Bulk Material Transport and Handling System
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Lecture – 56
Safety Aspects in Bulk Solid Handling and Transportation

So, for welcome boys we are now, coming to the last module of our discussion. In our discussion on the bulk solid handling and transportation we have discussed that different type of bulk materials different type of your industry different operations that is involved in handling this bulk material crushing screening. And then we have discussed different mode of transportation whether it is by truck or locomotive or by trolleywear system or by pneumatically or hydraulically we have introduced number of concepts which are used in bulk solid handling and transportations.

Now coming to the conclusive chapter of on this learning process and you are more or less if you have spent time on each and every module you are now, ready for serving the industry in that sector. But for that what is most important in working in industry is safety maintenance and monitoring. And we will be discussing in this lesson this module the safety maintenance and monitoring along with some of the latest development which has come in automation that we will be concluding our in the last lesson.

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Now, today we will be discussing the safety aspects in bulk solid handling and transportation. Now, safety means what and the safety is that is our without any disruptions when we can

work the disruption should not be there in the machine disruption should not be there in the persons who are working with the system or disruption should not be there in the services rendered. So, and that is why and this exactly get disturbed whenever in our common language we say whenever any accident takes place in the industry in your operations.

Now, this disruptions by accident what is this and then how our safety get affected that will be discussed. So, that after this discussion you should be able to define what is mean by accident identify the causes and effects of different types of accidents and describe the approaches of safety management in bulk material handling and transportation. So, in that this is a vast area each and every type of operations they have got depending on the technology deployed.

The arrangements made to manage the safety will be different. However there are some basic concepts that we will be discussing today why you can see in this figure that when you are working in a mines there sometimes your that whole high wall may collapse and you can see in this figure a truck is below this hole the brushes it has got buried. There is case there is many places a dump truck has got totally burnt out and you can see a conveyor belt they got caught under fire.

So, such types of things are hope though it is not a common nowadays it can be controlled by proper engineering. So, but thing is that all the technology of bulk material handling what you have studied. So, far they can lead to an accident or a breaking of safety if you are not following certain norms in while delivering the services.

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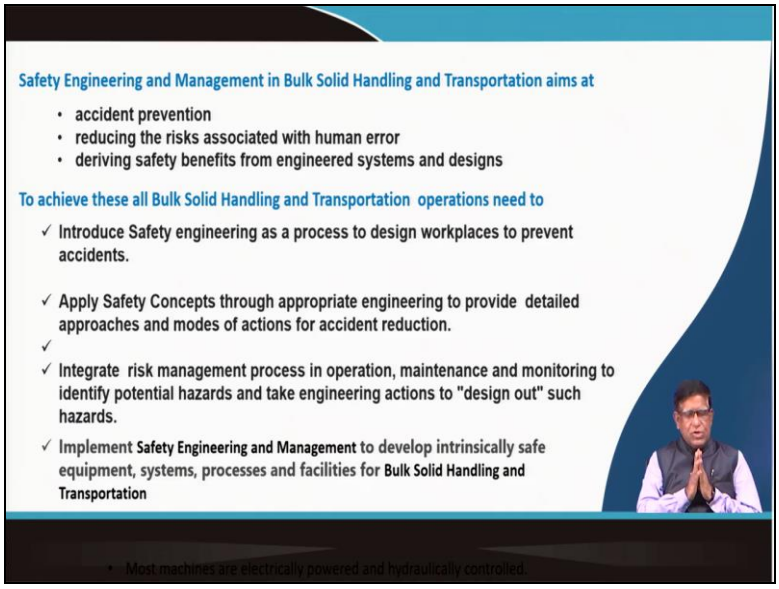

So, safety engineering and management in bulk solid handling and transportations there have they have got number of things they aims at your accident prevention that means whatever the disruptions we have just said that it should not be there. So, accident prevention is the first thing that when you want to engineer safety in a particular operation. And then it will have to be reducing the risk associated with the human error.

Many a times you know that they say while going by the roadside you might be seeing number of accidents taking place that many a time the persons they do some mistake as a result the accident take place. So, that our engineering safety or safety engineering that will be reducing this risk that means you will not commit error for that sufficient warning and sufficient whatever the work you will be doing in the industry.

It should have a proper indications and the operators and of workers will have to be properly trained and given proper instructions. So, that they do not commit those errors that may lead to accidents. Deriving safety benefits from engineered system and designs so, in a safety engineering or safety management in the in your process it will have to you will have to arrange your system in such a way that you can get the benefit of safety.

Now, to achieve all these objectives of safety management you will have to introduce safety engineering as a process to design workplace to prevent accidents. Now, workplaces wherever your this the machines will be working and then where you have made the site that is your workplace and there you will have to design that mean designing of a work place means which machines will be located where.

And then which machines will be performed by what level which is linked with the other machines and then in what are the precautions to be taken by there where it has been properly displayed that is the way how you will be designing the workplace and the apply safety concepts through appropriate engineering to provide detailed approaches and modes of actions for accident reduction.

That is a statement which says that exactly this applies safety concepts that is what the safety concept means they find out that how and under what actions of persons an accident can take place. Now that may be many things that if a person is he is taking a job where he does not know that what may happen without knowing if he put his hand over there accident may take place. So, that what are those concept safety concepts they identify that what type of operations may lead to a safety failure or accident take place.

So, for example the persons may be having a tendency to walking that is your walking by the side of a bridge where there is no railings. Definitely that safety break is here too one is if a bridge is there, there could be a big fall for that there should be a barrier for protection if the barrier is not given that means that work site is not providing the necessary safety provisions. And if the person is walking without a safety belt if he is going to the edge of the bridge that where it he may fall down that is also that means he is violating the safety concept.

So, those types of things we will have to learn then integrate risk management process in operation maintenance and monitoring. Now, this risk management that means the the risk you understand that there is a the probability of failure that is how risk statistically you can determine that what will be the risk at a particular workplace. And once you find out that there is a risk.

Then you can if it is a because of the design of the machine there is a risk then you can design it out that means if that your a dump truck it is to sometimes you may to may keep it standing on a slope. Now, if you put it standing on a slope then it may by itself wait it may skid and rolling down and then uncontrolled way it may cause an accident. But for that; that means it can be made a system design out means if it is there on a this inclined roadway that intelligence system can be there that automatically a parking brake will be applied.

That means if you are st you are parking a very heavy truck on an inclined surface because of the its own weight it may slide down. So, there the system should be design out the risk will be if it is standing over there if it is not writing or if the equipment if the machine understands that the operator is not on the steering that means it is unattended at that time automatically the parking brake will be placed.

So, that the people that this the truck will not be sliding down. Many a times this accidents takes place that sometimes you might have seen in places in a hilly hilly towns a common accidents take place that is if you are parking your car while going up in your house and there at the back side you keep a peg over there and sometimes the driver when he removes the peg and go wants to go to his steering position by that time the car rolls back and go to the road and at that time you need bus coming over there they get head up.

Such types of accidents where common if you go to Shillong and places you may find such type of accidents that take place. so, design out is a if you find out that there is a potential hazard of a particular system in a particular work site you will have to make this observations and then design out by applying your engineering knowledge. And implement safety engineering and management to develop intrinsically safe equipment.

Your equipment will be intrinsically safe means it is got it has been designed in such a way that its all system processes facilities are safe. Say one intrinsically safe example is say in underground mine we have said that if there is a fire dump meeting and air mixture is there and if it at a particular ratio if you switch on then the at the time of switching whatever the small spark is there that is sufficient to ignite that and goes an explosion.

So, that will have to be done all the switching circuit will be done in such a way that there will not be any spark generated. So, that means that circuit is intrinsically safe. So, similar types of things are there.

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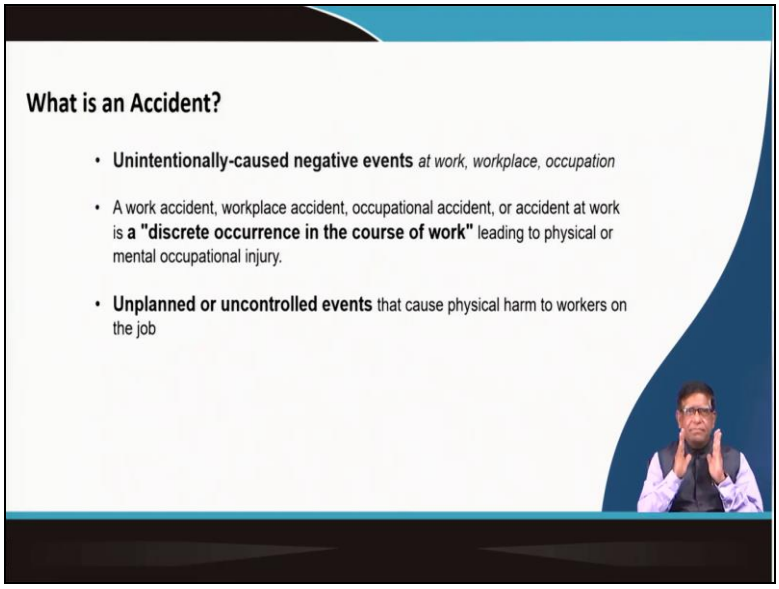

Then let us now, try to define what is accident. So, accident is unintentionally caused negative effects at work workplace or occupation. That means if nobody exactly intentionally create an accident. So, that is why accident is an unintentionally caused and each negative event because there is no positive outcome comes out of accident. So, a work accident or workplace accident occupational accident or accident and work there are many different type of accident could be there.

And these are a discrete occurrence in a course of work when the work is going on at that time something suddenly it happens and it leads to a physical or mental occupational injury. There could be in your in a certain work place if it all the time giving a lot of vibrations on your head you may get a little bit of angry your natures could be a different type. So, that in a occupational site in a in a very noisy railway stations.

If a persons are doing some very business where he gets irritated all the time then he nature that becomes like that he will be very that is irritated with every little provocation because of that you may find in many places they in a very the noisy very unhealthy working places when a busy people that working in a very hard labor they get very easily excited and they got started quarrelling which can be observed in many places then unplanned and uncontrolled events that cause physical harm to workers on the job.

So, there could be accident because of unplanned and uncontrolled event normally in a controlled event when something going wrong you can easily stop it. So, if it becomes an uncontrolled then it will be causing your physical harm. So, basically accidents are those

incidents that is which has resulted in the physical harm to the workers or which has caused damage to the property or machines.

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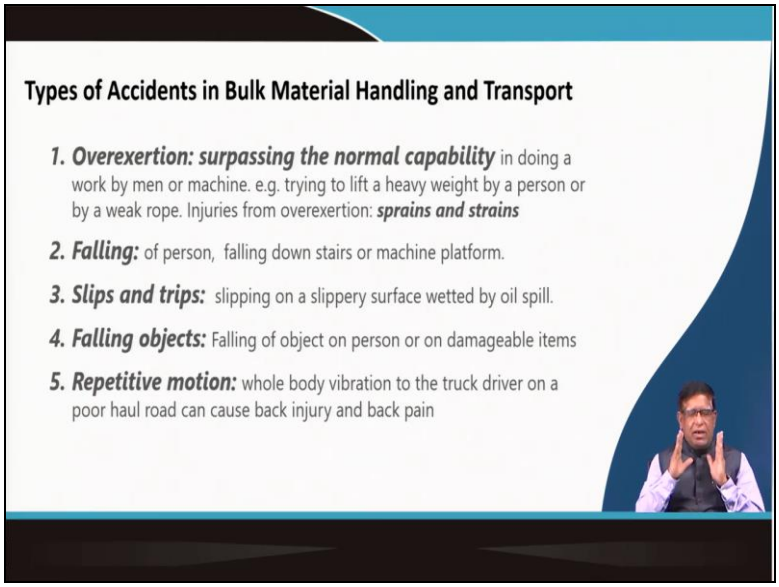

So, that is an accident and once you know this accident you can easily find out that what types of accidents are there in our bulk material handling. Now, this there will be different types of accidents could be there. The first is your over exertion that is over exceptions type is when you are exactly the surprising or superseding your normal capacity at that time a over exertion exercise accident may take place.

Say for example you know that while you are lifting a big bag of cement that every person she has got his physical limitations he knows that he cannot lift but at that time also by bending if he starts taking up over that load he may create a that is injury to his back. So, like that because of some over exertion you may get sprains you get strains you may get dislocate your arm may get twisted and those type of things are there.

In the machines also if a particular rope it can lift only say up to 500 kg if you put there 700 kg and want to do it that rope will get broken and then everything will fall down. So, that is over exertion other type of is a falling is a very common accident that is exactly you may find in the industry some person falling from a stairs failing from a bottom down falling from this or getting then slips and trips is also because there are many slippery surface may be there.

Your oil is splitting on the floor with your shoe when you are working that there it may slip and fall. So, then the falling objects many times when you are handling the bulk material

there will be boulders and all particularly in a mine you may find that is your the object is falling from the that is your from the high wall it may heat you can hit the machine, machine may break or if you hit a person, personally get bodily injury or sometime it can become fatal also.

Sometimes that is your the falling object may be just like a flying rock because when you are doing a blasting for the producing those bulk material in a mines at that time that if the blasting is not properly designed then there could be stones which are going and thrown and can hit. So, then there is a repetitive motion sometimes these vibrations they are also capable of causing harm you know that that is called your whole body vibration.

If you are having driving a very heavy truck say 270 on a truck and your road is undulating at that time when the driver will be moving and then his the seat on his sitting it will be giving a vibrations. Now, those upward vibrations you can think of that whole weight of the truck that is exactly giving an upward vibration means his momentum and by that his backbone it may get all the time repetitive vibrations by which he may get a permanent back injury.

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So, those types of things are also accident. So, this type of accidents in the bulk material could be even being stuck by a colliding with an object that is your the head on collisions it is often a case. That sometimes what happens your when you are having a very high truck and then from there you are having the side windows from the windows you cannot see you cannot see the things because that there is a visions.

So, there is a blind area in that blind area if something comes over there it may heat and you cannot know similarly if you are not having a CCTV then such a heavy truck when it will be going backward if any car or any object is lying over there it will be hitting over there and then there will be this collision will lead to an accident. Then there could be these twisting turnings bending lifting another; this type of accidents are also there.

Road traffic accidents are very common and other type of accidents is your electrical accidents. The electrical accidents can lead to electrical shock electrical burn and electrical fire may take place. In the figure you can see that this is a very it this has taken place in number of places you are having the overhead lines and then suddenly if the operator is not aware of and then he just raises dump body of the dump truck.

And that then dump truck heats that wear and get electrocuted number of fatal accident have taken place here in this particular thing which happened at Kentucky it has it is this the truck is burning and after burnt you can see the bond track how it happens. So, you can see that these types of lot of case studies of accidents in bulk material handling are there.

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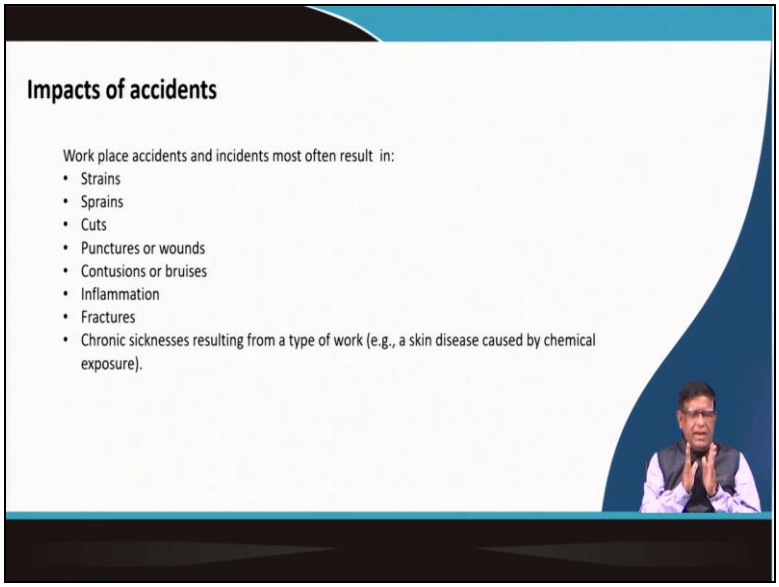

Now, when an accident takes place sometimes it may become fatal sometimes it may lead to a lot of your property damage and property destructions. You may get a big financial this financial loss because of this but other than that the persons even in small accidents they can have as severe bodily injury. He may lose his limb or sometimes he may break and he may get hospitalized for this months.

Because of the after the accident but the some common accidents like your getting strains brains cut that punctures or wounds and this some bruises containing place inflammation and the fractures some sickness may get induced because of this some skin disease and chemical like that in because in the bulk material you may be handling sometime toxic material sometimes some your that you say that with different type of fine particles which may be inhaled by that you may be damaging your lungs. So, there are many places where your certain accidents can take place.

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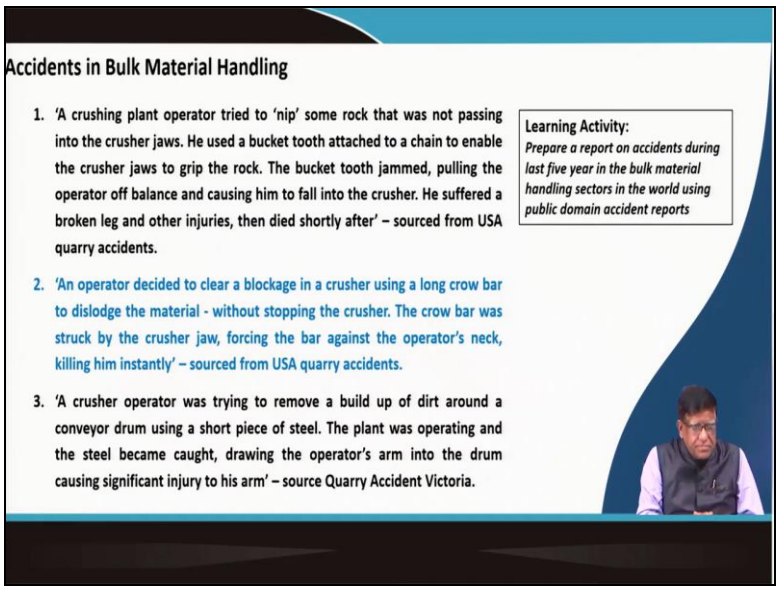

Now, there are many case studies are there you can find out the few things to know that you have now, learned a crusher screen and then conveyor belt these are very much there in any beneficiation plant or the colloisian plan. Here some example of how a person get injured in a crushing plant operator tried to nip some rock that is rock is getting stuck and was not passing through the cursor jaw.

You know as your crushers you have studied there is a fixed droplet and the other job plane is making like that with the toggle it is moving. Now, he found that this one rock boulder it is not passing through that and then he used a bucket to attach to a chain with a chain and then at the end he has done and by hammering it with that he was trying to break this jaw to by gripping that rock.

Now, the bucket tooth by which he was breaking that rock and trying to push that through the jaw crusher it got jammed and when it was gaming then you he when he was trying to pull because of the force he just fell down into the jaw crusher and you can imagine that when he

is falling into the jaw crusher jaw crasher is operating his got almost he got crashed his leg and all he got multiple injury and he died this happened in USA.

Similarly another case happened one operator he decided to clear a blockage in a crusher using a long rover you know that cropper by which he was having a longer arm. And then he did not he thought that because if you stop the crushers to that rock which is getting blocked for that he thought it is very easy you will just put the rock robber and that lift the rock it will be broken and then things will be there if the stop means 10 minutes.

Then it would restart and all the productivity will be lost and then his boss will be scolding him he thought that ok he will make the crusher running with that. Then the cropper was struck into the crusher jaw and then forcing the bar against the operator's neck killing him instantly because it was there then when he started putting it got cut. And this another example I can tell you this happened in when I was working in Neyveli Lignite Corporation.

A conveyor belt which was to be that you know that shiftable belt conveyor after the shifting it need to be aligned for a lining the conveyor belt is just hold by a pipe layer and on a hook and then the senior foreman he just watch that whether the alignment is proper or not. So, that what happened on that unfaithful day when this grain hook it was lifting the conveyor belt he was looking to that alignment at that time from that hook the wear rope it fell down and that whole steel cord belt it hit his neck he could just see like that and he died.

So, that means in a bulk material handling you need to be careful that is the first thing in the first two examples he is not supposed to he is not supposed to lift the this rock like that in this case he is not supposed to be under that unsecured conveyor belt that accident takes place. A crasher operator was trying to remove a buildup of dirt around a conveyor drum using short piece of steel the plant was operating and the steel became cut and drawing the operators arm into drum causing significant injury arm.

So, that means in a query this type of accidents take place. So, what is your learning activity please prepare a report on accidents during last five years in the bulk material handling sector in the world using public domain accident reports. That you make a just you just collect few there is a accident and see that how the accident reports are written there you will be learning what is the technology involved with.

If you do not know that what is the engineering of the equipment how it functions if you have not studied that then it may lead to that accident. So, while doing this exercise you will be understanding why we need to know the core engineering and how the things work.

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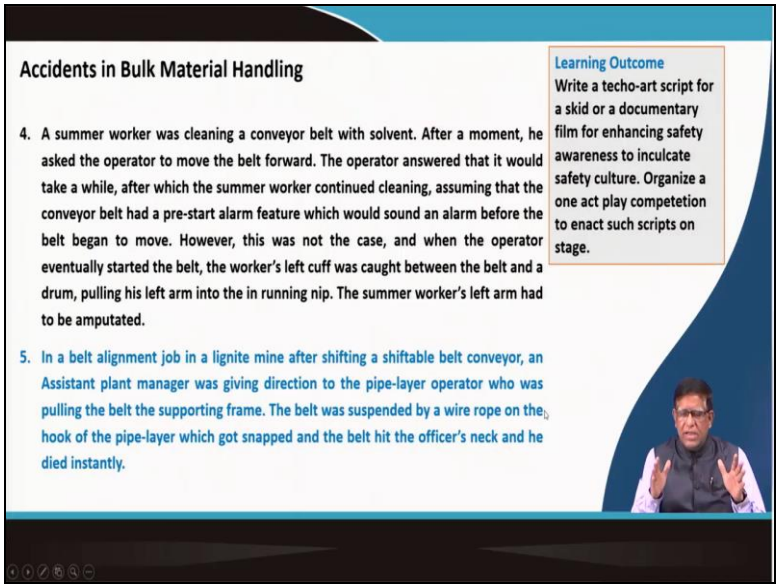

So, there are many accidents that reports are there you can see that is your in case of bulk material handling and transportations. So, I this is another learning outcome testing for you write a techno art script for a skid or a documentary film for enhancing safety awareness to inculcate safety culture. Organize a one-act play competition to enact such scripts on stage.

Now, these particular things if any one of you are having any artistic quality or dramatic experience try to write down that this type of accident which I have narrated here. You can collect such type of small story of what accident have taken place and then try to give a artistic outlook you can give a dance and drama or with a simple drama educative videos educative scripts you can prepare this could be also you can it can make you rich if you can do it professionally.

So, these are the some of the things that after learning this safety and after learning the technology and after learning this safety aspects of the operations you can do it.

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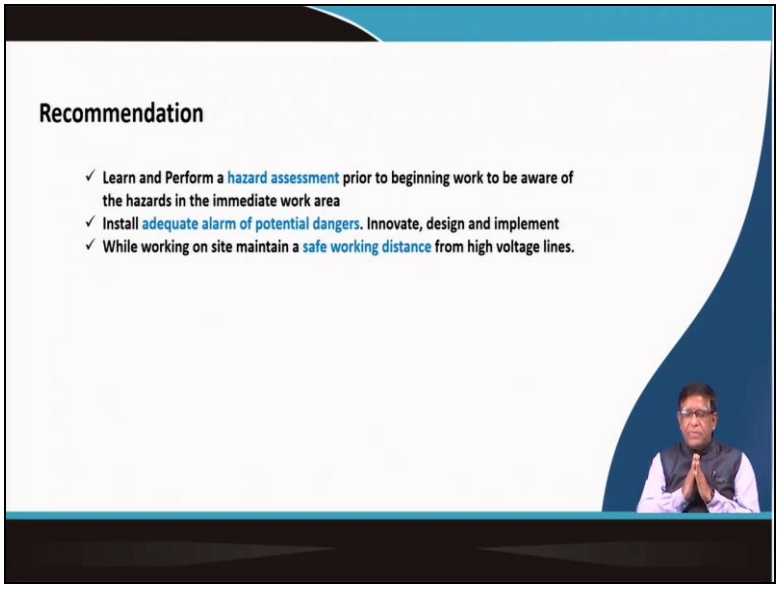

So, what is the recommendation here learn and perform a hazard assessment prior to beginning work to be aware of the hazards and the immediate work area. How the hazard assessment is to be done there are procedures and if you just make a charge and these are not very difficult things the first important thing is to know the engineering of it and after that how it is managed you will have to read and learn and do it.

Then there is a install adequate alarm for potential dangers. Now, where the danger is you will have to innovate design and implement as I said that if there is a truck and from the truck there is a blind zone. So, you can easily find out you can think of a small experiment that is your you and your friend that can be putting your light and up to what distance you can see around a car you can make a mapping you can survey the illumination level or the visibility level.

Then from a truck if you know that this is the region where the truck cannot see then you can put some signal that is if anything comes over there how the operator will be getting a warning such type of innovative appliances are coming up by many start of this days. So, while working on a site maintain a safe working distance from high wall lines. So, high voltage lines so, that means how the that you have seen that photograph that dumper operator got killed because of the electrocution.

But if there were a system that whenever it is coming near to the where that there will be a warning coming and then he cannot lift that the hydraulically lifted that your body that will get released and that it will never go up. So, like that protective systems can be developed.

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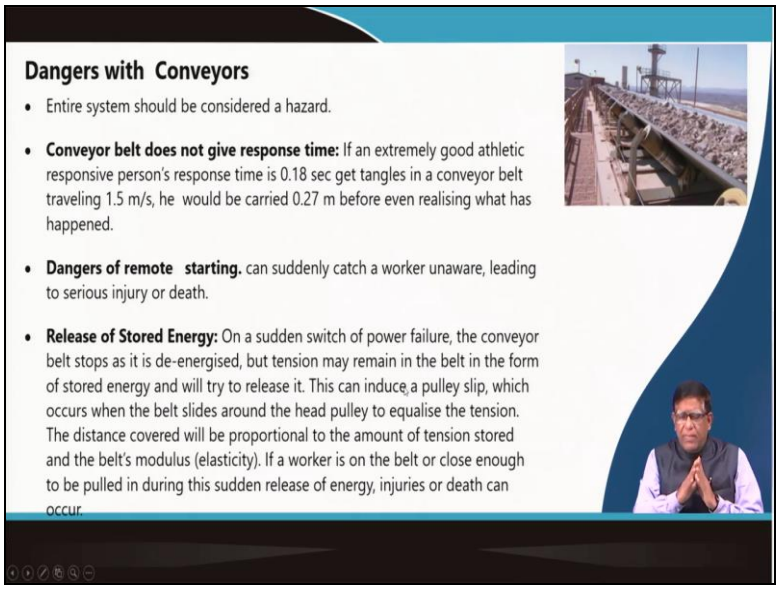

So, there are many issues like that there are dangers with conveyor belts conveyor belt can be a source of this lot of accidents as I said that one accident of Neyveli Lignite. Similarly when a conveyor belt will be started moving if you just stop it suddenly at that time it is exactly all its energy does not get released. So, that and also when it is running at a speed of 1.5 meter at that time it has got that is if you get stuck your hand over there is you will not having a response time to come out of it because by that time you will be pulled back.

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So, that is why you should be very careful even the these are the things that you should not cross a conveyor belt that is if your this is the return belt of the conveyor this fellow is trying to go to the other side because otherwise you will have to walk a one kilometer. But at that time if he just he fails that it is running very slowly. So, he can go and cross over there many

persons many workers does this type of mistake and they lose sometime bodily injury and sometimes they lose their life also.

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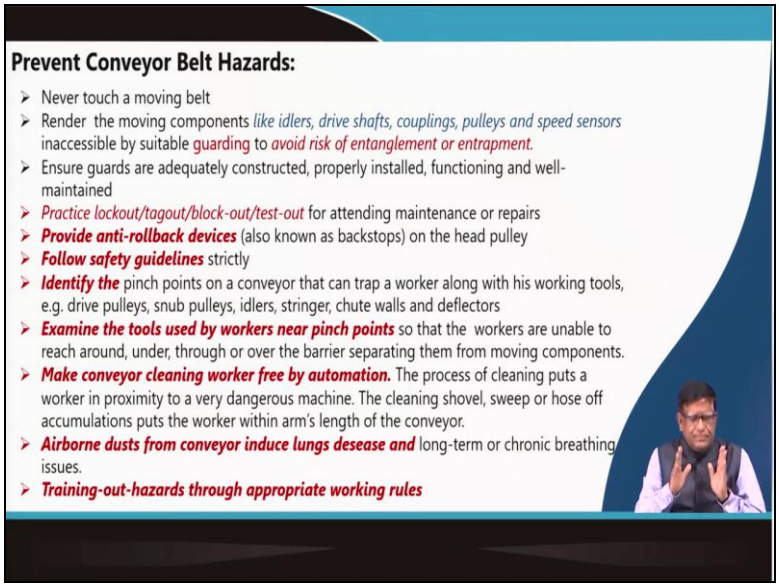

So, you can prevent this conveyor belt hazards by different methods. So, that some rule is never touch a conveyor belt render the moving components like an idler driver that is your driveshaft coupling all these things. So, that there should be wherever the moving part is there you should have proper guards we discussed in our conveyor belt discussions also. And you ensure that the guards are adequately constructed it is not just like a if you come and you are leaning on to the guard and then along with the guard you fell down into the moving part will be dangerous.

So, it should be properly designed engineering thing should be adequately done. And you should have lot of this wherever it is an anti rollback devices your the all the safety guidelines given by the manufacturer will have to be followed. So, there are many issues which you can follow these things I will be giving you all these information's in your Moodle part which I have already given you the passwords go through it.

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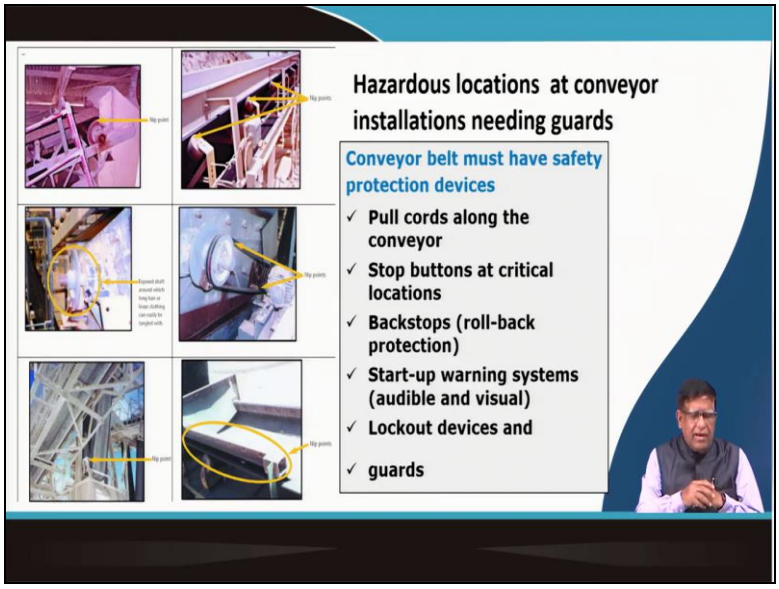

And this will be giving you a idea that in your bulk material handling what type of different locations where the hazards can takes place and then what you must do for your safety purposes. So, in all conveyor belt there are pool carts which along the conveyor there are stop buttons there are back stops there are startup warning system there are lockout devices there are guards and you must check.

When you are working with such a system try to find out the literature what are the safety devices there how they are operated how they are maintained because if you do not maintain there will be problem.

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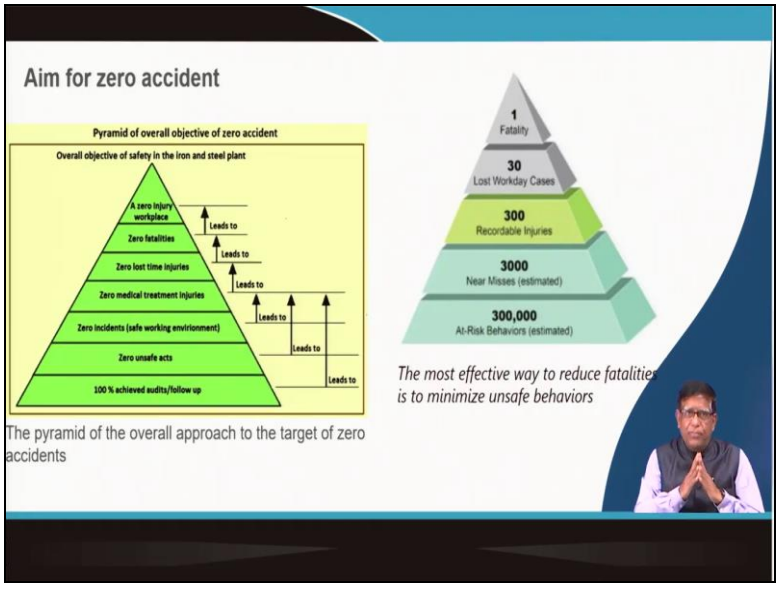

And your objective should be aiming at zero accident and there is the management task you will have to manage safety in such a way that you first take to identify that is your the your at

the lower level your at risk behavior if the behavior is risky then there will be near misses and there will be recordable injury and loss of work there causes and then will be fatality. So, you will have to do at the same time that is if you know that zero unsafe acts will lead to your zero medical treatment injury that will lead to your zero fatalities will lead to a zero injury workplace.

So, that means certain things you will have to develop the behaviour and culture. That safety culture if it is not there you will not be able to zero accident things like that.

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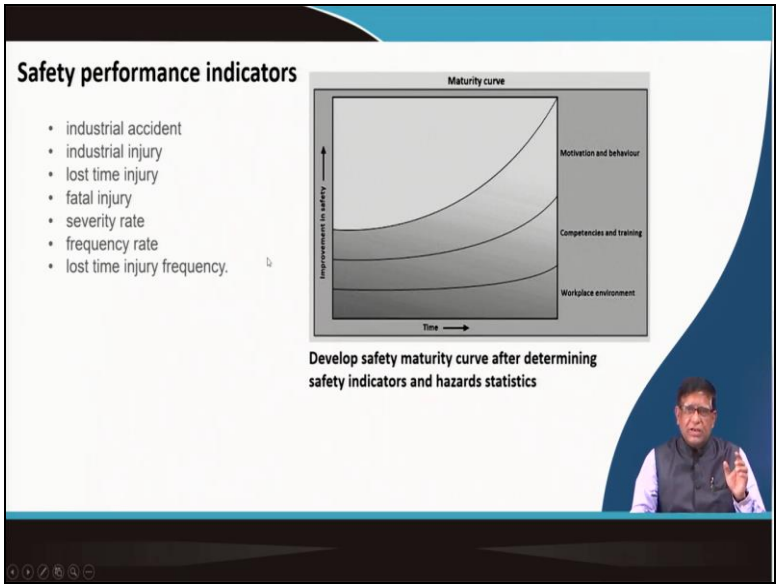

That is why whenever you join in the industry try to see that how your safety works are maintained and you need to find out that safety maturity of the company your safety performance indicators that will be your industrial accident in industrial injury lost time injury fatal injuries severity rate frequency rate lost time injury frequency these are statistically collected.

And over the time how it has taken and you can find out whether your particular area is your safety maturity is achieving or not.

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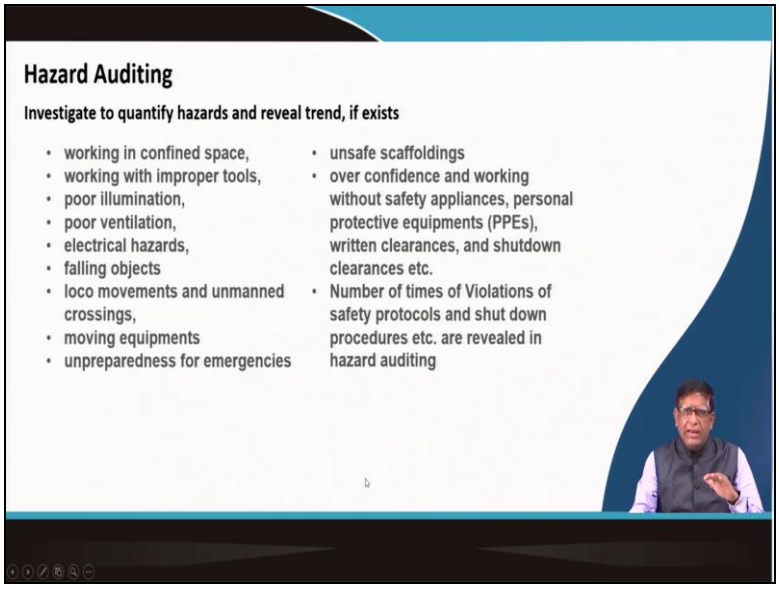

So, there exactly the terminology is hazard auditing just like a safety auditing you need to investigate the quantify that what are the hazards and then you can come up to a that is your safe operation. So, many of the reasons you can find that hazards may come if you are having a more very confined place to work. If you are not having a proper tools if you are not having proper illumination if you are not having proper ventilation if there is an electrical things are unsafely kept your if the falling objects can come without any resistance restriction. So, like that you identify depending on your situations.

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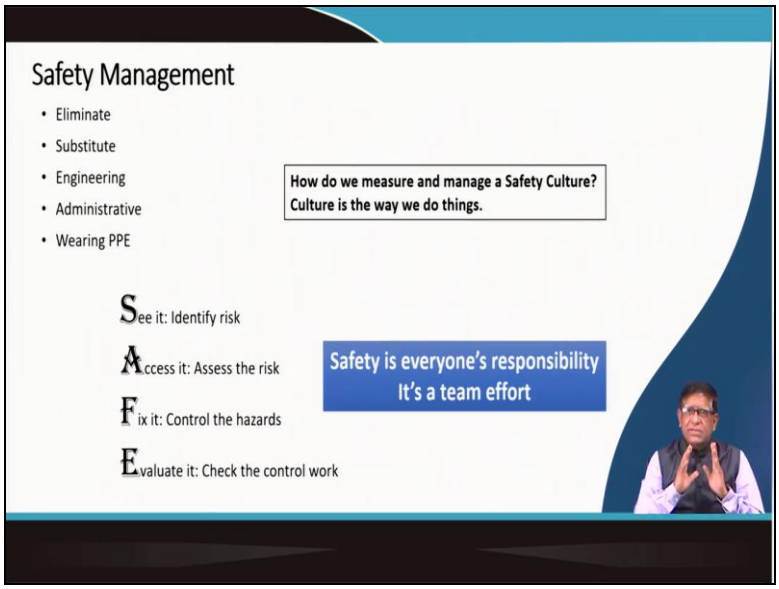

And you will have to make the safety management by eliminating substituting engineering administrative and wearing personal protective equipment and for that you will have to identify risk you will have to assess the risk you will have to control the hazards and you will have to check the control work that is the safe thing and safety will be achieved. But in the

mines or in the material handling system you always remember wherever you are working safety is everyone's responsibility and it is a team effort.

Then the competition may be there in your student life but once you are there in the field you will have to work as a team and that safety is achieved through a teamwork only.

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So, there are number of references on this subject is a very vast you can do a lot of work on it you can do a lot of your academic work also applying how to apply statistics and all safety engineering itself is a subject but here I have just told you to have a general idea. Because now, you will be ready for going to the industry to work as an engineer that whatever engineering and the technology you have learnt will have to be applied by considering the safety aspects.

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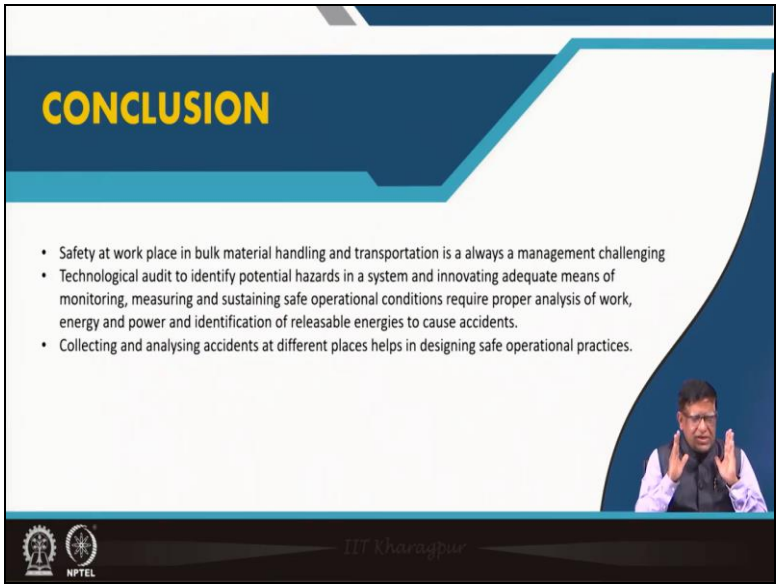

So, safety at workplace in bulk material handling and transportation is always a management challenging. And technological audit to identify potential hazard in a system and innovating adequate means of monitoring measuring and sustaining safe operational conditions require proper analysis of the work. And there you will be applying your knowledge of the subject so, that you can design out all the safety problems.

And you can manage the things without any accident without creating any problem an uninterrupted undisrupted service to the industry can be provided while handling your bulk material and transporting, thank you.