Health, Safety and Environmental Practices in Offshore and Petroleum Engineering

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Module - 02
Operational Safety
Lecture - 15
Hazop III

Welcome friends to the online course on HSE Practices in Offshore and Petroleum Engineering. We are discussing lectures on Module 2 where we are focusing on Operational Safety. We are continuing with the lecture on Hazop.

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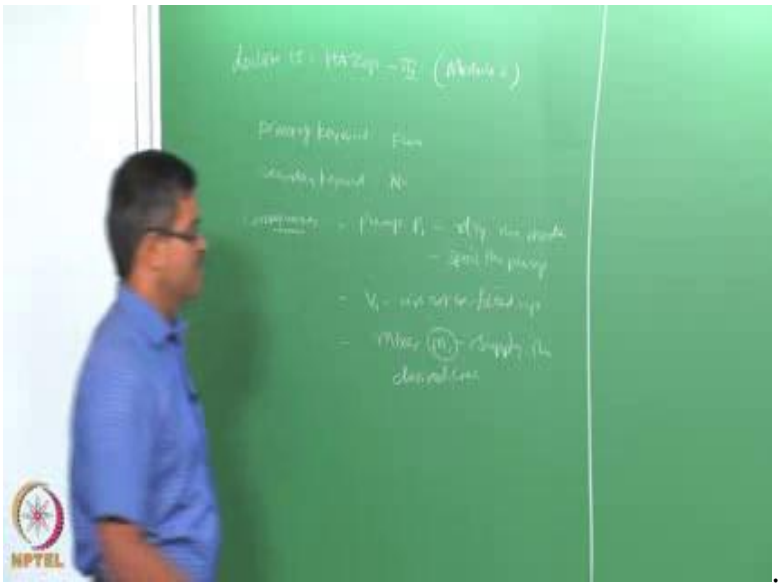

We are now looking at Lecture 15 which is titled as Hazop, the third lecture in hazop. Of course, this is the part of Lectures and Modules of 2 of HSE course at NPTEL IIT Madras. We will take up an example and see how a hazop report can be easily diagnosed. Friends please look at your screen now.

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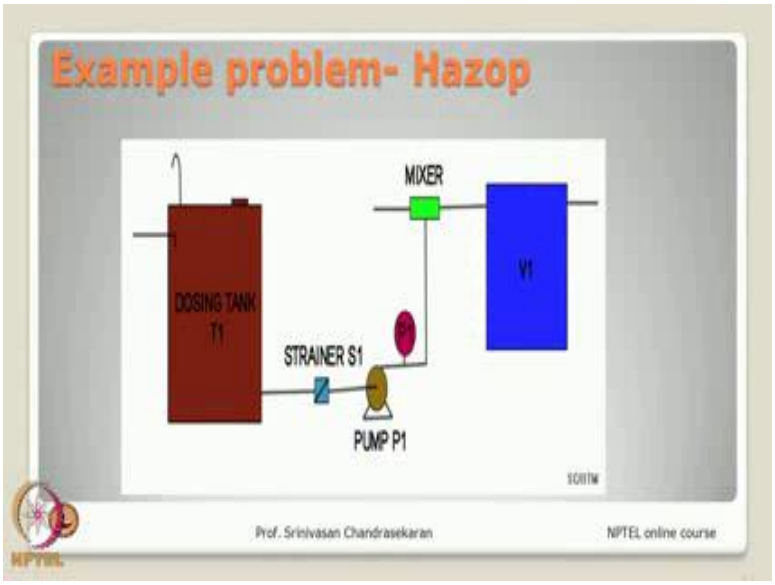

There is an example problem graphically posted in the screen, let us try to explain this first understanding the problem. Let us say, I have a dosing tank T1 which has a specific capacity which receives input for a specific line. So symbolic indication, this dosing tank T1 is now going to supply to the tank V1 through the strainer, because the dosing tank T1 receives input from some external source which may have some particles which may not be admitted or desired at the tank V1. Therefore, I put a physical strainer here which prevents the floating large bodies present in the chemical input in the dosing tank T1.

There are two reasons for putting S1 strainer here, because if these objects get pass through the pump then the working of the pump may be affected. Therefore, to safeguard the efficient working of the pump we also put strainer S1, so the strainer S1 prevents large physical bodies moving through the line which takes the line from the dosing tank T1 to the pump P1. Once the pump P1 is passed it pumps out the liquid from dosing tank T1 to the tank V1, while doing so the tank V1 also receives mixer from another line which is not passed through the pump P1 but through some other source.

So, the mixer takes gets off a proper proportionate mixing of the content coming from T1 and coming from this line and then the mixer is been supplied to the tank V1 which is then been taken out for further processing. So, it is a continuous process line at which

only small segment from the tank T1 till the tank V1 is looked upon for hazop study. So, our job is to first identify the design intent when the deviations are essentially the choice of primary and secondary keywords to be very specific to write this report.

Now, let us look at how we can write this report. Let us pick up the primary keyword as flow, because we need to actually ascertain a proper flow in the line so therefore the primary keyword is flow. The secondary keyword what we want to choose is let us say no, because if there is now flow in the line what would happen. Now there is no flow in the line there are many consequences. The consequences could be if there is no flow in the line if you recollect the figure what we draw or what we showed in the screen previously; the pump P1 will enter into a dry run mode which will spoil the pump, if there is no flow in the line obviously tank V1 will not be filled up.

Similarly, the mixer M1 will not be able to supply the desired concentration. Because mixer M1 supplies one external source mixes that with tank T1 and gives the mixer output to the volume or the tank V1, therefore one of the reasons, one of the causes.

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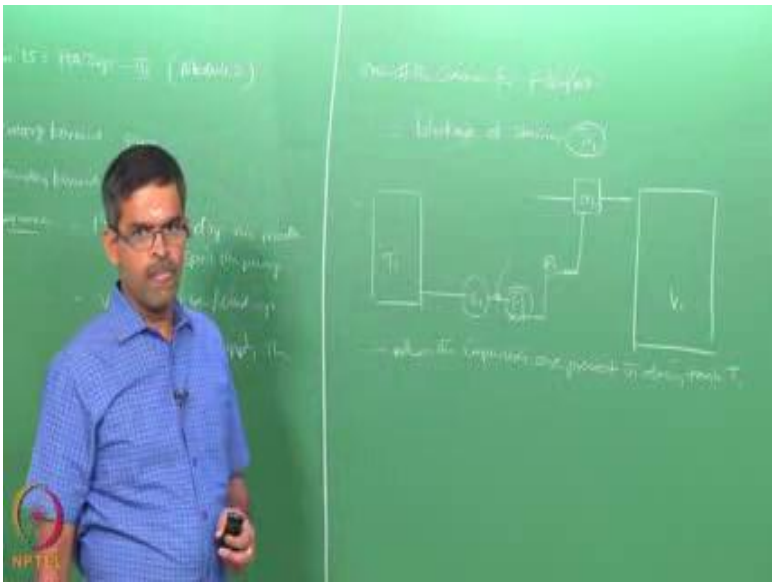

For flow no could be the blockage of strainer S1, if strainer S1 blocked obviously from the tank T1 the line has to pass through the strainer S1 then has go through the pump P1

and there the mixer M1 which this is another line and then sends it to tank V1 that is the idea, this is the pump. If the strainer S1 is blocked there is no flow in this line.

So, one of the causes for flow no could be blockage of strainer. When this will happen? When the impurities are present in the dosing tank T1; when there are more input present in the dosing tank T1 this will result in choking of the strainer S1, when the strainer S1 choked then there is no flow in this line it will result in empty run of the pump P1. It will also result in ineffective mixer of M1 as a result of which V1 will not receive the desired concentration as it should have been.

So, the consequences could be there could be an incomplete separation or improper mixing happening at the tank V1 which should otherwise get proper composition from the tank T1 and from the mixer M1. So, there can be additional cause.

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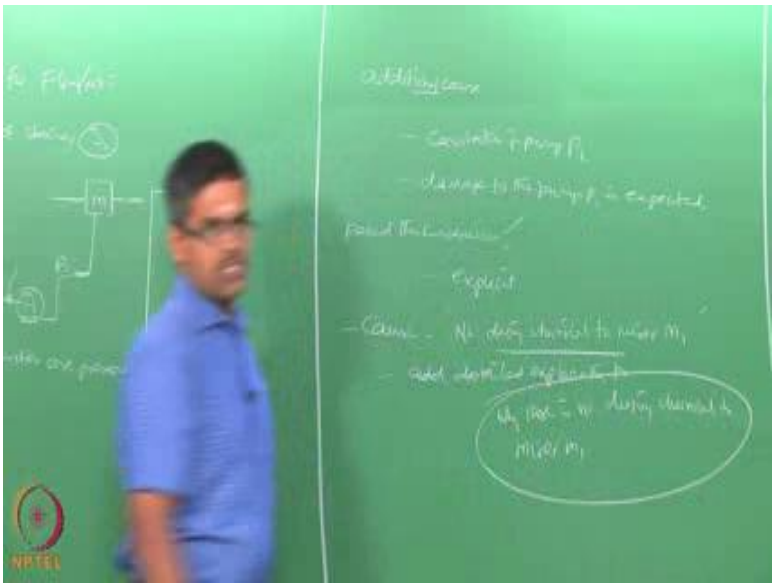

The additional cause could be it will result in cavitation of the pump P1 which could cause damage to the pump P1, so that could be the additional cause. Therefore, when you record the consequences in a report you should be very explicit in writing all details about the consequences. So, your consequences should be explicit arising from what reason why it is happening. For example, instead of recording no dosing chemical to

mixer, let us say you say there is the cause no dosing chemical to mixer M1. Let us say you want to write this statement. It means you are not allowing or you are anticipating that there is no dosing chemical in the mixer M1.

When assessing the consequences one should not account for any protective system or instrument which is already present in the design that is very very important. So, while writing no chemical dosing in the mixer M1 it is better to add detail explanation to why there is no dosing chemical. So instead of saying or instead of stating that there is no dosing chemical to mixer M1 always try to add elaborately. The reason why there is no chemical dosing to mixer M. When you record the consequences always be explicit, when you assess the consequences in terms of safeguards present do not try to take advantage of the existing safeguard present in the system in terms of let us say strainer S1, sensor, etcetera, because with all these present in the system you are identifying the deviation.

So, do not try to say sensor not working properly. That cannot be actually a consequence or cause for a function. You instead of that you to try to recommend newly included things in the design. Let us say I have a word like flow no which is been indicated by the hazop team for this example. The flow no can also be resulting from the second occasion the spurious closing of the valve which is activating to the pump view there can be a valve here. Let us say the second reason could be.

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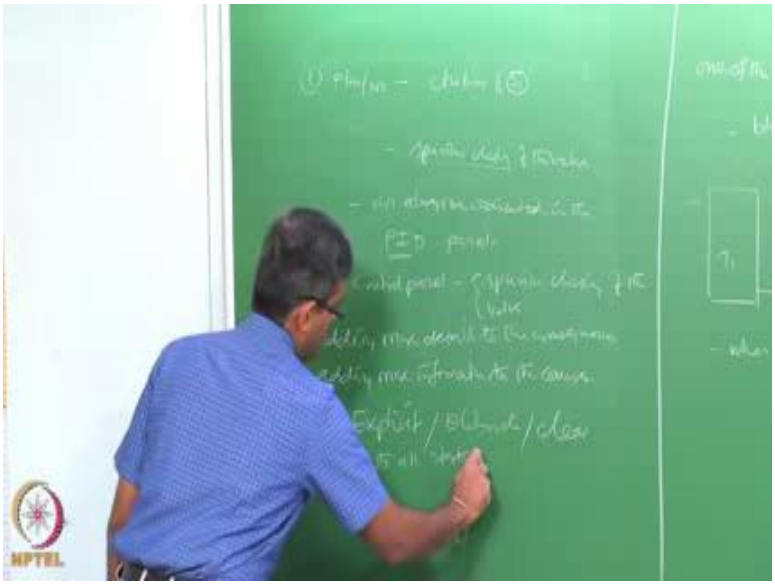

The first reason for flow no as we saw is because of choking of strainer; that is the first reason. The second reason could be spurious closing of the (Refer Time: 10:33), because there will be a control valve which will exit liquid from tank T1 and pass through the strainer to the pump P1. So, if you mistakenly close this valve spuriously then you can always say there is no flow in the line, but instantly and interestingly any spurious closing of the valve will always be indicated in the process intimidation diagram panel which is present in the board. So, the control panel will show that there is a spurious closing of the valve. This will be indicated, it will also show the physical questioning of the valve.

So, you cannot say this is one of the important indications as a recommendation report you will also account for additional safeguard in the given system. In this situation one may think of adding more details to the consequences, adding more information to the causes. So, your writing for hazop report should be explicit, should be elaborate, should be clear with all statements self explanatory that is very important. Let us look into the format of report.

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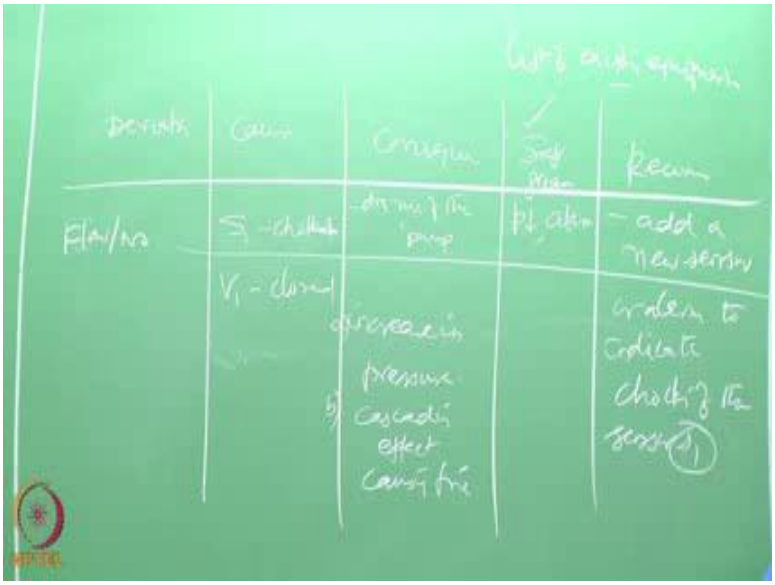

Let us say deviation, cause, consequence, safeguard, recommendation. The deviation is strainer S1, let us say flow no. The cause could be strainer S1 choked, valve V1 spurious closing. For each one of them one can explain the consequences when the strainer S1 is choked it may result in dry run of the pump. The safeguard is you can always say when the pressure in the pump is lowered there is an alarm which already existed; safeguards are the one which show list of existing equipments. The one what you want to add new should be record in the recommendation. So, recommendation can be add a new sensor or an alarm to indicate choking of the sensor. So, one can easily add few legible statements to improve clarity of the whole flow.

In this example under consideration if you look at the spurious closing of the valve which could result in flow no operations it can also cause increase in pressure. So, the cause could be increase in pressure also. Increase in the pressure in upstream line will also have a cascading effect leading to fire, so that can be a consequence a. B, can also lead to cascading effect causing fire.

Therefore, it is always better to add all additional safeguards in the recommendation column in spite of presence of alarm system which already existing in the given flow line, because with all these present in the flow line we are unable to maintain the flow

that is the deviation. So, we say flow no. So, it is always better to add additional safeguards in spite of the presence of the alarms system in the control room. Therefore, while recording hazop reports friends one should not take the credit of existing protective systems or instruments that are in place, but recommend additional alternate safeguards.

Therefore, any existing protective devices which either prevent a cause or safeguard the adverse consequences should be explicit mentioned in the hazop report. Safeguards need not be restricted only to adding equipments or hardware; they can also be restricted to or extended to giving sufficient training to people, because in case of alarm being activated in the spurious closing of a valve somebody has to physically close the valve if the valve is not operational automatically. Therefore, an intensive training given to the person of control board is also important can be also a sort of recommendation in this particular example.

So, if a credible cause results in negative consequence it must be decide whether some action should be taken along with its priority. Therefore, when you give the recommendation column you also have to give the priority of the recommendation which is fore most important, which is the least important. Similarly, when identifying the safeguards you must give acknowledgement to the one which is very actively present, the one which is not actively present. You must indicate all the presence of safeguard in the given system with all detailed explanations.

Therefore friends hazop report is a very elaborate report written on diagnosing a specific flow line which indicates all possible design intend and deviations and corresponding the reasons for the deviations which we say as the causes, and the consequences which are outcome of this deviation and how this consequences are generally addressed in the design in terms of presence of existing safeguards, and what you want to recommend in the hierarchy in the priority.

So therefore, it is felt that the existed protective measures are adequate if you feel so then in the safeguard or in the recommendation column you must write no action is required. So, a report should be complete you cannot simply live assuming to the reader the recommendations will became a part of the readers job. Why because, hazop report as I

said it is a legal document any recommendation suggested with hazop team have to be mandatorily followed by the company or the company has to give an explanation for not staying in compliance with the recommendation given by the hazop team.

So, the hazop team or the hazop report becomes a legal document. Therefore in any legal document which is going to challenge the safety practices of company should not have any ambiguous statements it should be always complete, so do not assume anything to be left over in any column if you feel so; the existing safeguards are sufficient enough to counteract the consequences or to address to the deviations possible then you must write here the existing safeguards are sufficient enough no new recommendations are made. You must explicitly say in the report which is very very important part of the hazop report.

So, when you want to record the recommendations then you must remember recommendations can be in the following two groups.

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Recommendations can be in two groups; one could be the action that removes the cause, the other could be that eliminates the consequences. Generally recommendations are suggested to address consequences. So it is always better to suggest recommendations

which eliminate the consequences, however sometimes they can have a direct impact on the causes therefore sometimes in general even addressing the recommendations which can lead to the avoidance and mitigation of causes is also better production.

So, if you do this in the first format this will lead to risk reduction, if you lead to the second format it will lead to risk elimination. So, it is better which way you want to suggest accordingly you must lay down your recommendations, but all the time you cannot always switch on to only one line you can have both set of recommendations in the given report. Some of the recommendations can address the cause, some of them may address the consequences; therefore a few of them will lead to this reduction, a few them will lead to risk elimination because risk and hazard are anyway combine as a coupled defect.

Therefore while recommending actions in the hazop report one should not always recommend for engineer solutions like, adding instruments, adding alarms, drip of switches, etcetera, because they will all cost to the production line number one. Number two, they cannot be added easily in the existing service name because you have to shut down the line to add in a deviation of drip of switches. Therefore, any failure of mechanical system should not resolve the actual hazard identified in the original process layout.

So, you must always give regards to the existing safeguard systems available, you must accounts of the working properly. Further compliance should be considered while writing the hazop report like, training the personnel, giving maintenance properly (Refer Time: 21:34) are added to it, maintenance are equally complicated and expensive therefore one has to be very careful in listing the recorded or recommended actions in hazop report.

So, friends in this lecture we have seen an example of hazop report. We have taken up a simple segment of a small process unit. We said how hazop report can be elaborated in different columns as you see here. We have also said what precautions you must undertake when you give list of recommendations whether they should address to risk reduction or they should address to risk elimination they are very important. I hope you

follow this. We will take up another example in detail in the next lecture to understand hazop report more in detail.

Thank you very much and bye.