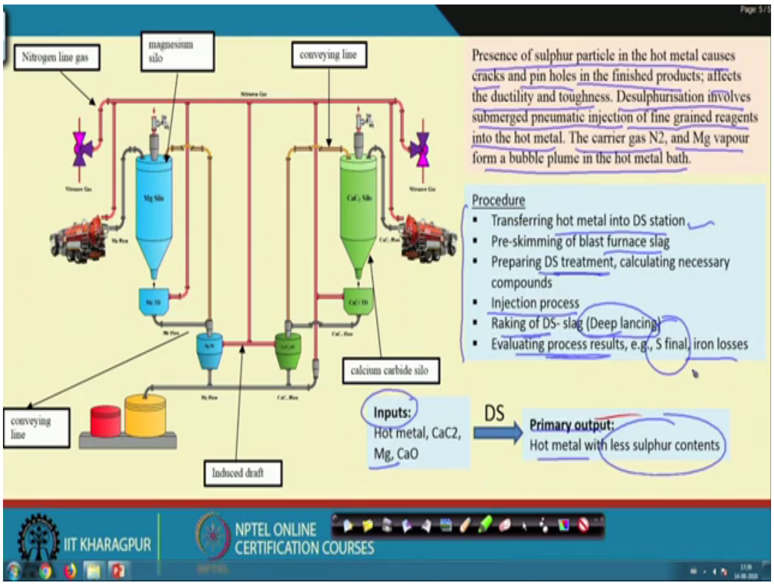

The case is it is a basically a desulphurization unit; where molten metal from the blast furnace this will come to that DS plant. And then what happen? This hot metal will be will be basically treated with the help of calcium carbide magnesium CO and all those inputs, the primary purpose is the sulphur content in the hot metal that is to be reduced ok. So, let us see that this is a schematic diagram for the hot metal. So, presence of sulphur got is the issue presence of sulphur particle in the hot metal causes cracks and pin holes in the finished products. Affect the ductility and toughness; desulphurization involves submerged pneumatic injection of fine grained in reagents into the hot metal. The carrier gas into mg vapour form a bubble plume like this.

So, for the time being you understand that, that from blast furnace hot metal is coming to the desulphurization unit. Purpose is, reduce the sulphur content in the from the in the hot metal. Because sulphur content in hot metal is not good for the resulting products what you produced in a steel melting steel melting, shop or in a steel plant. So, what are the what are the inputs? Inputs are these, and this is the desulphurization unit; where you see that magnesium silo Ca C 2 silo, and then ultimately there are different different carrying lines. Nitrogen gas lines Ca C 2 line so many things are there ok. So, all those ultimately for certain purpose it is there. So, all those ultimately are the hazard elements. And there will be several initiating mechanisms. And ultimately several threats can will be will be may be realized not will be may be realized.

So, what is the output primary output hot metal with less sulphur content. And this is the procedure once. Things come to the first one is, hot metal will come to the DS station. And at the DS station slag removal. Then you have to prepare the treatment plant. That is calculating the necessary compounds depending on the hot metal composition. You have to find out the what are the inputs to be added there. Then injection process will start and ultimately. Desulphurization the raking of DS that deep lancing will be done. And then finally, after that evaluation of these is means what is the final sulphur content, and what are the other that is outputs like iron losses and other things that is to be computed ok. Now this is this is not tell what is the system. I am not going into the detail of the system because this is not required at present. And it is it is basically a desulphurization plant, and used in primary in the steel making steel plant.

So, what I want to do? I want to show the SFD with reference to this plant. So, let us see what we will do. Now see that our aim is here, what are the hazardous element? You recall the first few lectures. So, hazardous element is the nitrogen gas line, conveying line induced draft magnesium (Refer Time: 21:06). These are the few things, we have not we; obviously, hot metal is also hazardous element. But from this point of view we are concentrating on this in the desulphurization unit what are the things are there, what metal is obviously it is there.

So, what are the initiating mechanism? Moisture in nitrogen gas line that is that is in not desirable. Leakage of calcium carbide conveying line that is not desirable. Leakage of magnesium in conveying lines pressurization is induced draft oxygen in magnesium silo there are the; these are the few initiating mechanisms. And ultimately all those things lead to different kind of threats; like, process shutdown emission in working environment, low impact fire, then bursting high impact fire. So, let me just repeat for a minute. This is our system what you required to do? You required to find out all the hazards, and you required to find out what are the initiating mechanism that can take place. And finally, you required to find it out what are the threats or; that means, the accident scenario that could happen.

So, here ultimately I have I have listed few hazards like hazardous element; few or the important initiating mechanisms, and important accident scenarios. By giving these 3, I am not saying that the entirety is covered here, from the hazards element initiating mechanism and target threat point of view. But it is the most of the important things are covered ok. So, then what is the stakeholder concern here? Stakeholder concern is this box. This box is stakeholder concern. So, they do not want this thing to happen. Suppose that mean you have to you have to know now, what is the risk of all these things happening? So, let us see how do I find out the risk of all those things happening.

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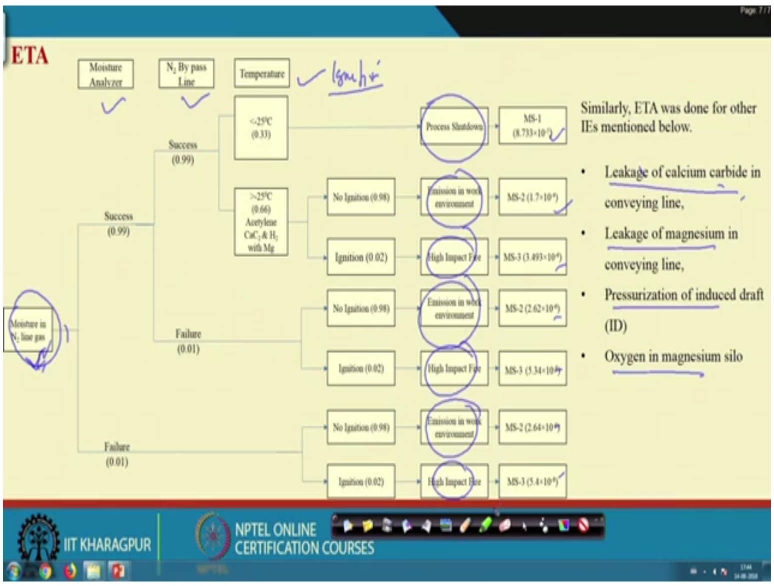

So, we have consider one of the hazard that nitrogen in nitrogen gas line that moisture in nitrogen gas line. So, this is our initiating mechanism, that moisture in nitrogen gas line. So, what is the probability or frequency of moisture in nitrogen line gas, that is to be estimated also. So, for the time being you say that moisture in nitrogen gas line and that is estimated because using fault tree you can estimate this one. Then moisture analyzer n 2 by pass line and temperature. So, these are the sum of the basically protection thing. So now, what you will do if depending on the success and failure of these; and the; obviously, that ignition source ignition source.

So, then what are the situation one of the situation is process shutdown. Emission in work environment high impact fire emission in work environment high impact fire emission high impact fire ok. So, that mean high and low impact fire so, that will be that will be there ok. So, resultant this and then we knowing this probability this probability also or the frequency, you know what are the scenarios of this ok. So, this probability this value I have not put here, but we have computed it.

Now then ultimately we found out the difference scenarios what is going to happen. So, that is if this one this event tree with reference to moisture in nitrogen line gas. So, similarly what are the other initiating mechanisms? Leakage, calcium carbide magnesium in leakage, pressurization induced draft, oxygen magnesium silo, for all other similar event tree can be computed. And what we will find out that considering all the those things.

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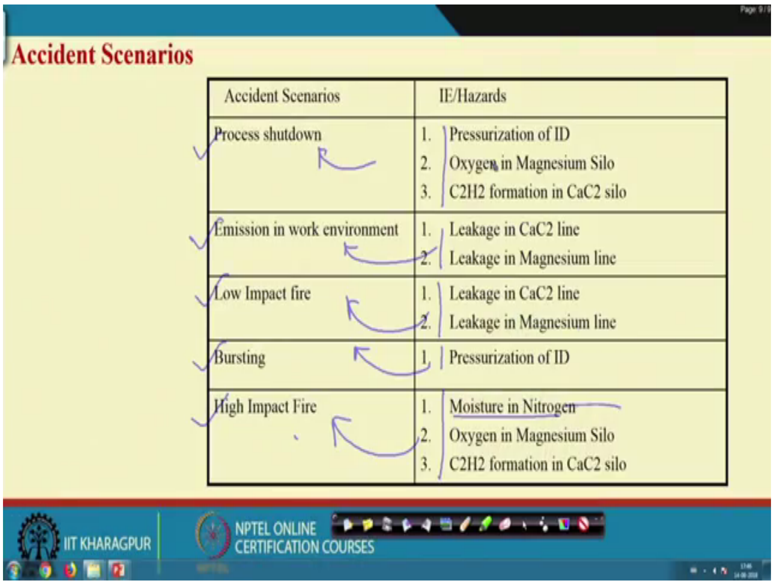

So, ultimately the what will be the result is this. So, these many accident scenario or stakeholder concerns are identified, low impact high impact like this. And all those things ultimately that from initiating event point of view these 3 leads to process shutdown. These 2 hazard or initiating mechanism lead to emission. These 2 low impact fire, this one lead to bursting. These 3 hazard lead to high impact fire ok. So, moisture in nitrogen gas line leads to high impact fire.

Similarly, moisture so that means, you have accident scenarios, and you have initiating mechanisms or as such hazard, hazard element. And initiating mechanism combine is the hazard we are writing. And here what happen the initiating mechanism? Why this pressurization of I d will take place leakage will take place you can develop fault tree and find out the root causes ok. So now what we want? We want to see that how this hazard how hazard control hierarchy will be used what is this? This is accident scenario; now let us go to the next importance measures sorry, sorry.

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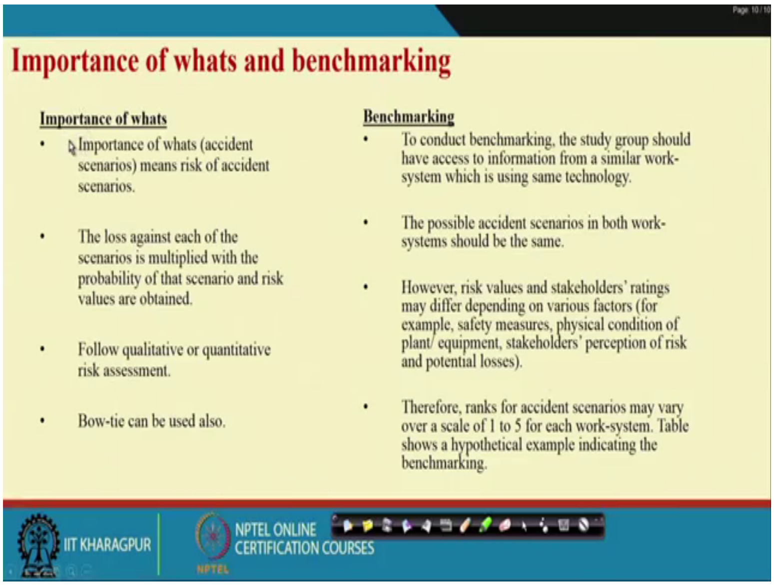

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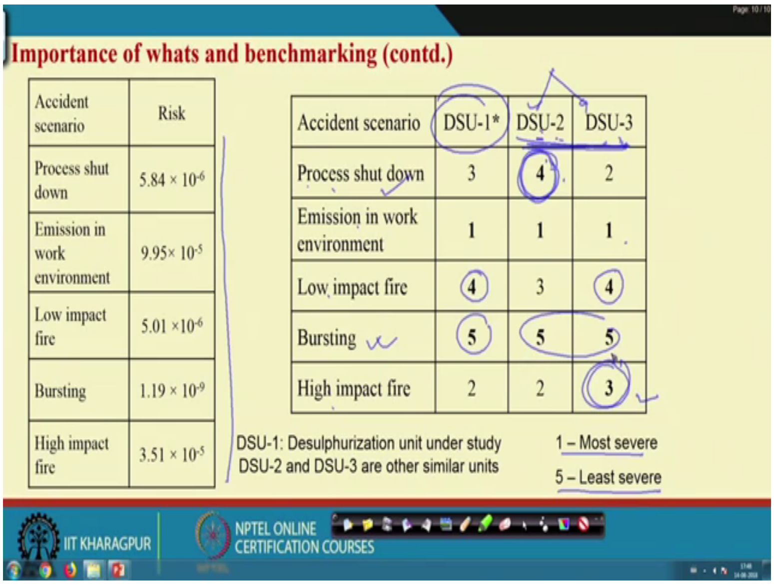

Once you know the scenarios importance means, what?

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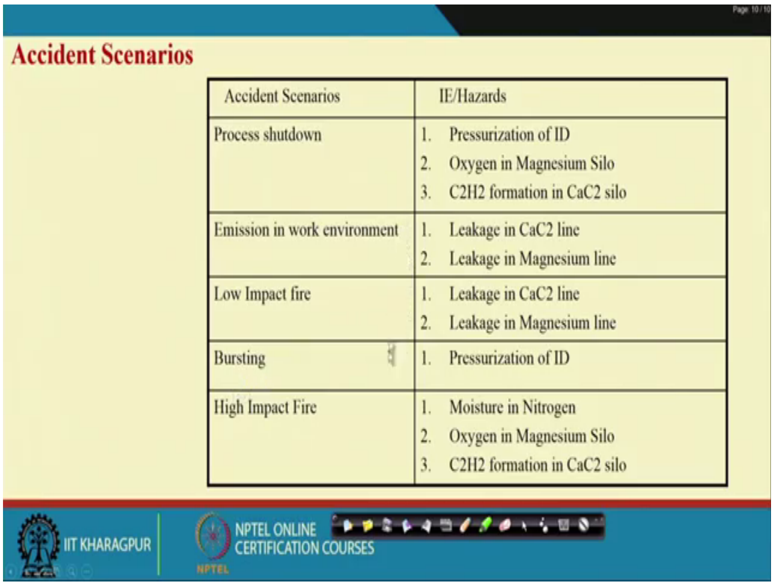

Risk, so let us compute risk. We have seen that from event tree, you have computed the risk. Risk is probability of that scenario times loss, I have I have given you the loss calculation part consequence modeling. So, what are the different kind of losses, that you required to calculate. That you calculate, and in monetary term it is possible or in some index value you create. And then once you multiplied with the probability of that scenario occurring, times the loss you will get the risk. So, we have we have seen the risk value here.

Now, then what we said that you just compare your risk value with the benchmark. We did not get any benchmark such system, but hypothetically we have created 2 bench 2 2 another similar system. And then we compare this is this is our system vis a viz the comparable system. Then we found out that from the one is most severe and 5 is less severe in terms of risk. So, that mean from this scenario point of view you are doing fine others also doing fine. This scenario point of view you are best; these scenario point of view all are equally worst. And this scenario point of view DSU 2 is the best. And this scenario point of view DSU 3 is the best.

So, that means, what DSU 2 and 3 doing with reference to this, and this if you know then you will be in a better position to reduce the risk ok. So, process shut down risk can be reduced up to the risk of this unit, high impact fire can be reduced up to this unit. This is one comparison, but you may go for ALARP principle also.

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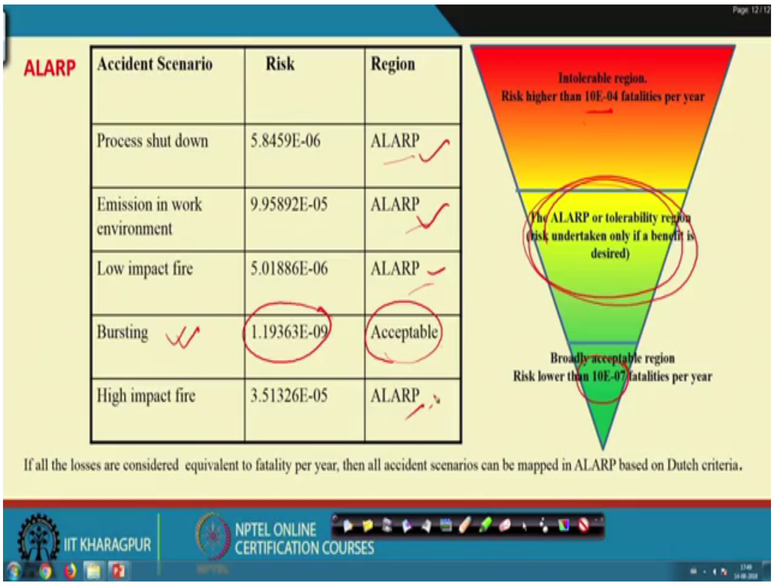

And then you check that with reference to all those accident scenarios, what is the status? There in ALARP, ALARP, ALARP and acceptable, and this ALARP. ALARP means the ALARP or tolerable region ok. So, if we consider that this risk is equivalent to fatality risk, then using the Dutch criteria. We can use the if it is 10 to the power less than 10 to the power minus 4, that is acceptable which is acceptable, if it is sorry if it is less than 10 to the power minus 7 acceptable this is acceptable one. But if it is 10 to the power 4 or more this is untolerable no one is there. But most of the things are falling under ALARP. That is why ALARP, ALARP, ALARP, ALARP.

So, you want to reduce this risk ok, this is the principle. So, your hazard find out the accident scenarios through the methods what we have already consider. Then accident scenario risk you understand. And then you say that what are the risk that are acceptable what are not acceptable. What are in the ALARP zone, and then you have to reduce this. So now use the hazard control hierarchy principles. So, all those 9 principles I have already discussed P 1 to P 9. I do not want to discuss it now; you know this.

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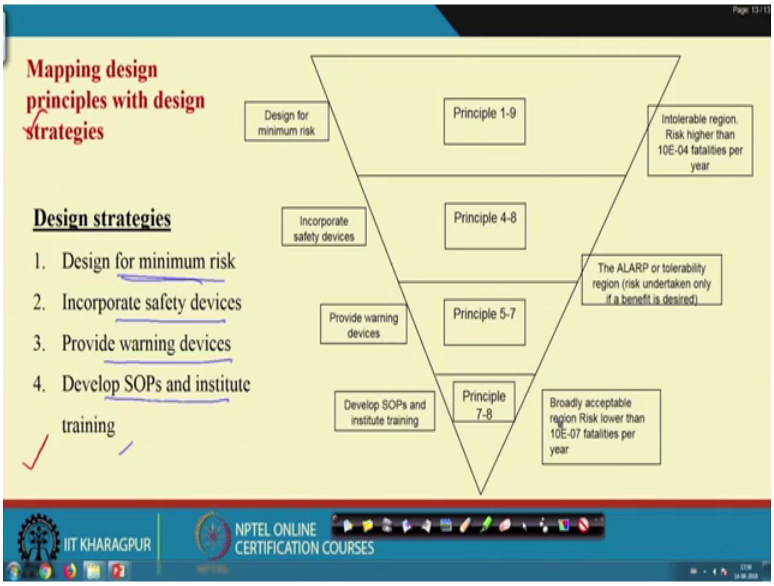

Then what happen within the in the in the ALARP zone kind of things? So, there will be different strategies designed for minimum risk incorporate safety devices provide warning devices sop institute training this 9 principles we have mapped here. So, that means, what you will do on depending on your strategy what are the principles you will be using. So, what I suggest you here it is clearly written what is to be done. So, you in the video you make a have a pause, for the video and first note down this and then understand and use it.

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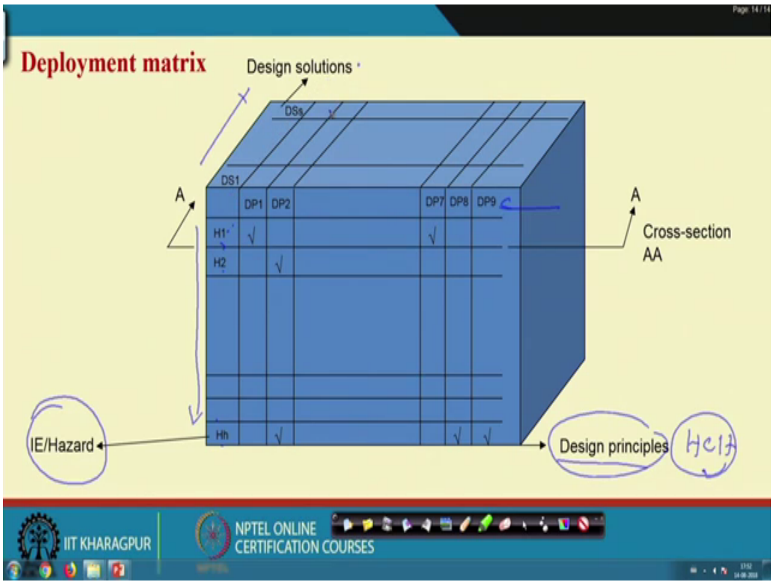

Now, come to the deployment matrix which I want to explain it because this is important. So, maybe next 15 minutes time we will spend on this deployment and other slides ok. So, what you have known so far? You have shown that there are initiating mechanism or hazard. So, this side we are using interchangeably this, but actually it is basically hazard which ultimately lead to the initiate that initiating event. So, there are suppose a kind of different kind of different types of hazards or different hazards. Then what happen? We have already seen the hazard control hierarchy with 9 principles these are design principle from hazard control hierarchy.

So, first you map this 2, that the hazard with hazard control hierarchy what are the mapping, how many with reference to a one hazard, which of the principles that can be applied ok. And then there will be another axis known as design solution, once you have hazard wise principal mapping, then based on your design knowledge hazard knowledge and your lessons learned, then you will be able to find out some of the design solutions. So, what is the first level mapping? First level mapping is hazard verses design principle which is basically 9 principles of hazard control hierarchy ok. So, let us now see this. That in order to see this, let me take a cross section a cross section and how it will look like. It will be something like this ok.

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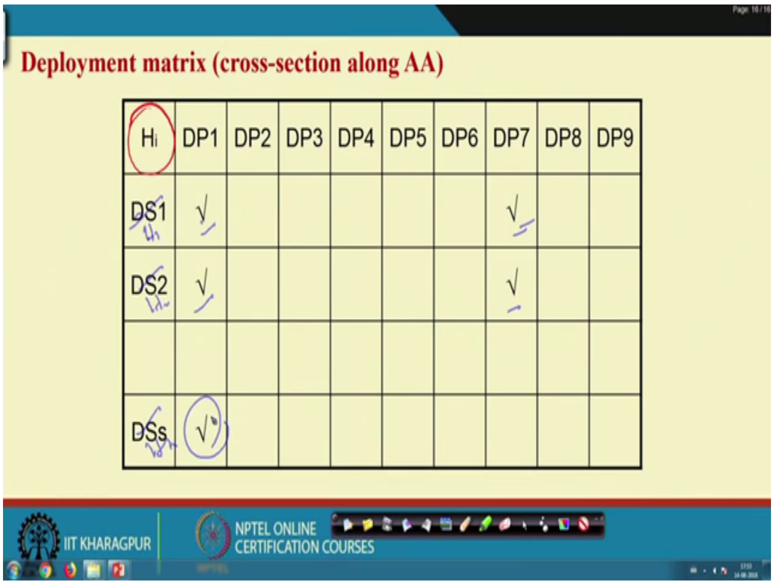

So, here in this particular slide for H 1, DP 1, DP 7 like this, it is these are applicable so; that means, DP 1 and DP 7 related design solution should be there. If you take cross section, you are getting that this slide that mean the for this is my hazard. A particular hazard maybe H 1 maybe H 5 whatever maybe. And then you see we have seen that DP 1 and DP 2. So, what I want basically here, what we want basically here? You write hazard one hazard 2 to hazard H ok.

So, that will be better so, then hazard 1, these many principles are applicable. You may get you get DS also in the other cross section not problem and issue. So, hazard these 2, second 1 these 2 third one maybe this. So, that mean you know: what are the principles that will be applicable for the different hazards; obviously, you have the system and design knowledge, otherwise you cannot do it ok. So, with reference to our example that desulphurization unit.

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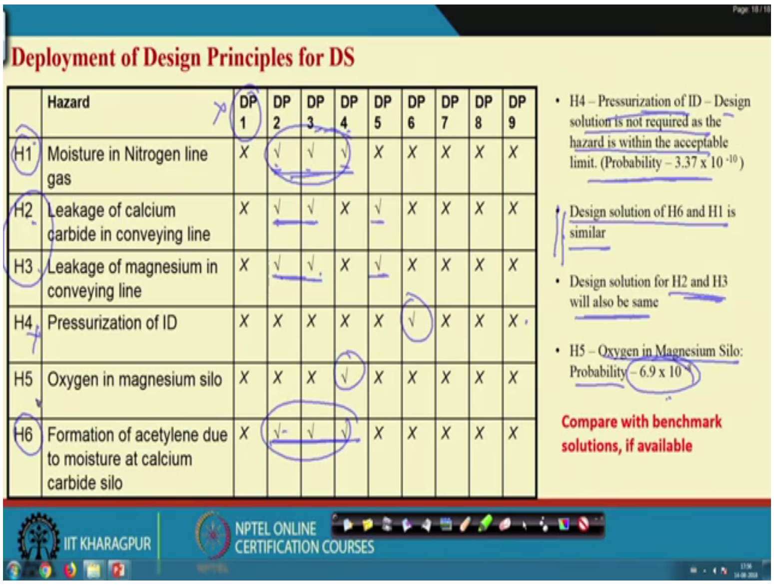

Now, let us see that we have 6 different hazards; then a group of 5 engineers who are basically having knowledge of this desulphurization plant. They have they and for the existing plant they have developed it; that with reference to moisture in nitrogen line guess they founded that this DP 1 that avoid hazard, it is not possible for any of the hazards. So, this is totally ruled out, but for first one DP 2 DP 3 and DP 4, principle 2 principle 3 and principle 4 are applicable. For the second one P 2 with principle 2 3 and principle 5 is applicable.

For the third one P 2 P 3 as well as P 5 is applicable. For the 4th one, I think only DP 6 is applicable, for the fifth one DP 4 is possible. For the 6th one again; that means, the first 1 to 3, that formation H 6 that is P 2 P 3 this principles are possible. Then that team also found out that pressurization of ID design solution is not required as it is acceptable. Probability is very low acceptable limit. So, this is not required, nothing is required for this. Then design solution for H 6 and H 1 are similar.

Based on your expert knowledge what happened? You found out that based on you expert knowledge, found out that H 1 and H 6 for these 2 hazards the solutions are similar. Here these 3 principles applicable and these 3 principle applicable. At the same way from design knowledge they found that the similar design solution will help in fighting against these 2 initiating event or hazards ok.

Similarly, H 2 and H 3 they are also same. So, H 2 H 3 they are also same. And H 5 oxygen in magnesium silo the probability value is also very, very low ok. So, that essentially that mean H 1, H 2, H 3 and H 6 these are the hazards or the initiating event whatever way you can. But initiating mechanism, but for the time being we are always using hazard or initiating mechanism. So, let it be because from event tree point of view initiating, mechanism from the hazard triangle point of view is the hazard ok. And in between the transition from one to another, and as well as basically their nomenclature terminology you also know. So, I do not think that it will create any confusion to you. So, what you will you will do now? You have to find out the solutions with reference to this. So, how do you do?

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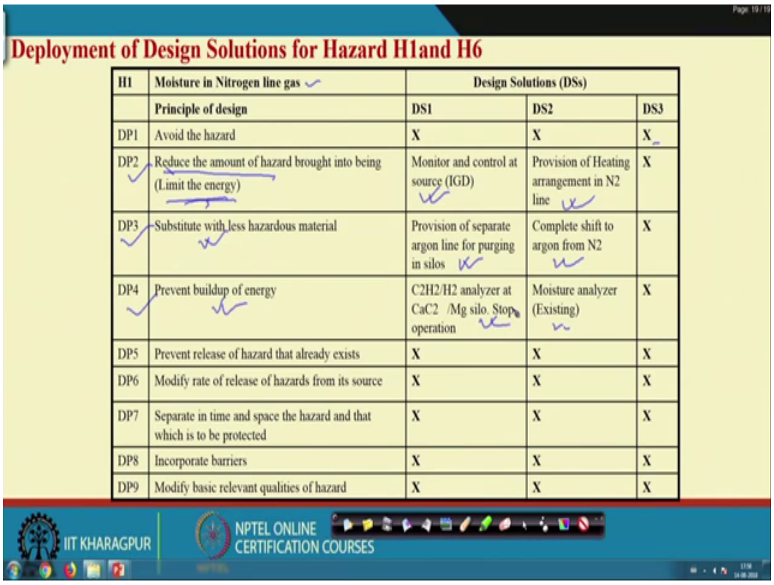

H1	Moisture in Nitrogen line gas	Design Solutions (DSs)		
	Principle of design	DS1	DS2	DS3
DP1	Avoid the hazard	X	X	X
DP2	Reduce the amount of hazard brought into being (Limit the energy)	Monitor and control at source (IGD)	Provision of Heating arrangement in N2 line	X
DP3	Substitute with less hazardous material	Provision of separate argon line for purging in silos	Complete shift to argon from N2	X
DP4	Prevent buildup of energy	C2H2/H2 analyzer at CaC2 /Mg silo. Stop operation	Moisture analyzer (Existing)	X
DP5	Prevent release of hazard that already exists	X	X	X
DP6	Modify rate of release of hazards from its source	X	X	X
DP7	Separate in time and space the hazard and that which is to be protected	X	X	X
DP8	Incorporate barriers	X	X	X
DP9	Modify basic relevant qualities of hazard	X	X	X

You see, the deployment moisture in nitrogen gas. What are the things about the hazard not possible? We say DP 2, DP 3, DP 4 available others are not applicable. The expert team found out that in order to do you use this principle. But if we use this principle what are the intervention that can be put? If you use this principle what are the interventions that can be put? If you use this principle what are the intervention that can be put? Now moisture it is already there.

So, please see the for the existing system, these things are to be put means because of your expert knowledge or design knowledge process knowledge you have. Now with this approach, you are able to find out the solutions. So, that is the issue, that is what is basically we are saying the deployment. You have hazard knowledge, you have design knowledge, you have system knowledge, you have operational knowledge you have the team and you have, we have given the total path. And now you are in a position to deploy it. So, it is so, for hazard 1, this is. Now in the same manner if you do for hazard 2. You are finding out some more.

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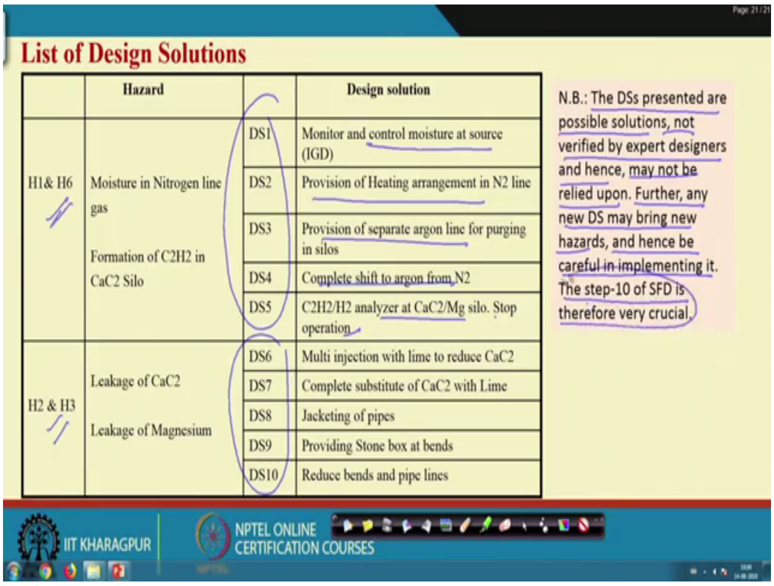

If you go for similarly hazard 3 and like this and finally, what happened? You have you have got so many for hazard one and 6 hazard 2 and 3. So, there are 5 solutions moisture control, provision of heating arrangement, provision of separate argon line, complete shift Ca C 2 analyzer stop operation and here also there are another 5 ok. So, that mean with reference to this desulphurization plant the team the team we are we if we assume that they are expert really, then that is this is the good solution. If really they are not expert enough, they will be the solution is inferior.

So, you should not rely on this solution, what is important here is, that how to use SFD to ultimately reaching to design interventions or a design interventions which we are talking about design solution. So, that is why I have written here the DS's presented are possible solution, not verified by expert designer and hence may not be relied upon. Further any new DS may bring new hazards and hence be careful in implementing it. The steps 10 step the step 10 of SFD therefore, very the step 10 is 10 step is very, very crucial ok. So, I have gone very quickly.

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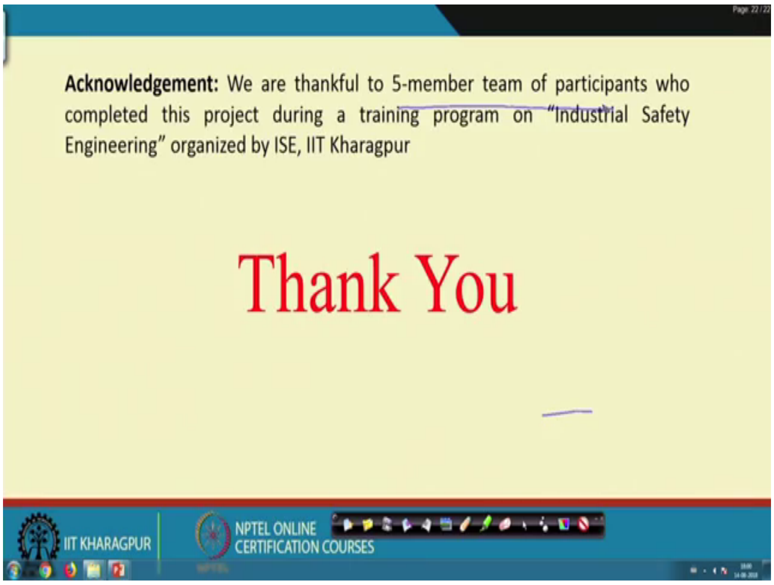

And the reason is very obvious because most of the things are known to you, and I have just giving you one after another in a systematic manner. So, that you will be able to map hazard to design solution, and you will come out of few design solutions which can be implemented at the at the system level (Refer Time: 40:50) low level. And that is: what is the purpose of this very, very important quotes industrial safety engineering. And I we are really thankful to the 5 member team actually they were the participants in one of the training program on industrial safety engineering. That is what I have organized with help of my colleagues ok.

So, if you like this lecture I will be extremely happy because this is a concept what we have developed. And I want all of you should apply this; whenever if you have this opportunity to apply. And if you find problem in understanding that how SFD to be applied, then definitely you can write to me or you can write in the discussion forum. Definitely it will give you much needed; that means, much needed a tool that will that is required for you to actually do prevention through design in the plan.

So, but this is one of the concepts only. Please do not think that this is the concept for finding out the design solution for safety related to safety. And we have already seen bow tie and the safety barriers that is also that can be also used and can be done. Similarly, there may be others like your there is asymmetric design for so many different concepts are available. Trees is another concept, that is also available there are multiple many concepts available. So, you can use them, but this concept what SFD I talk about it is in line with the quality function deployment. Because in quality function deployment our objective is design quality into the product in safety function deployment our objective is design safety into the system or facility you are going to develop.

Thank you very much.