Industrial Safety Engineering
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Lecture – 43
Human Error Identification

Hello everybody. Welcome to today's lecture. Today we will discuss Human Error Identification.

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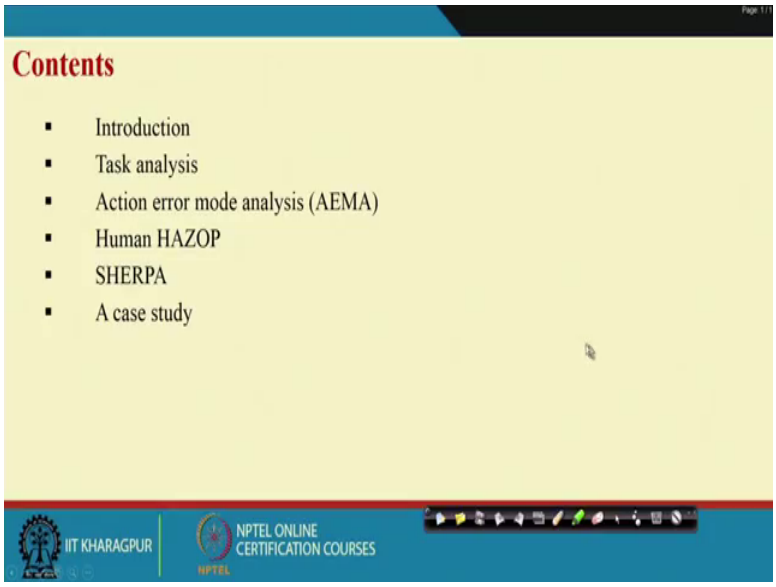

We will start with what is human error identification? And, then we will give you the steps first one you require to do task analysis, then there are several ways to identify human errors. One of the methods is action error mode analysis, then we will discuss Human HAZOP. Then systematic human error reduction and prediction approach and one case study will be showing you what we have developed.

And, then I will show you some of the human errors, which were studied and developed by Kirwan given in his book a practical guide to human reliability analysis in appendix 2.

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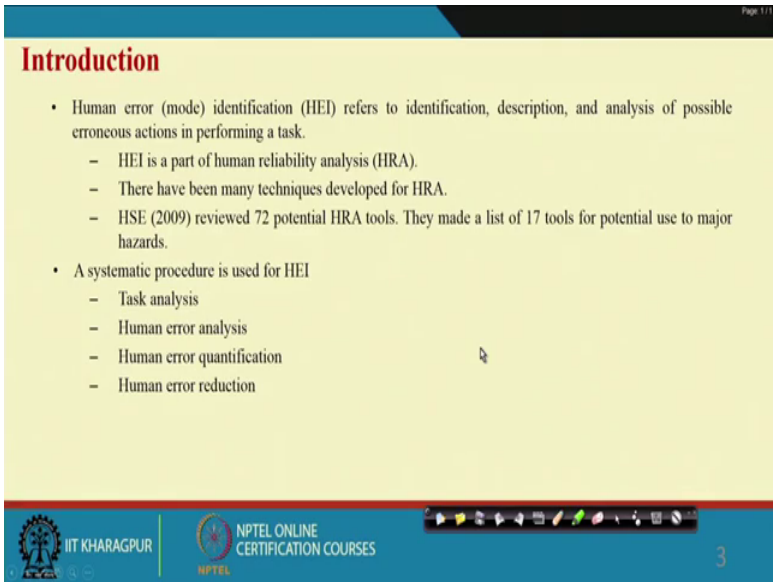

So, if you recall my last class, where we have defined human error. And, we have given classification of human errors and also we have identified the causes and brain bottlenecks. So, we discussed about human error in terms of slips, laps, mistakes, in terms of knowledge base, rule base, and skill based, work and human error. And, a today we will see more of practical issues means, when you are working in a plant and or even as an engineer you want to charge the or you want to identify the human errors. So, those kind of discussions should be made today.

So, human error each well discussed topic. Actually, it is a part of human reliability analysis. So, you will find out that there are many techniques developed in the area of human reliability and impaired HSE in 2009 they delivered 72 potential human reliability analysis tools. And, then finally, they made a list of 17 tools which are applicable to major hazard condition. In fact, they have given a good review of it the procedure the tool the advantage, disadvantage and the situation under which it will be used.

So, now when you talk about human error identification, it is definitely a systematic procedure and you know the human error is a difficult thing to understand and identify it. So, systematic procedure is require; the procedure comprises primarily these things more or less and you will find out some additional steps it all are the varieties only, but

otherwise you must do task analysis, then human error analysis, then human error quantification and then human error reduction.

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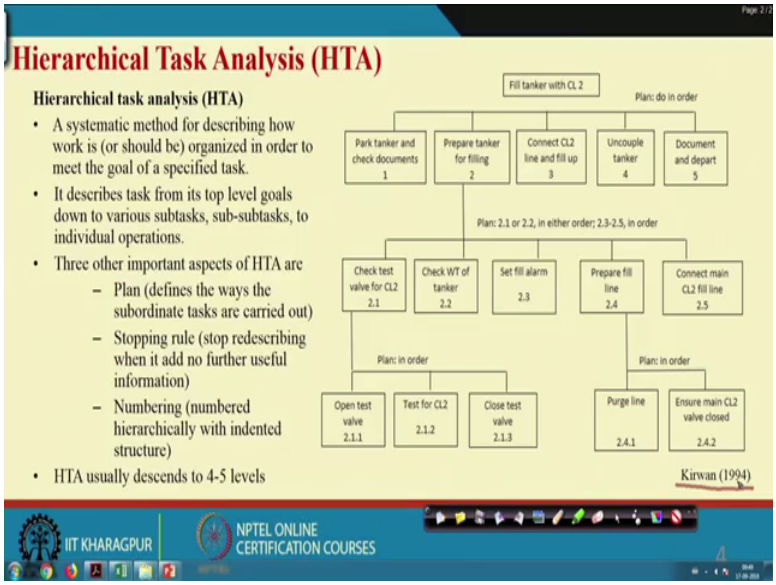

Let us see so, first we will discuss task analysis. This discussion is made or this PPT is made based on the book a practical guide to human reliability analysis written by Kirwan, and this example also taken from his book. And, let us see what is task analysis, its task analysis means you in order to when you are doing work any either it is a physical work, cognitive work, whatever may be the type of work or a mixture of physical and cognitive work. So, ultimately you have certain objectives or goal in mind. And, you do that work to achieve that objectives and goal. And, in order to achieve the objectives or goal the work is done in several sequential and or parallel steps.

So, task analysis basically it is basically a systematic method what happened it basically described how work is organized in order to meet the goal of the specified task. So, what it does basically it describe task from its top level goals down to various sub tasks, sub-subtasks, to individual operations. So, for example, you just think of that feel tanker with CL 2 chlorine that is basically the work or the task that has to be done. Then task analysis what it will do, it will this is my goal that we want to fill the tanker with CL 2. So, in order to achieve this, what are the things to be done? And, that mean you do first plan what is to be done and then the sequence also of execution also you have to identify and

action to be taken or do the task so, that is what is task analysis. So, fill tanker with CL 2. Now, in order to fill tanker with CL 2 what are the things you have to do?

So, first you are planning, that do in order. In order you have to do first park tanker and check documents. Then, prepare tanker for filling, then connect CL 2 line and fill up, then uncoupled tanker, document and depart this is in order you have to do. So, there mean in order to fill tanker with CL 2 these are the this is the goal these are the task you have to do. Now, then when you just see that read the second one prepare tanker for filling, then again you plan that how do you do it.

So, here 2.1 2.2 2.3 2.4 2.5 it is clearly given check test valve for CL 2 to check WT for tanker, set fill alarm, prepare fill line, connect min CL 2 lines. What is the plan, that 2.1 or 2.2 in either order or 2.3 to 2.5 in order. Means these followed by these or these followed by these that you can do, but these 3 in order you have to do. So, in the again if you see that how this can be done, then again there are sub-subtasks. So, in this manner you will basically decompose or describe re describe the task to sub-task, sub-task, sub-task for to the operation level and exit operation level.

So, if you see this you are finding out many things. So, one is a plan and then these are the actions, and then again some plan actions, some plan actions, like this, but ultimately when you are basically coming down to that level when there is no further decomposition is required. So, this one if you clearly observe that 3 important aspects. First one is that goal to the individual operation level, 3 other important aspects is one is plan, define the ways subordinate tasks are carried out.

So, if I say a fuel tanker with CL 2 is the primary main task, then plan that how the sub tasks will be subordinate tasks will be carried out to do this main task. Then there is stopping rule stop re describing when it add no further useful information. So, you should not like park, tanker and check documents is it required further decomposition it does not require.

So, you do not do this. Where you find that yes it is really require further and re describing because it adds value in the operation then you go on doing it and third one is numbering. So, then what is task analysis? This is our hierarchical task analysis, because we started with the ultimate goal and then finally, we break down to the individual operation level.

And, in between what happen when you are interested to do this, whenever when you are starting with this overall goal, then you are planning that how that overall task will be completed. And, then again the sub task if it requires to further re describing, then you have done this in this manner you are you are coming to the bottom level, when no further description is needed because you are at actual execution and operation level.

So, an HTA usually descends to 4 to 5 levels, when we are in 4 5 levels it will be covered. This is hierarchical task analysis; there are other task analysis also like tabular task analysis. So, usually we use hierarchical task analysis and this is what is approach, it ultimately gives you all the elemental tasks to be completed for the overall goal to achieve. And, then or at each of the elemental level you will you try to find out what are the error that can happen ok. So, that is why this task analysis is important.

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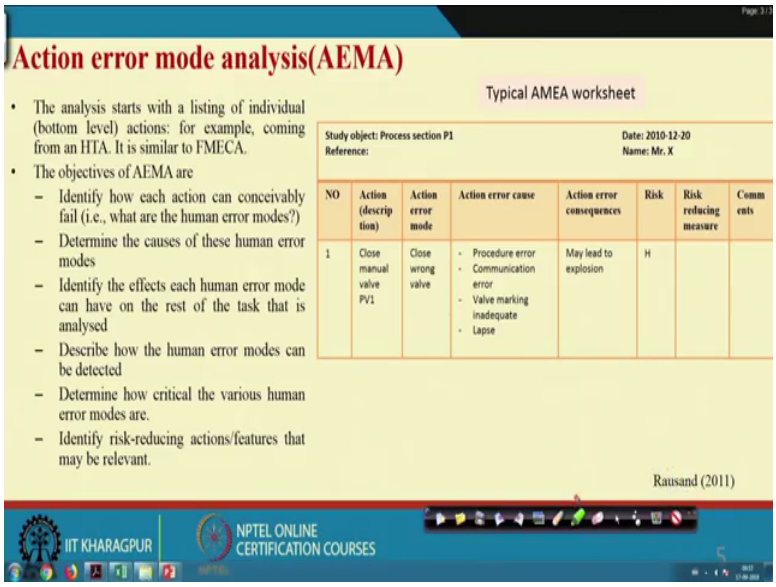

Now, now let us see some of the techniques. So, you have seen earlier failure mode and effect analysis. The equivalence of failure mode and effect analysis in tasks in human error analysis is action error mode analysis. So, what happened, then analyse start with listing of individual actions.

So, he have already seen, when you have done the task analysis. So, task analysis gives you the bottom level actions. And, then what happened, you just do those things that identify how each action can conceivably fail; means what way when you are doing that

action. Suppose you are basically parking of looking at the documents preparing the document. So, what are the errors that you can make.

So, then deter if you make error there what are the causes that lead that led to that error. Then identify the effect, then describe how the human error modes can be detected, and then determine how critical this mode, then identify risk reducing actions or features. In FMEA what you have done you find out the failure modes, find out the effects find out the detectability, then also the causes of that error failures and consequence of this failure and, how to reduce the risk of that failure modes. Exactly in the same manner what happened.

So, action description close manual valve suppose PV 1 you do close action error mode close wrong valve, then action and error cause maybe procedure error, or maybe communication error, or maybe valve marking inadequate, maybe laps. And, then action and error consequences may be lead to explosion risk is very high, then there will be some risk reduction measure and some comments will be given.

So, that mean dissimilate to failure (Refer Time: 13:43), but please keep in mind that task analysis is the starting point here. Once, you have broken the overall task to the elemental actions, then against each actions at the operational level, actual execution level. So, there can be different kinds of errors. So, what way we are identifying error here? What way the human can fail to do this elemental task. Ok. And, then rest is like failure mode and effect analysis. And, also you can add the criticality analysis, now Human HAZOP.

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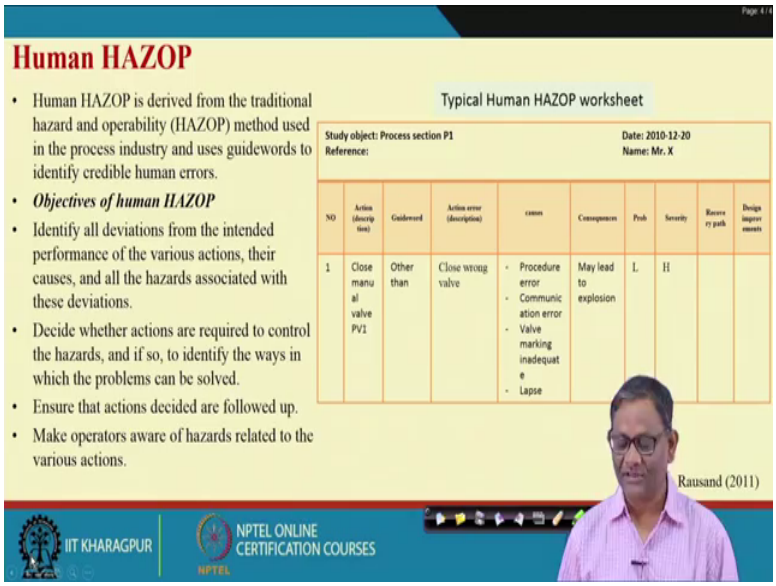

You know what is HAZOP? Hazard and operatively studies, what we have seen in HAZOP, we have we have identified the process parameters, then for every process parameters, we have chosen effective guide words. And, then using the guide wall to process parameter you found out the deviations. And, then those deviations are the important thing, because they talks about the deviation the normal operating conditions.

And, then you want to find out the causes of the deviation and consequences of that deviation and finally, your this one recommendation for improvement. Now, in Human HAZOP the same way you have to you know the elemental task or the elemental task by means the task which is not required to further re describe.

So, at the bottom level task and then at every bottom level task, you find out that what way what are the guide words that is applicable for that task. And, then find out the deviation that can take place. And, find out the causes of those deviation, consequences of those deviation, and how the deviations can be removed. So, this is what is the work sheet.

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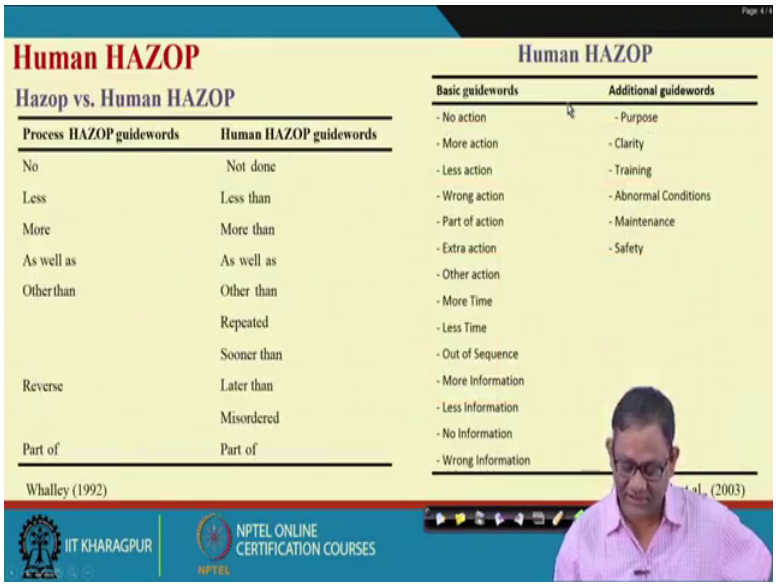

This is what is the work sheet given here, that action description, guide word, action and then action what kind of error, and then what are the causes and consequences like this. In FMEA what you have done there you found out what we what moods and here you are finding you to the deviation and more or less they are similar, but it d here we are basically using guide word. So, maybe more scientific way you can develop this ok.

So, I do not want to discuss the objectives and steps further, because these are similar to HAZOP study what you have done earlier. Now, I will show you some of the guide words for human nature, because the guide will be different than the process HAZOP. You see that guide words here. Process HAZOP words when you have discussed we have more or less discussed these are the things. Now, human HAZOP guide words no means not done, when a similar analogy less less than, more more than, as well as well as, other than other than, repeated, sooner than, something like this, reverse later than, misorders part of as it is part of ok.

So, because it is the human work so, your guide words should match with the human work the task human is performing elemental task. So, that particular task on close the valve it is not done ok. So, in case of HAZOP basically when you are talking about valve who there we go got the process parameters may be that flow so, no flow so, here it is not done.

So, then these are the basic guide words some more basic guide words given here no action, more action, less action, wrong action, part of action, extra action other action more time, less time. So, different guide words are given. So, my request to all of you, just do one human HAZOP test study, using this guide line, what you have to do, you do the HTA task analysis, find out the elemental tasks; at every elemental task you see that what are the guide words applicable, find out the deviations and then follow the normal HAZOP table.

Now, we will discuss something which is little higher than or more popular in human reliability analysis, the systematic human error reduction and prediction approach, that is known as SHERPA. This was developed by Embrey in 1986, Embrey 1986. So, we will see one case study using this also. So, we will spend some time here. What are the objectives? Objective: identify all human errors action errors related to the study object, their causes and consequences.

So; that means, we will. So, SHERPA has given in SHERPA we see that some of the error types. Actually, what happened during execution of the task? As is the probability and severity of the error identify possible recovery actions, that may present that may prevent the error from leading to significant consequences, decide whether actions are required to control the hazards, and if so, to identify ways in which the problem can be solved. Make operators ever of the hazard related to various actions.

So, these are the objectives. Now, you will find out the what are the typical walks it will be like this. First is action description, then what is the error, then what are the causes, and what are the consequences, whether recovery is possible or not, probability, severity, actions and then comments. So, we let us see that what are the different arrow types used in SHERPA and we will we will also show you one case study that we have done using SHERPA technique, but we will not describe the everything about the case. Whatever needed to for today's topic human error identification that part we described now.

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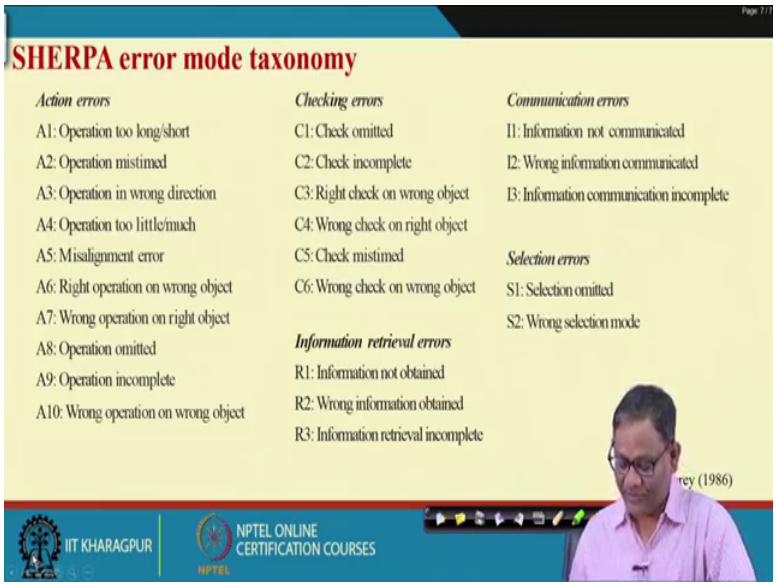

SHERPA taxonomy, error taxonomy has action error, checking error, information retrieval error, communication error, selection error. So, 5 types, again under action errors so, this many 10 different errors are given, under checking error 6, under retrieval error 3, communication error 3, and selection error 2. So, it is more or less sufficient. So, when you see any tasks people are doing elemental tasks you will find out that the error will fit to either one or more of the different types.

So, under action error operation too long too short, operation mistimed, operation in wrong direction, operation too little much too much, misalignment error, right operation in wrong objects, wrong operation on right object, operation omitted, operation incomplete, wrong operation on wrong object. Checking error check omitted, check incomplete, right check on wrong object, wrong check on the right object, check mistimed, wrong check on wrong object.

Information retrieval information not obtained, wrong information obtained, information retrieval incomplete. Information not communicated, wrong information communicated, information communication incomplete these are the communication error; selection error selection is not done or wrong selection done. So, that is selection omitted and wrong selection omitted. So, there in 10 plus 6 26 plus 3 29 32 34, 34 different error modes ok.

So, if you try to do human error analysis for your workplace people who are for the job, then I think this 34 error modes that really helps you and now we will show you how this can be used in a real case.

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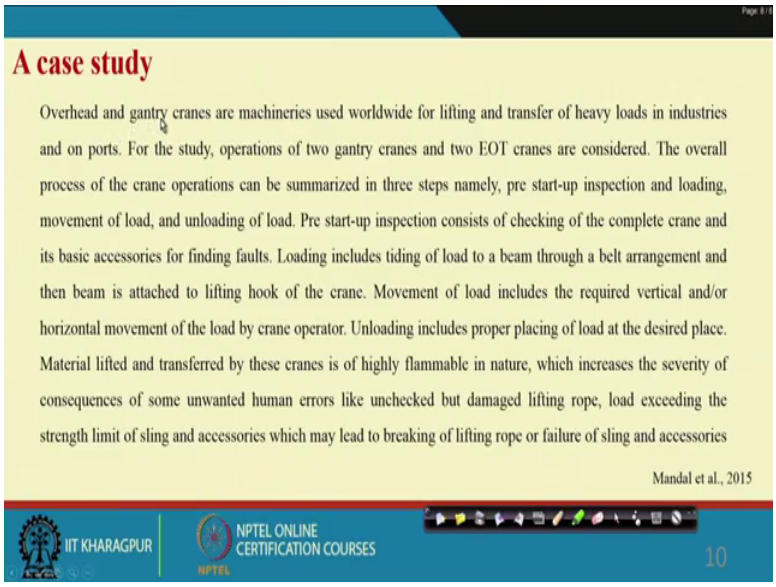

So, we have done a operation study on overhead and gantry cranes. So, let me read a read out this overhead and gantry cranes are machineries used worldwide for lifting and transfer of heavy loads in industries and ports. So, for this study operation of 2 gantry cranes and EOT cranes are considered and the overall process, how the crane operates what of the different stages of operation, and what are the ultimate elemental task. We will discuss in the next slide.

But, you all know that crane basically take the load transfer load from one place to another and an unloading in some other place are downloading point. And again during loading there will be lot of cell elemental tasks, transfer time elemental tasks and also when the unloading time minimal the task will be there. And, these are basically done by that operator will be there and helper will be idea. And, the facility under which the crane is operated that is also important, because it is facility design will may lead to safety and related problems. And, as well as because of this there can be human error or other way human error also can lead to safety problem.

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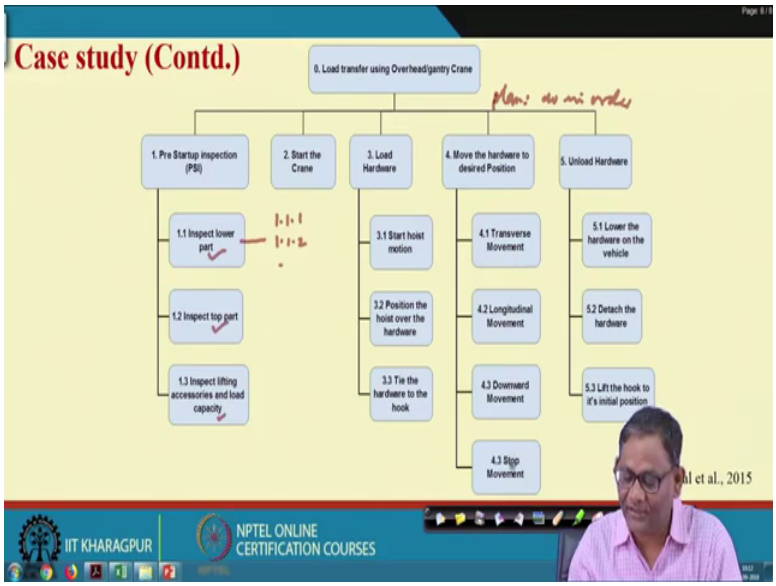

So, here load transfer using overridden gantry game, that is what we are showing here ok. So, first is pre start up inspection, start the crane, load hardware, move on the hardware to desired position unload hardware. So; that means, what is the overall goal overall good unload will be transferred from one place to another. So, then immediately what you are doing you are basically planning.

So, plan then what do you do first is inspection start then load the hardware move hardware from one place to the desired place and then unload hardware. So, in sequence you have to do. So, do in order. Then 1 2 3 4 5, now again what are the pre start-up of inspection by saying system is it clear is not clear, because you have to what to each to be inspected that is important. Then it is further broken down, inspect lower part, inspect top part, inspect lifting accessories and load capacity. Now, if you say no inspector lower part there are many parts.

So, then you have to further bro break into 1.1.1 1.1. 2 like this. So; that means, ultimately decomposing the overall the task to sub task sub task to elemental task ok. So, we have done this so; that means, here 1 2 3 here then here 3 4 5 6 7 8 9 10 11 12 13 14. So, like this putting a elemental task prepare.

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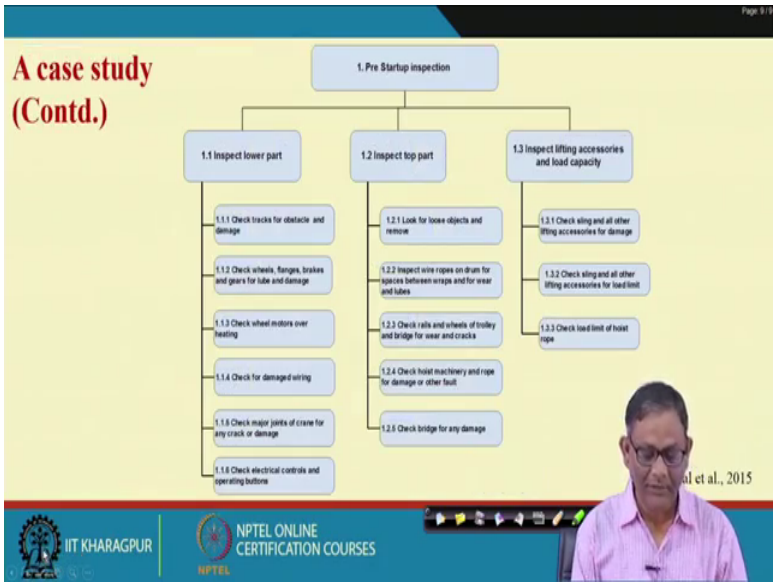

Now, again as I told you that that inspect the let me go back inspect the lower part. This one further broken down you see how many 1 2 3 4 5 6. So, if I if I say this is the main task, overall task, these are the sub tasks, this is sub task, then this is elemental task. If we do not further breakdown this to lower level so, the lower level I am telling the elemental task. So, in this manner what happened, the entire elemental task total elemental task we are computed.

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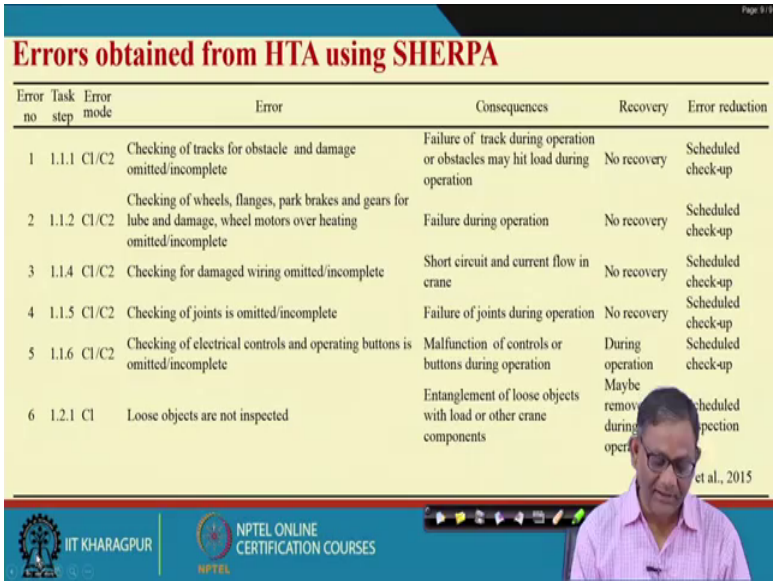

So, error number then task type error mode. Now, then what we have done basically. For every elemental task like 1.1.1, 1.1.1 check tracts for obstacle and or damage. Then check tracks for obstacle and damage omitted incomplete, this check is omitted or check is incomplete. So, it is basically checking error either omitted or incomplete.

So, from the SHERPA that taxonomy you know the task sorry you know the error mode from the SHERPA taxonomy, and from task analysis you know the task you compare the 2. How many that error modes out of the 34 error modes, how many are applicable for this particular elemental task and then accordingly you write? So, either it will be checking error, or it will be retrieval error, or it will be inspection error, or it will be action error or attribute selection arrow.

Then error consequence recovery, whether no recovery possible or not possible we have written no recovery so, that is what we have understood and then we asked the people, who were working there and supervisors engineers, and based on group discussions we have identified all those consequences. First we have done the task analysis and with the help of them we verified that, then we also shown them train them with the error modes, SHERPA modes then group meeting and finally, things were developed. So, it is required for human error identification.

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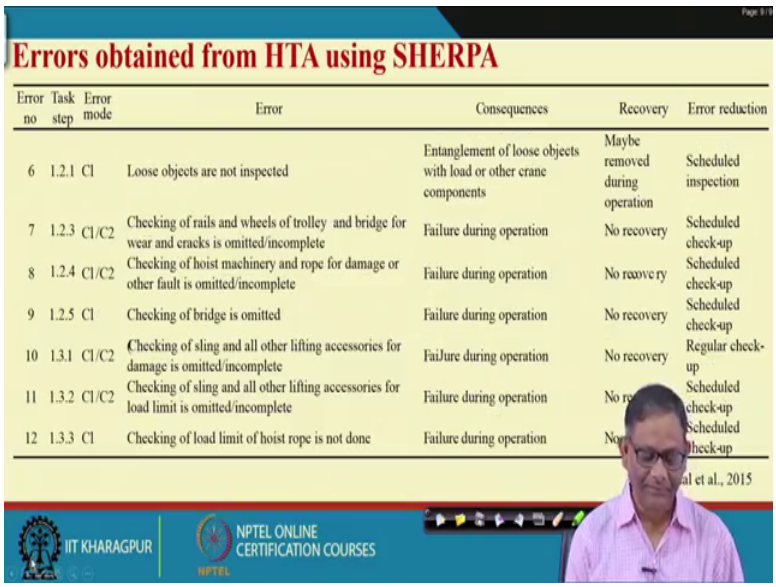

You see that all those errors are it is basically we have given 1.3.3. So, just a minute so, 1.3, the pre start-up of inspection, this one we have shown, but if you see that ultimately

the there are 1 2 3 4 5 sub tasks. So, under 1again 1.1 inspected power 1.2 inspect top part in, then 1.3 in spirit lifting accessories. This we have that 1.1 1.2 1.3 this we have further re described and finally, gone to elemental task to represent in this lecture or to present in this lecture. And, other things also we have done and it is available in this literature Mandal et al. The detailed analysis up to quantification it is available in this literature.

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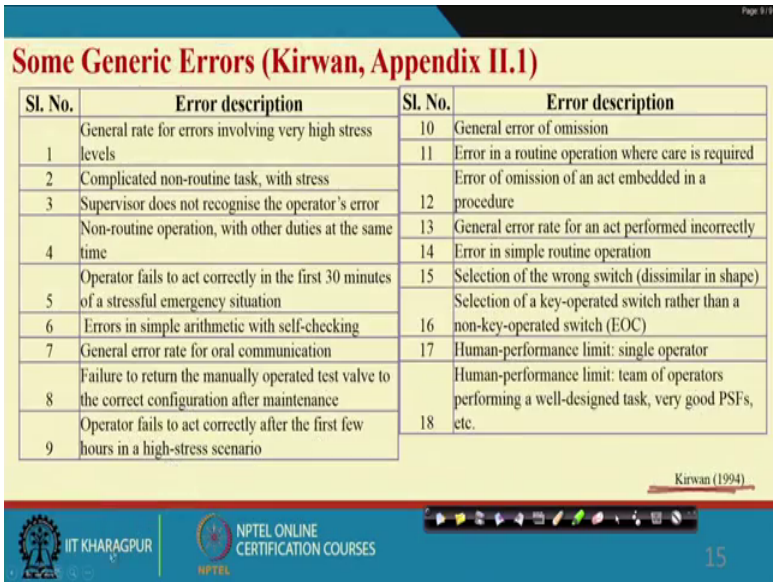

Now, I will show you that you can go through this book Kirwan a practical guide to human error analysis in appendix II, they have given different errors. In appendix II to 1, they have given the generic error some generic errors like; general rate for errors involving very high stress level, like your error in simple routine operation. And, their probability level also they have given.

So, they have not only described the errors they have given what is the probability of obtaining having that errors. So, you please you may go through; I am not reading out these things, but I have listed here just to tell you that that there are resources available. It is a fantastic book a wonderful book for human reliability analysis.

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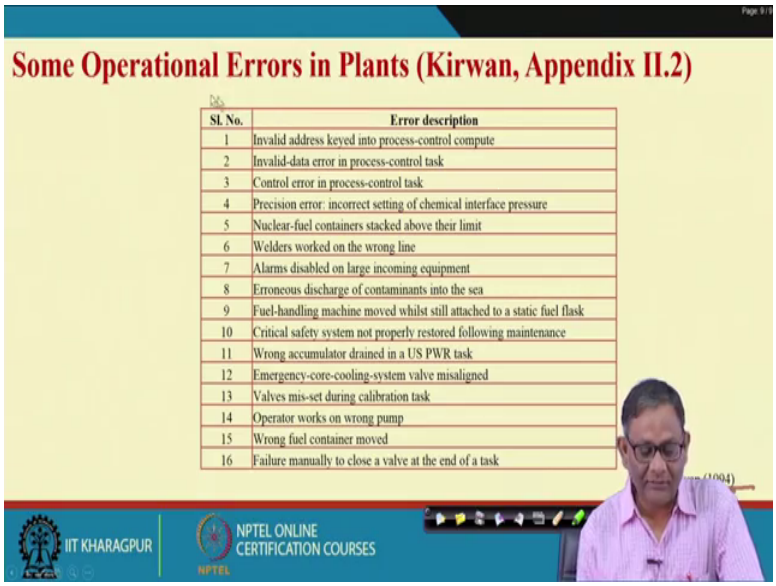

Then, they have given some operational error in plant in appendix II, like your control error, or like your precision error, like that welder walked in on the wrong line. So, the several 16 different errors are giving.

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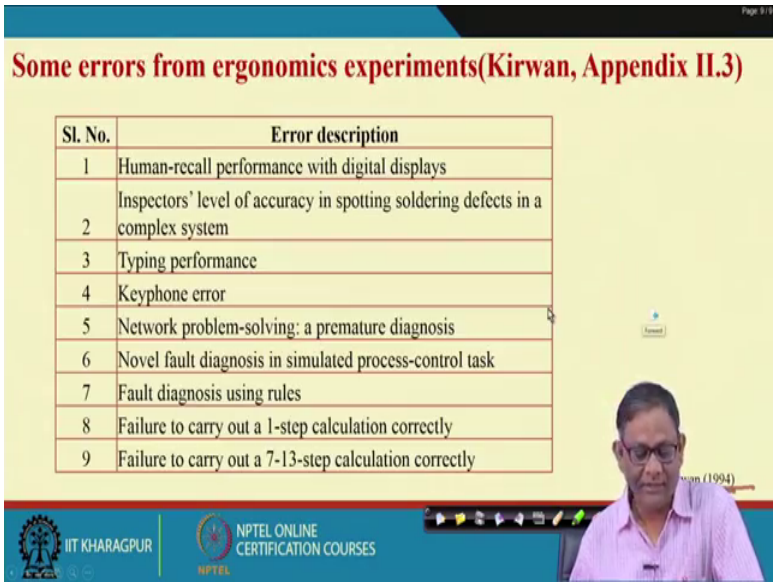

So, then some ergonomic experiments was were conducted by them and then also there also they put some of the errors from ergonomic experiments, typing performance, human-recall performance something like this.

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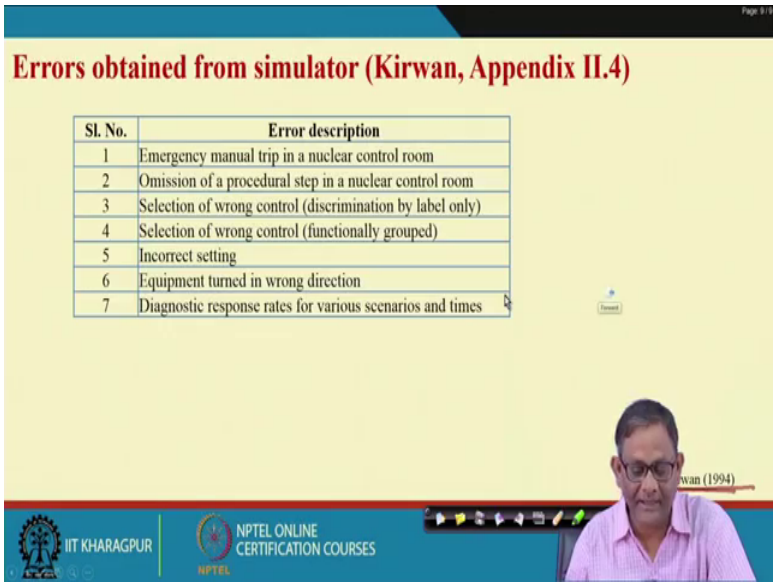

And, then they have also developed some simulator and from there also for a particular therefore, nuclear control room operations point of view, they identified simulation, they develop simulator and from there they have identified different kinds of errors. So, 7 different types of errors are given. In fact, in this book I have just the appendix II, I have shown here not the full appendix II, and just a that only the error types or error modes in fact error modes not error types error modes. And, he has Kirwan has given example against each of their own modes there in the appendix II and the probability of happening such errors also given.

So, it is a much more and the entire book is very lucidly explained. And, you all who are interested in human reliability analysis may go through this book that will help you. So, finally, I will show you the references what we have basically gone through.

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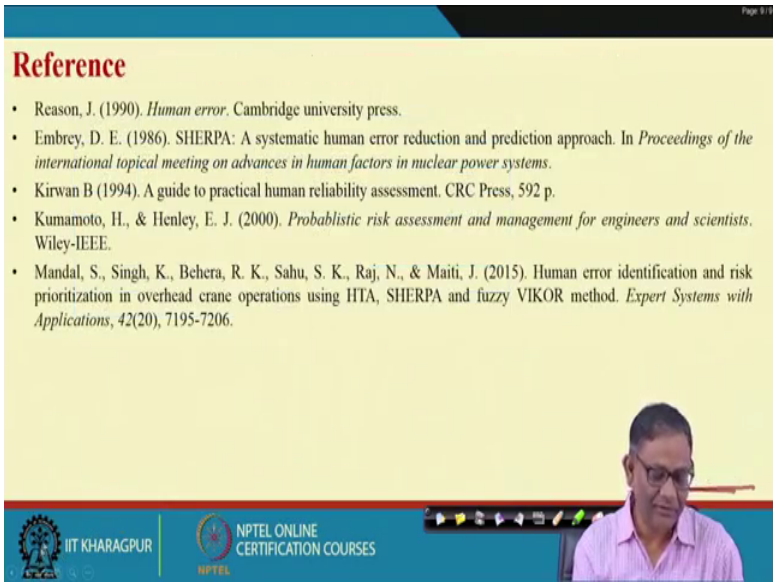

In my last 2 lecture I told you that this Reason Human error was main book and today I think therefore, SHERPA this Embrey this is a very good material, then Kirwan 1994 it is for overall human reliability analysis and understanding many of the techniques it is very good book.

Kumamoto and Henley also given one good chapter on human reliability analysis, and the case study I have shown a part of the this paper, part of this paper this is basically our paper. So, I hope that you got some information today, which will help you in practically doing human error analysis particularly in identifying the human errors. So, the analysis part will come soon and we will show you some of the more techniques and then quantification of human error.

Thank you very much.