Health, Safety and Environmental Management in Offshore and Petroleum Engineering

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Module – 02
Operational Safety
Lecture – 17
Hazop V

Welcome friends to the 17th lecture on module 2 on HSE practices and offshore and Petroleum Engineering.

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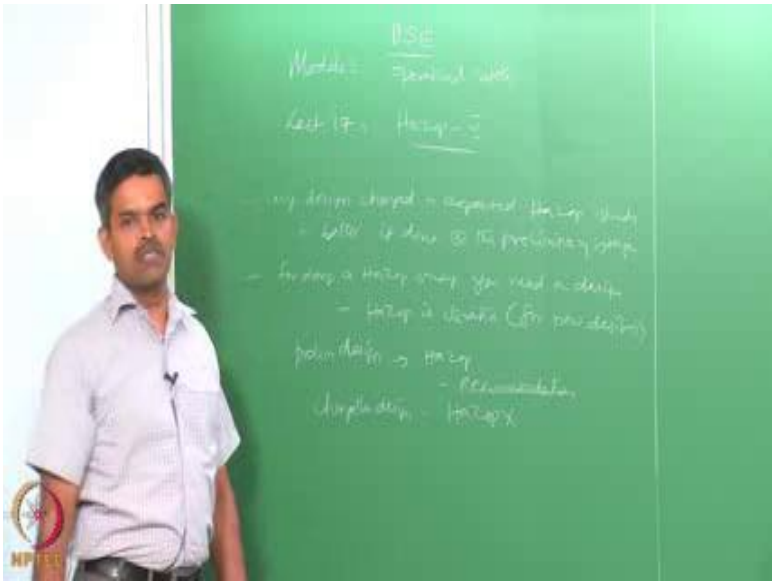

So, these are lectures on module two where we are focusing on operational safety we are talking about the 17th lecture where I will continue with the hazop study. So, I call this as as hazop 5 the 5th lecture in hazop as we discussed in the last lecture we have seen at what instances at what conditions hazop studies are generally carried out. It is interesting that when we want to make any design change then hazop study is better if done at the preliminary stage.

But interestingly you know for doing an hazop study we actually need a design now as we said in the first point hazop study is done only to make changes in the design therefore, to some extent you know this looks like it is iterative, especially for the new designs. As we first said in the last lecture itself you first do a preliminary design, conduct an hazop, list recommendations, which will amount to change the design, so change the design what I should say update the design, but no need to do hazop back again, as long as all the recommendations are actually implemented in the new design there is no need to look back again an hazop report and study therefore, a good hazop study will always land up in a revised design which is much improved than the original version of the design and it will not cause to any much that is very important. So, as a compromise, hazop study is usually carried as a final check, when a detailed design is completed, that is the practice what is being done in oil and gas sector.

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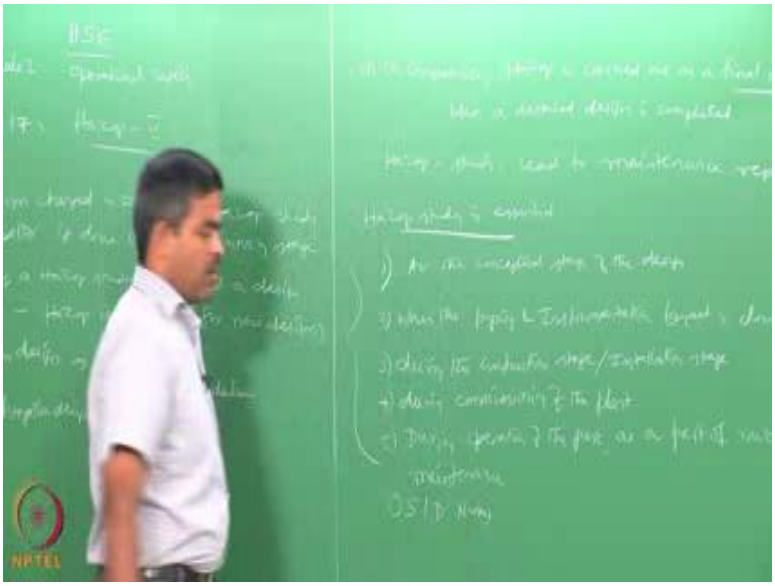

Hazop study is can also be conducted on an existing facility as a part of the maintenance problem. So, hazop study can also lead to maintenance reports there are some explicit situation where hazop study is mandatory let us see when hazop study is very essential. One at the initial conceptual stage it is important, it is also done when the piping and instrumentation layout is done. It can also be done during the construction stage or

installation stage because any final changes which are desired to be made based on the recommendation of the hazard can be even done at the installation stage itself.

The next could be during commissioning of the plant, next could be of course, during maintenance of the plant during operation of the plant as a part of routine maintenance. So, these are the 5 levels at which a hazop study can be conserving to be mandatory. Of course these are all recommended as mandatory by OSID norms oil safety industrial directorate of course, the last one is mandatory, the earlier once can be optional if you really wanted to revisit the design in safety perspective of course, this is mandatory you have to conduct hazop study at periodic intervals which is a part of the maintenance program which are routine program in a given sector, an oil and gas industry is mandatory. So, once in a year are preferably once in 6 month hazop study are generally reported as the part of the routine maintenance in a oil and gas sector.

There are types of hazard which can be conducted.

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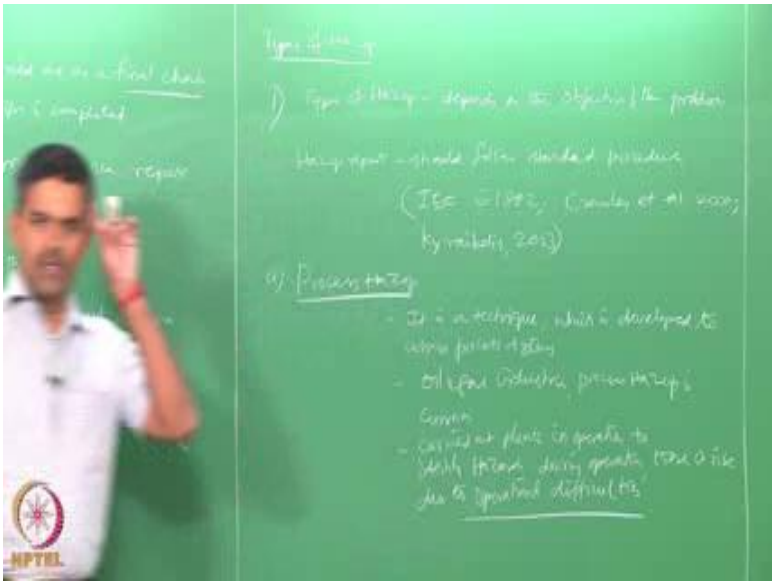

One can be, let us say the hazop report or the types of hazop, depends on the objective of the problem. Hazop report of course, should follow standard procedure all steps should be completed in a proper form so that hazard report can accept. So, these steps are

explained as we discussed in last lecture in different references, depending up on the applicability the hazop can have different types let us say the first one could be what we call as a process hazop. Process hazop is actually a technique which is originally developed to assess plant and process system.

It is quite commonly practiced in oil and gas industries in oil and gas industries, process hazop is quite common. So, this the study which is carried out on, plants in operation to identify the hazards, during operation, those arise due to operational difficulties it is very important.

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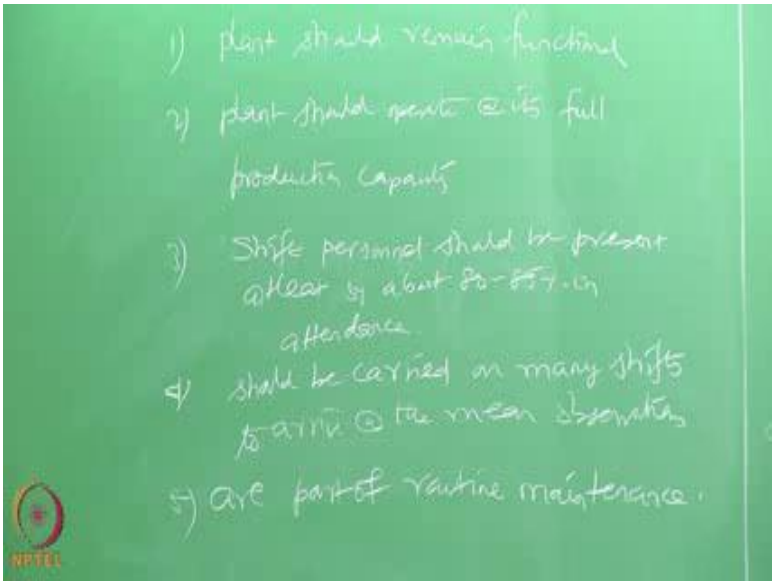

So, operational temperature weather pressure etcetera, to carry out process hazop, what data is required one the plant the process plant should remain functional the plant should operate at its full capacity. 3, shift personal should be present at least by about 80 to 85 percent in attendance, it should be carried out on many shifts to arrive at the mean observations. Generally such hazop reports are part of routine maintenance. The 2nd type of hazop report is human hazop.

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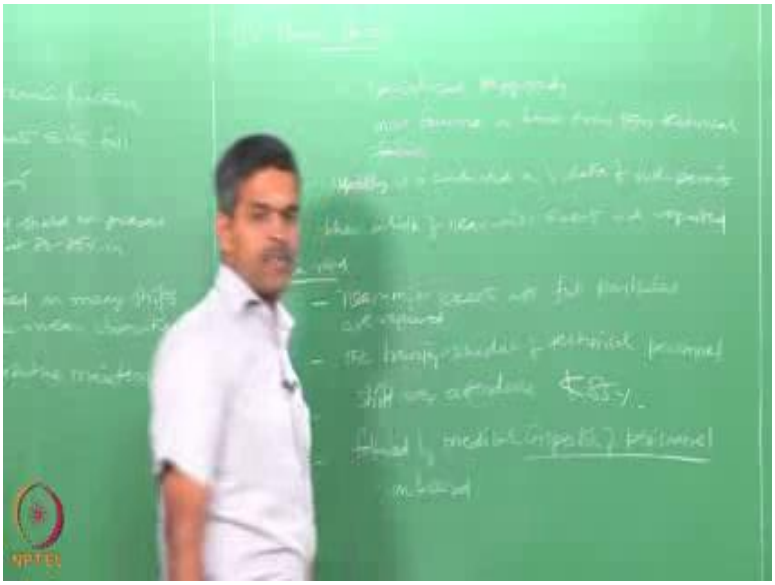

It is a specialized hazop report it is more focused on human errors than technical failures. Usually it is conducted only on violations of work permits, it is also conducted when near miss events are reported, and these are instances where human hazard is conducted. Now what is the data required to conduct human hazop, human hazop is conducted only when near miss events are reported therefore, near miss events with full particulars are required along with this.

It is also important that, the training schedule of technical personnel is also required, in addition, the shift over attendance should not be less than 85 percent, otherwise, you cannot conduct a human hazop. Fourthly, human hazop should also follow, followed by medical inspection of personnel on board, to understand the physiological physical and social characteristic of the person, who is involved in the whole production line. It is important that human hazop is generally followed by a medical inspection also of the personal team. The third variety of type of hazop is what we call as procedure hazop. This is the hazop which generally done to review this carried out to review the process procedures.

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It is also useful to review the operational sequence. Sometimes this is also called as safop - which is safe operational study. This is generally carried out when there is a major deviation in the production line. Data required to do this hazop detailed process and instrumentation diagram that is old and new with modifications - detailed process and flow diagram old and new with modifications. Material inventory, which means the chemical physical properties of the material involved in the production line, shift over personnel should not be present, where lower than 80 percent people should be available online. Plant should operate at its full capacity.

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The study should be conducted, during different shifts, to obtain the mean recommendations. Details of near miss events should be available. So, these are the data is required to conduct the procedural hazop. The other type of hazop is what we call software hazop.

As I told you earlier, most of the process in instrumentation is inter linked using sensors and their control using software on the central control board. Therefore, people generally inter link the sensor, like fire alarms, pressure gauge, etcetera using sensors which are recorded which are inter connected, may be with wired or wireless using the software. Sometime the software can also go wrong. So, one has got to really control and assess the probability of the software not being properly updated or not being properly interpreted. So, software hazop essentially is used to identify possible errors in the development of the software itself. It is also useful to analyze the hazards that may arise because of failure of automated control system. So, failure of automated control, which are generally rooted through software can be accessed using a software hazop.

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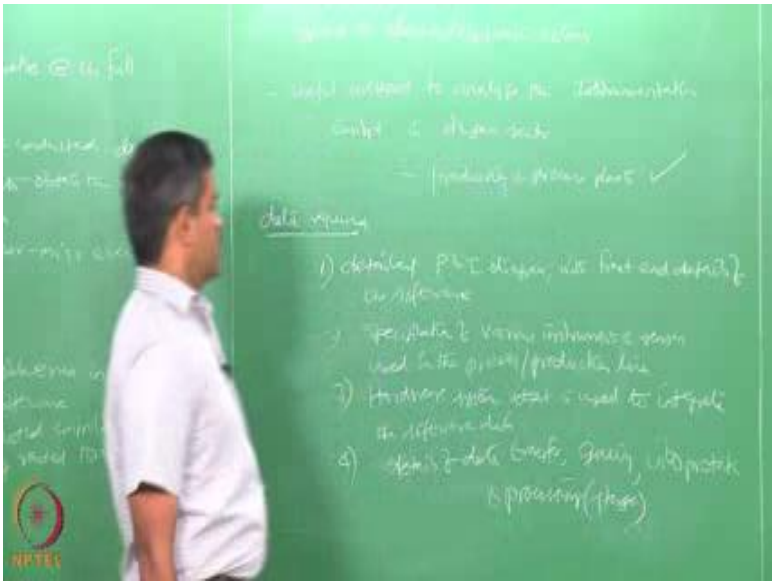

It can also be applied to all electric systems. This is a very useful method to analyze the instrumentation control, in oil and gas sector. Especially in the production and process line, it is a very commonly used hazop study. So, there are different types of hazop, depending on the objective what we want to conduct, the data required for this kind of hazop study. One detailed process instrumentation diagram, with front end details of the software, specification of instruments, various instruments and sensors used in the process production line. Hardware systems used to integrate the software data. Details of data stalking, data transfer, queuing, interpretation and processing, including storing. So, these are all detail required to perform a software hazop. So, there are different types of hazop which can be performed depending upon the very objective of why we want to conduct the hazop.

So, hazop studies are generally conducted to improve upon the existing primary design. And the revisions can be easily made in the design without costing much. They actually illustrate the seriousness of hazards present in a given system under operation. Because operational temperature and pressure or the operation wear and tear of the system can always cause serious hazards, which cannot be envisage during the design stage itself. Material specification can go wrong. Equipment specification can also exceed the

threshold limits of the equipments and machineries, which can lead to some kind of hazard situations.

So, all these put together will be seen in different types of hazop including the proper working of software inter connectivity with the hardware, with that of networking of sensors, alarms etcetera. So, hazop study is actually a technical look out of what could go wrong, how it could go wrong, if it goes wrong what would be the consequence, what are the reasons and factors making it to go wrong, what are the safeguards which are present in the system which will overcome the difficulties arising when it goes wrong, and if they are absent if they are insufficient, what would be added to the existing process production line, so that the process production line can be more made more safe.

So, the recommendations will end up in making hazop study. And of course, as we all now know and agree strongly hazop study reports are legal documents and in fact, legal compulsions for people to follow and they should be adopted. In fact, a follow up hazop report can always question the recommendation which are over ruled by the executive authority, and seek explanations from the company for not following the recommendations made by the hazop team. So, hazop reports are legal documents which can be waited, which can be challenged, and if over ruled can even become primitive.

Oil and gas industries do follow this rule very stringently therefore, many of the accidents which are very serious in nature or easily avoided therefore, we know the oil and gas industry sector is very powerful towards safety practices, because their hazop tools are very highly practical and very efficient. Because hazards can always be perceived and if at all they can be prevented risk will never occur. However, we will keep in mind at the back track that oil and gas industries do allow basic level of risk acceptance because any risk which is impractically correctable, or which is very high to make it zero risk, is not actually practiced in oil and gas industry. So, therefore, hazards are looked into in detail and then maturity of these hazards with the consequences looking very severe, which arise in to risk will all convert and will all be consider in a detail design.

After said this lets us say we will take up an example for a life problem, which has been done biased with team of hazop on a group gathering station. I will not able to disclose the location of these strategic reasons, but; however, the plant remained functional when the study was conducted. So, we are now looking at hazop study of a group gathering session.

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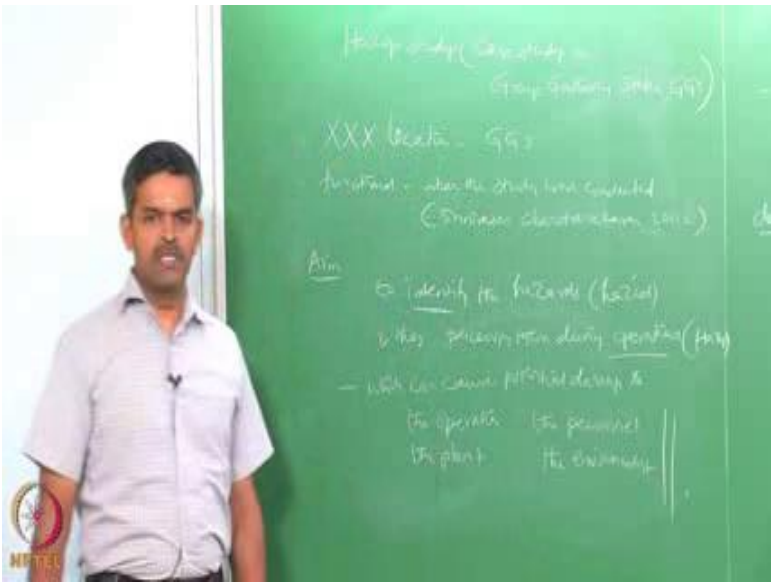

So, there is group gathering station which is located at XXX location which is considered for the study I will show you the layout of the GGS now the plant remained functional when the study was conducted. More details can be seen at Srinivasan Chandrasekaran 2011c, as a reference given in the NPTEL website. Of course, we will discuss it very briefly here. I will show you the hazop report generated from the software what software has been used I will discuss there. Now what is the aim of this particular study, the basic aim of this particular study is to identify the hazards essentially. It is a hazard study and of course, then and then perceiving it during operations therefore, it is a hazop. To identify the hazards during operation this can cause potential damage to the operation, to the plant, to the personnel, to the environment.

So, all were looked into in the specific type of study which we now discuss in detail. So, the main objective of the study is to eliminate or reduce probability and consequence of incidence.

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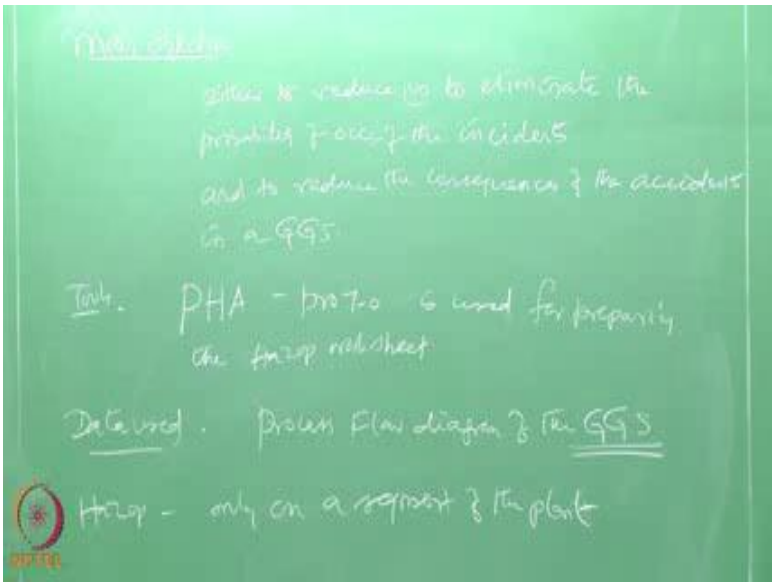

Occurrence of the incidence and to reduce the consequence of the accident, if it occurs, in a GGS that is the objective of the study the software, used what we say tools PHA pro 7.0 is software used for preparing the hazop, work sheet has shown in a specific example. What the data used data used is the process flow diagram of the group gathering station, which I will show in the screen now. However, I will also explain the brief working of the group gathering station and hazop is done only on a segment of the plant which is discussed. The whole hazop of the plant is not discussed, here only a small segment of the plant will be illustrated to the reader now.

So, let us look at the screen now.

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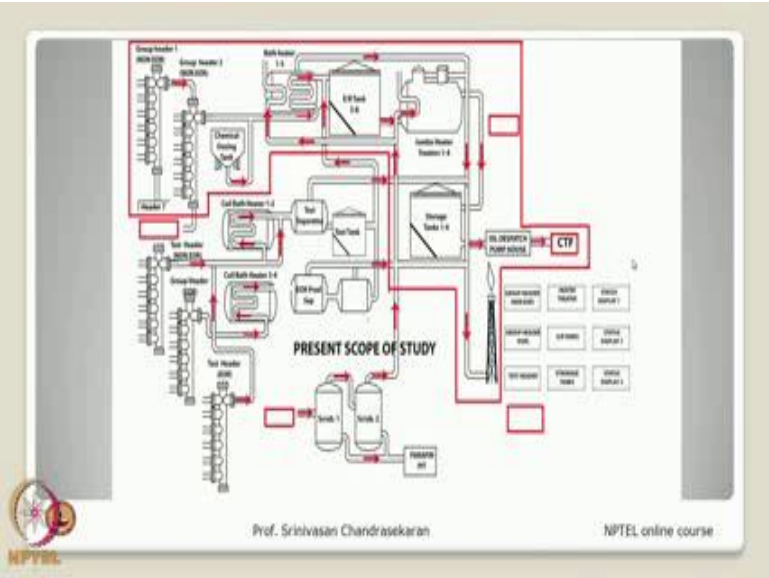

Friends please look at the screen here. The screen shows a group gathering station process and flow diagram. So, to do an hazop analysis we need to understand this pfd. Let us try to understand this. There are many group headers classified as group header 1 and group header 2. 1 is meant for non EOR, other is also meant for non EOR. There are two different group headers. It means the supply line to this group headers are from non enhanced oil recovery lines.

So, the production line can be from 2, one is from the enhanced oil recovery lines, one can be from the non enhanced oil recovery lines obvious this chemical engineering you will agree that the process line which leads chemical or the crude form enhanced oil recovery line has a different kind of process compare to that of non EOR. So, these are group headers which are connected to non EOR. There are header 1 header 2 here shown. There are many such headers available. There are total seven headers in this group. Each one of them is the pipelines which is receiving the crude oil from the non enhanced oil recovery sector.

Once the crude oil is from exploration site, it is passed on to the bath heater there are five in number I have shown a schematic line only here. The remaining 4 are back of this is aligned in the same line. So, there are 5 bath heaters the purpose of the bath heaters is to

separate oil, water and gas present in the service line. Once the gas is separated by a chemical treatment here, the gas is taken out from this line, is goes to the flaring stack.

So, once the gas is separated the gas is escaped from this line, and taken to the flaring stack here and is burn off. So, now, it contains of course, partially mixture of oil and water. This is now sent to the ER tank. We call this emulsion recipient tank there are 5 to 8 numbers of this tank kept in series which receive the content from the batch heater. The bath heater transfers the mixture of oil and water to the enhanced, sorry, the emulsion recipient tank. The emulsion recipient tank does further processing and separate oil and water further. The water separated is taken to a fluent treatment plant, and treated separately and deposed off to the environment.

Now, after the emulsion recipient tank, basically you will get only the oil which is free from gas and water. The oil is further transferred for storage, and it is taken to the jumbo heaters treated further chemically, and then transferred to the storage tanks, from which the commercial product is sent to the central transfer form. The CTP is indicated from where it is pumped to the sites. Now let us look back the red segment which is only considered for the hazop study now. So, I am looking only the part of the problem the whole layout is continuous from the left to the right I am looking only to the segment. The segment shows the group headers supplying oil to the bath heaters. The bath heaters separates gas send it to flash tank. Oil and water is further send to emulsion recipient tanks. Further treated, water separated sent to a fluent treatment, plant chemically treated and disposed off. Oil is further send to jumbo heater theaters treated further and then the oil is send to the storage tanks, from there send to central storage form, from where it sent the commercial product.

So, this is whole problem. The red one is the present scope of the study. So, now, let us look at how will handle the whole problem. So, to understand the hazop study it is important to know the functionality of the whole system. We have seen the process and flow diagram. We have also tried to understand the important equipments instruments present in the whole flow system through PNID diagram. Then we will try to write down the hazop report for this. So, let us reiterate the process how it was working. The fluid from the emulsion recieved at the GGS ends is distributed through the production

manifold. From the main grouper header, well fluid gets into the bath heater theater for the first stage of separation of oil gas and water. The separate oil is subsequently passed and stored in emulsion recipient tank, which we call ER tanks.

Now they are associated with the gas tank. The gas is separated out and taken to flash tank for burning the gas. The separated water is taken to effluent treatment plant where it is further processed and then disposed off. It is moved from e ER tanks the oil is then fed to the jumbo heater theater, where it is further refined the feeding is happening through feed pumps. In jumbo heater theater further separation of oil and water takes place, separated oil is then sent to CTF which is called common tank form, from where it is sent to the commercial market the process line is shown to you on the screen which you saw just now.

Let us quickly see what is the methodology we are planing to adopt for preparing the hazop report for the study.

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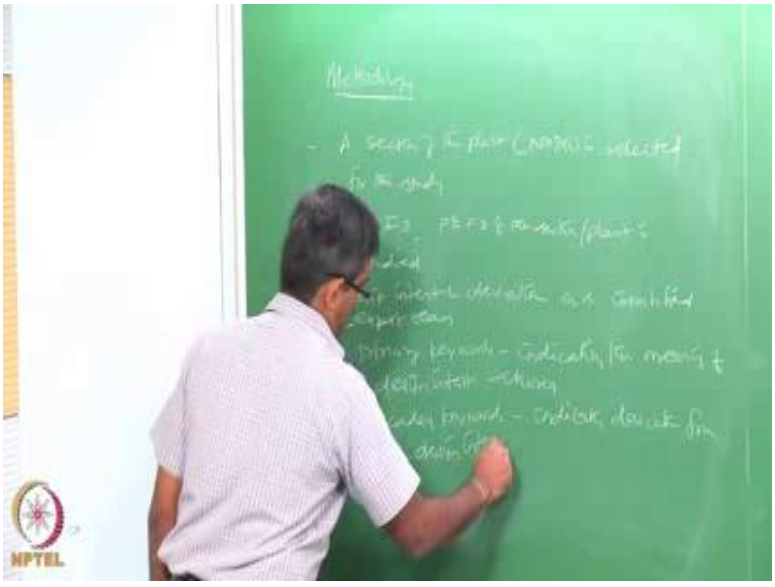

First only a small section of the plant, we call this as node is selected for the study. The process instrumentation diagram, process and flow diagram of the section and the plant is studied which I showed you. Design intent and deviations are identified with help of

expert team. Primary keywords indicating the meaning of design intent are chosen and predefined. Secondary keywords indicating the deviations from the design intent are chosen, their combinations are declared in the beginning of the study.

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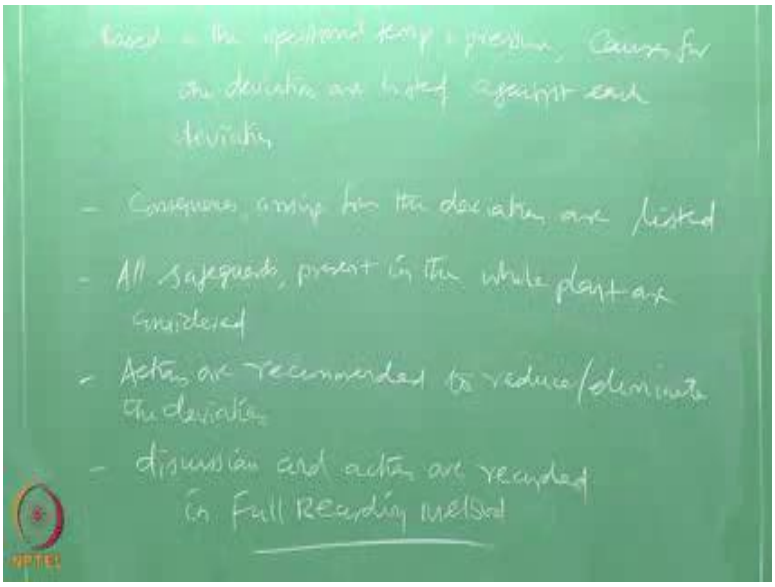

Based on the operational temperature and weather and pressure, causes for the deviations are listed against each deviation. The consequences arising from the deviations are listed. I should say or perceived listed all safeguards present in the whole plant are considered, not the segment.

Actions are recommended to reduce or eliminate the deviations. Discussions and actions are recorded in full recording method. So, this is the steps adapted methodology adopted for this. So, in the next lecture we look at the hazop report. Try to understand each one of them in detail and try to infer certain decisions and discussions from the report, which is meaningful for the given problem.

So, friends in this lecture we try to understand what are different type of hazop, what are the objectives of various types of hazops, how they are conducted very briefly, what are the data required to conduct different types of hazop etcetera. So, we will look into a discussion of hazop report of a practical problem which we did in the next lecture.

Thank you very much.