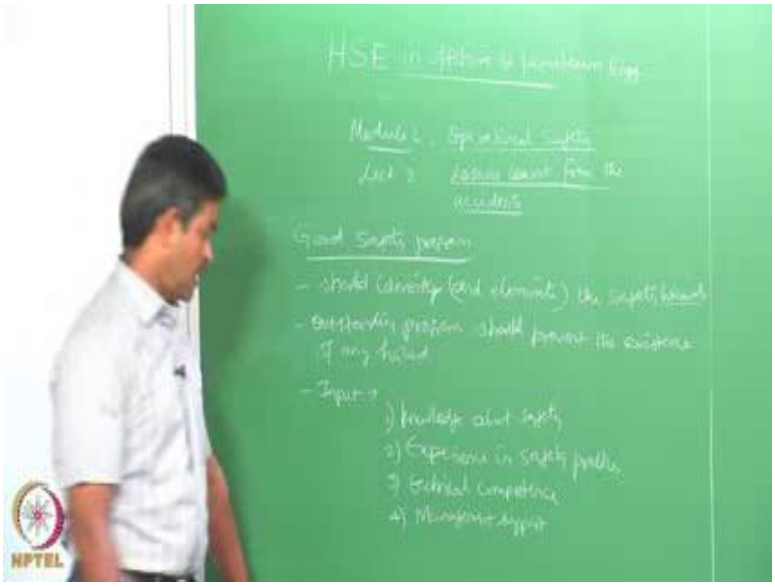
Health, Safety and Environmental Management in Offshore and Petroleum Engineering

Prof. Srinivasan Chandrashekaran
Department of Ocean Engineering
Indian Institute of Technology, Madras

Module – 02
Operational Safety
Lecture – 03
Lessons learnt from accidents

Welcome friends, to the lectures on second module, on the online course title HSE Management in offshore and Petroleum Engineering. We know that in our module 2, we are focusing on lectures related to operational safety. In this lecture which is a third lecture in module 2. We are going to discuss about some lessons which, we could learn from the past accidents. We just happen in oil and gas sector, we already said in the last lecture that rule based regime and the alternative methods could lead to certain converging ideas in terms of establishing or assuring safety. So, now, let us ask you question.

(Refer Slide Time: 00:56)



What should a good safety program have? Because once we know what are all the contents a good safety program should have or should be present in a program then, violation of this could lead or must have lead to certain accidents, which are remarkable accidents in oil and gas sector which will discuss in this lecture.

So, good safety program should identify and eliminate the safety. Others please understand we are talking not about the risk; we are talking about the scenario. In the scenario itself the safety program should address. Therefore, prevent the existence of the hazard in the first place itself should prevent the very existence of hazard of any hazard in the first place. So, therefore, what should be the input for such type of program? You must have thorough knowledge about safety which we are intending to learn to this course, we should also have experience in practising safety. One should of course, have a technical competence in implementing the safety programs. Of course, one should have management support, if the client or the user is not interested in implementing or realising the importance of safety you are good, you can never survive and of course, over all there should be a big commitment to safety this very very important.

(Refer Slide Time: 03:17)

So, one and all including the employer and every employee should realise that safety should be inherent path of the business of day to day life. So, commitment safety is very important. Now the difficulties a good safety program has a great demerit what could be seen as a major disadvantage in a good safety program, it is very slow to response any milations will not cause immediately effect on reversing the safety program.

Therefore, safety program is always intended to react very slow the second issue is, it gives very less emphasis on continuous revisions. Let us say continuous updates this is one of the greatest demerit which has been filled in oil gas industries, which is initiated,

thanks to the government sector and the private operators overall in this business for many years as realised that each and every employee including the top level management must undergo a safety program at least once in a 6 months period or at least once in a year as a minimum requirement update the latest technologies and tools in terms of assuring safety and identifying and removing a managing hazards.

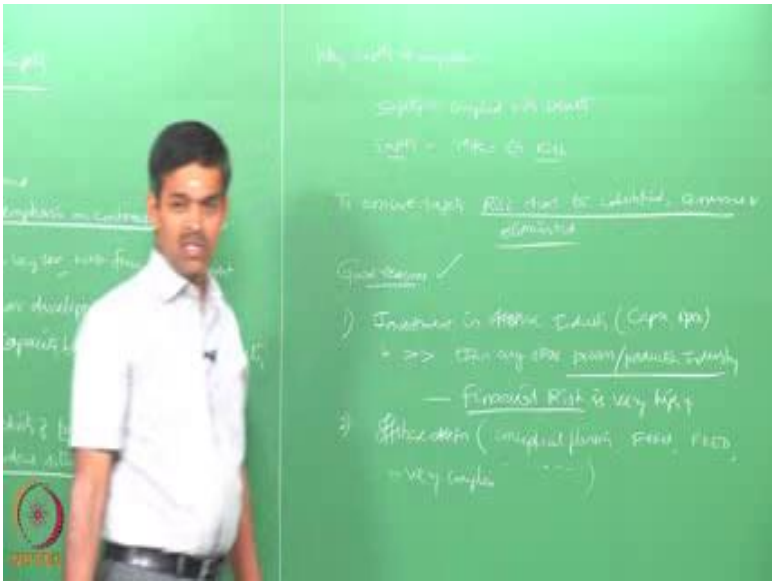
The third issue is very serious for countries like Asian countries like India where, population is very high and technical man power is available or excepted to be available in abundance. It has got a very less work force involvement because, people strongly believe that safety can be ensuring by mechanical means that is.

For example, you can put sensors you can put fire alarms, you can put fire detectors you can put smoke detectors you can also implement certain control mechanisms in the machine, which can implement safety automatically that is not the case that cannot be the case because, under survives you have a technical support, which really reacts this kind of indication because in certain cases, Wherever accidents have happen in oil gas sector all this alarms sensors, where found to be failing because the first thing which happens is an electrical short circuit in case, which will make all these mechanical and electro mechanical devices in operative therefore, a person or a personal or a team should be completely train in adhering to safety practises that is very very important.

So, man power development towards safety program, what we call in larger brackets as capacity building is very important towards safety then the question comes what is safety. I mean what are we talking about is it safety of human being along working in the plan is a safety of employer, whose investing money in the plan is it safety of the equipments, is it safety of the environment is safety of the societal responsibility, what we are talking about safety is a health activity of preventing from, being exposed to hazard a situation, that is a general definition, given by international rules or ISO safety is a health activity of prevention from being exposed to hazard a situation the keywords, you can please see here preventing to get exposed from hazard a situation. So, safety is coupled with health, all the time that is why the program is called health safety and environmental. So, health and safety go together of a human being they go together they are coupled together they cannot be separated.

The moment you say safety is ensure, you ensure also that the working environment is healthy. So, therefore, by remaining safe the disaster consequences can be avoided thereby; can result in saving of human live plant and environment, where the industry is located. Now, the question is very clear why safety if important why are we bother about safety.

(Refer Slide Time: 08:55)



Safety is important because naturally, any living creature around the world prefers to be safer, rather than risking the life for unfavourable conditions. So, inherently everybody is psychologically inbuilt to be remain safe and nobody wants to take risk this is true, even in the case of machineries. So, the term safety always refers to risk it is a term, safety is coupled with health, that we have learnt term safety always refers to risk also this is safety risk is also in held, that is why safety programs are generally assessed using risk analysis tools.

So, when the chances of risk are becoming higher than the situation is set to be highly unsafe. Therefore, risk as be assessing and eliminating to ensure safety. So, to ensure safety risk has to be lets, say identify assessed and eliminated that becomes very important. Therefore, one can say a good safety programs should focus on assessing identifying and eliminating risk present in a given situation. However, if you look at the definition classically in ISO safety does not refer to this it refer to hazard a situation

please understands. So, the very objective of a safety programs is to identify, the occurrence of risk.

Even before it becomes a risk, because we already know from the previous lectures risk and hazard are classically different though one follows the other. So, now let us see important of safety in offshore petroleum industries. So, we all know that safety should be assured in offshore petroleum industries because, this is one sector which is highly prone to hazard a situations because of the nature of business.

Now, I can give you 2 good reasons for practising safety, 2 good reasons for practising safety one very important may be disagree able of few of you, but still it is very important it is actually the life practise what people will be focused in at least in oil and gas sector investment in offshore industry, I am talking about both capex and opex operation and capital investment. So, investment in offshore industry is several times higher than any the industry please understand this. So, this industry is involved with a very high financial risk. So, please understand my safety programs should not only take care of the health safety of the human being and personal. It should also take care of the economic investment otherwise the business cannot survive, the second reason could be offshore designs right from the planning, let say the conceptual planning development of the structural form let say the front and engineering and analysis erection commissioning etcetera offshore design in every stage is very complex.

So, how does it count for safety since the design is very complex, it is not easy to reconstruct and exiting facility Bhattacharya at 2010 a and b.

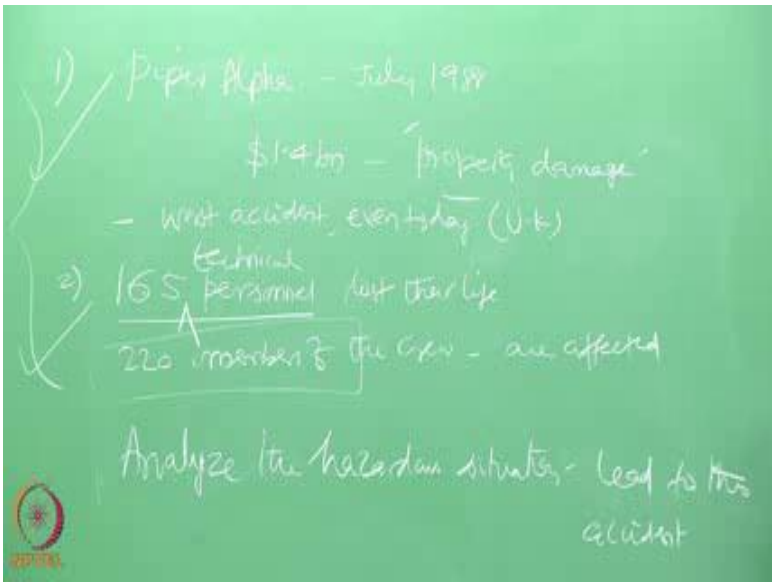
(Refer Slide Time: 13:36)

It is not very easy to reconstruct exiting facility because the designs are innovative sites specific function specific economically driven dominated I should say. So, put together we can say offshore platforms are custom designed in sense you cannot recreate or reassemble or re plan an invest on such platforms which have been put to use. So, 2 good reasons investment is very high designs or innovative.

So, one has to go to really ensure safety in offshore industry prior to analysing safety, one should understand the key issues in petroleum processing in production safety can be ensure only by identifying and assessing hazards. So, the for more step in safety identify or identifying and assessing hazards I can put more specific in each and every stage of operation, these also inherently says the back feed loop that hazard is present in every stage of operation identifying and assessing an hazard can be done in 2 ways it can be done either qualitatively or quantitatively both are QRA.

So, qualitatively can also access hazards what we call as Hazop studies quantitatively, can also hazard or analyse hazards which we call as risk assessment, because risk has to deal with the number, which should say what is the probability of accidence of this number or this value in terms of accepted goals having said this let us talk about some lessons what we could learn from accidents.

(Refer Slide Time: 17:05)



I am going to pick a couple of in accidents which is happened in oil and gas sector, where the diagnosis is available and people all are aware, but; however, it is important for me to reiterate this. So, that people get this capture of idea in one short in the middle of the lecture. So, they realise that accidents or they happened because of vibration of good safety programs. Let us quickly see what are responsibilities of different personal before and after accident, why such accidents have happened can these accidents be avoided if at all they have happened what are the consequences. Lets us talk about the hazard scenario and the risk evaluation both together in this example. We all know a classical piper alpha, which is widely very spoken and read and learnt and understand derivarated in many congress in petroleum engineering, happened in July 1988 in the for most issue, when we talk about this particular accident is the financial loss occurred to the investor.

The financial loss was estimated then approximately about 1.4 billion US dollars. So, very high value in terms of the original campus investment because, persons or companies or organizations are the nations together invest on this kind of innovative structural system, only as a development towards the economic growth. If any such situation happen which leads to our financial disaster this will not only effect the growth of the company or the nation, it will also affect the global standards of a economy because oil in price high and lowering causes rescission or enhancement or financial weakness, which is being felt realised understood and experienced by every citizen of

every nation in this world, over all using oil as one of the important commodity further industrial development, where in India nation countries for sure this is un replaceable sector.

So, when such high investment is being at stake, which as cause a financial damage what we call as property damage, which is the one of the important issue. One can immediately ask me sir, safety program is related to health, health means it is attached to human, but we are focusing on the financial part, please recollect one of the important reasons why safety is important and necessary in offshore industry? Is offshore industry is dealing with very high investment and as a very high financial risk? So, in any safety program, if your program does not analyse assess the financial risk caused because of the consequence. If the incident of the accident then, that is not a good risk analysis or it is not ensuring a good safety. So, we are talking about the financial risk first. So, property damages assess to be then in this time about 1.4 million dollars US dollars this is considered to be one of the worst accident even today in UK.

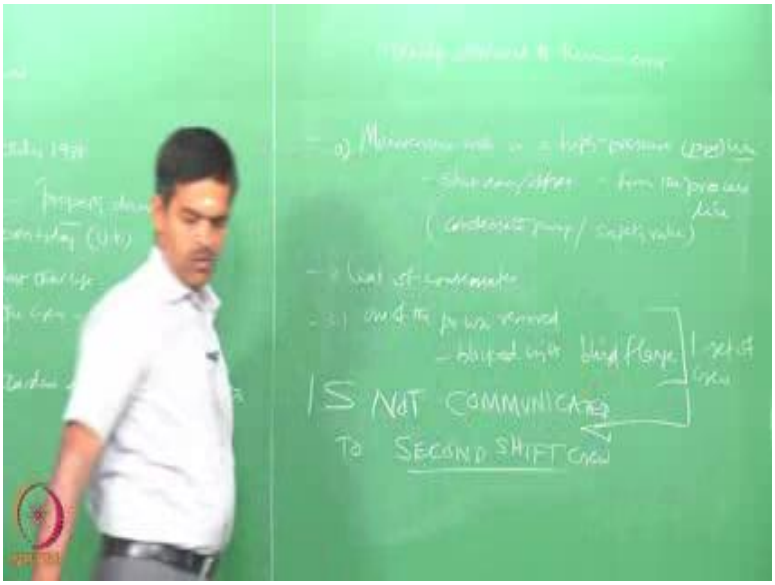
Now, let us come to the second argument about 165 people lost their life a crew of 22. I should say are effected by different manner. So, there is a potential there is a potential of human health loss, there is a potential of financial loss. Now let us focusing on this specific part it is not their 165 personal, who ended with the life, it is 165 technical personal each one of them who has lost the life for experience training towards safety programs to replace this or this set of people and the set of crew to develop confidence in them that, no such accident who repeat or reoccur is very difficult as engineers as technicians as managers as economist. When we read such incidence and understand the reality behind them no one of us could come forward to really work in such worst scenario because we always think will our life be at risk.

If such a occur a instant reoccurs will our life be at risk. Therefore, as a public as an employee as an environmentalist as a government authority even as a common user we would like to know what are those steps the company or the investor or the employer as taken towards ensuring my safety. So, crew to look at it in general we should say what are those situations which has occurred or which a resulted in such accident. So, that is an engineering analysis an economic will also like to love to look at that because we should always address in avoiding in depleting eliminating or controlling those scenarios.

Therefore, safety programs the post investments of any accidents will always teach a lesson towards about safety programs in improving the tools of analysing the hazard situation. So, that two issues here great loss of human life which is non replaceable irreparable we all agree we feel very sorry. In fact, we salute all those people have been responsible for sincere working towards the particular production of the industry and we feel very, very sorry that we are not, we learnt from the news that this gentleman or this set up people and where people have been effected because of accident. So, as an engineer what is our role.

Let us try to analysis the scenario which leads to this accident they says the analysis says it was mainly attributed to human error.

(Refer Slide Time: 24:59)



This was of course, a very big eye opener in the operational industry to revisit safety issues based on such incidence coating this as a very evident example, all safety programs where revisited by different organization and safety became a very top priority in terms of the management policies. So, let us quickly see what happened here the maintenance work where going on a high pressure pipe line let us say so; obviously, when you do a maintenance work on a specific line the line will be generally shutdown or off set from the process line from the main process line using what we call as a condensate pump and the safety value we use this of that analysis to isolate the line from the main process line because, the production cannot stop; obviously, in offshore designs

you will always notice the process and flow line will be design in such a manner that no single life line will be actually meant in the design there will be always alternatives because of 2 reasons; 1 during maintenance you need to have an alternate line, 2 during due to operational safety you may not close down all the lines because the pressure the line will get build up in the input source.

Now, interestingly let us see the maintenance work was been carried out as a part of the system since this condensate pipe and safety value was closed this lead to leak of condensate. So, since condensates got leaked that pressure wall was removed one of was removed interestingly remove a wall or a condensate pipe or the condensate pipe you generally blocked. It blocked with your blind flange that is what we generally do more interestingly this operation carried out by one set of crew is not communicated to the second shift crew.

(Refer Slide Time: 28:53)

So, let us say the main difficulties or let us say the main source is your bad shift over. So, I should associate this only as a human error whether the error comes from the managerial side direct comes from the employee side does not matter I put all of them as human error equipments plans has nothing do with your bad shift over let us again continue. So, one crew in the earlier shift who did the blind flange remove the p v the safety wall from the condensate pressure line was not communicated documented to the shift.

So, without knowing this the new crew or the second shift crew turned on the pipe line turned on the i, let say alternate pump thinking that one of the condensate pumps was in damaged because of maintenance problems and they switched on the other one. The moment they switch on the other one the blind flange which is not supposed to be design to take away the pressure created by the pump failed. So, firewalls fail resulted in high pressure I mean very high pressure leading to several explorations not one.

So, now, what all mathematical tool you have to study the explorations the atmospheric pollution the mathematical way of finding out the distance at which the exploration or the pollution could reach the land will all go in way, if we do not have a basic plan it means here the main reason can be associated to lack of safety training the intensifier explore due to failure in closing of the flow line of the gas from the tartan platforms to be very specific. So, the tartan platforms flow line was closed which are resulted in this unprecedented accident.

(Refer Slide Time: 31:40)

Now, the fundamental question comes can this be avoided, we all know that yes it should be avoided, but this was actually negligence I should say let us say over sight. So, safety training to personal is very important now there is a mechanical failure which is happened subsequently now automatic fire fighting systems remain inactive since there where diverse working under water before this instant happen.

So, when the human person is involved in maintenance work you do not switch on the automatic fire fighting systems you have to do it manually. Therefore, the primary source of these incident arrows essentially from human error which essentially occurred from lack of training in shift hand over this is one of the very serious issues after this very significant and stringent changes have been made in the offshore industry with regard to the safety management regulations and training with effect only to this incident.

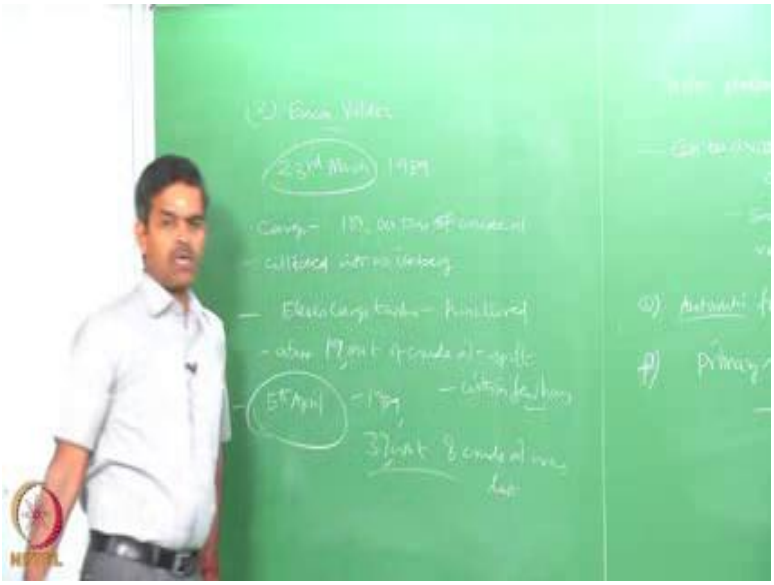
So, gentleman though decision is very bad to really know it is occurred result in a very high financial and human lost; however, this incident or accident has given a very interesting and important on vital lessons lesson to all the offshore engineers from which one can learn that how violation in simple terms, negligence or over sighting etcetera can cause devastation a small error can pile up to end up in a disaster. So, each one of us is responsible for ensuring safety in such situations. So, please look at the screen now there one image showing the piper alpha disaster.

(Refer Slide Time: 34:59)

There is a tartan plant symbolically shown where, the gas line exploration was realised and the fire is spread and see a devastating exploration and fire occurred is resulted in very serious consequences for the industry for the environment for the country and for offshore oil and gas set in total.

The second case study which we will discuss will be the exxon valdez.

(Refer Slide Time: 35:38)



Very interesting very informative many of us have read this and we all know this, but still let us again diagnose what could be a new dimension for this particular accident happened on twenty third March 1989, which is under way from Valdez Alaska, which is happened on a Cargo. The cargo was carrying one 80,000 tons of crude oil this collided with an ice berg which resulted in this accident. Now 11 cargo tanks got punctured within few hours about 19,000 tons of crude oil spilt within few hours. We just caught cost a very serious environmental pollution by the time the tanker was refloated which happened on fifth April, we can see the dates of course, 1989 about 37,000 tons of crude oil was lost. You can see the commercial loss the hard work done by the people for exploring this crude oil is also lost and it also resulted in very serious environmental consequences.

So, now is got very indirect consequence let us see what is that?

(Refer Slide Time: 38:07)

About 6600 square kilo meters area of the fishing around near the site had (Refer Time: 38:18). So, it is coast a very serious environmental damage to the ecosystem. So, the size of damage was the size of spill was very, very high it happened a remote location therefore, the resque operations in industrial effort to control the spill was actually inactive not very effective; if you look at the screen now.

(Refer Slide Time: 39:16)

You will see the picture which is depicting the Exxon Valdez oil spill from the specific vessel which has caused serious pollution to a very large area which is effect in the fisheries.

Interestingly the data show that the spill resulted in about 20 to 25 percent of the capacity of the tanker is lost. Therefore, friends we must agree that safety should rather play an important role in offshore industry because, we do not want any financial risk in the business it will affect the economy. If the nation will want any loss of life because they are technical people who are responsible for supporting and improving the economy of the country though oil exploration and production and processing.

We also want to be sure that if you want to join this business or this sector in the future want to run this want to lead this, we should ensure that our safety is also taken care of and as a good citizen as a good contributed to the global economy being an engineer and scientist. We must ensure that the public the society and the environment is completely safe even though I intervene with environment to make my business because, oil exploration is intervention with the environment we are exploring oil from this event. So, even though intervene with the nature, but; however, my business is going to remain safe which cost no hazard situation we have to practise this. So, for practising this learning tools or secondary the primary things is feeling the importance.

So, safety assurance is a feeling it is not education it is to be practised not to be learnt it is to be felt not to be advised it should be realised without seeing it. It should have it should be followed without challenging its consequence; however, please understand and remain noted that offshore industry still have certain risk acceptance levels that is important you cannot reduce a risk to 0 percent there are always some situations where, the investments towards risk reduction are becoming highly impractical. Therefore, do not attempt to make the hazard a situation completely 0 or the risk to practically to want to be adamantly 0, there are always acceptable risk levels do there is always a small compromise made. However, what is a level what is the acceptance criteria who fixes this we will talk about this in certain case studies and examples in the coming lecture.

I hope this lecture was interesting and you could understand the diagnosis of these 2 events, how it was very important to really realise and feel why safety program is

necessary. We also learn what are the 2 factors and many factors contributing the good safety program, why it is important after all? What is safety? How you define safety?

Thank you very much.