**Chemical Process Safety**
**Professor Shishir Sinha**
**Department of Chemical Engineering**
**Indian Institute of Technolgy, Roorkee**
**Lecture-39**
**Safety Reviews & Risk Assessment-1**

Now welcome to this module of Risk Assessment. Now, let us have a look about that what we have studied in the last module. We had a discussion about the different definitions of risk and hazard. We have gone through the process protocol of hazard identification.

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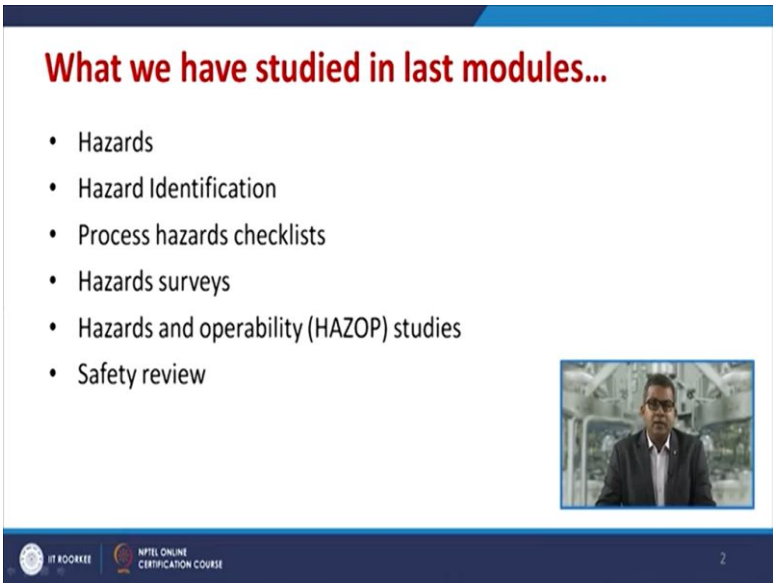


Identified that what are the basics ingredients in list, which should be enlisted in the process hazard check list. We have gone through about the importance of hazard service and gone through the basic concept of hazard and operability studies and in the last module we started about the brief review about the safety review that what is the importance of those safety reviews and how we can go ahead. So in this particular module let us start with the remaining part of the safety review.

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Now, this is as we had a discussion that these are the very vital part of the working safety system in various large companies they are built right into the corporate safety strategies and they are these safety reviews they usually come in different forms based on the specialized one and based on the need of that particular company.

So ultimate aim is to reduce the hazard to reduce the economy loss towards the company. Now let us have a look that what is the difference between safety review and the safety audit. Now some will equate that a regulatory audit company with a safety review but it is not true because the safety audit is partially different thing with the safety review.

The purpose of audit may be to make the safer by ensuring it complies with all kind of regulations it is not a safety review. Now it is a regulatory compliance that is an audit and nothing more. So the regulatory compliance or through regulation being put down by the several competent authorities like government, local government, federal governments, central government, etc. based on the need of the society. So safety audit ensures that there is a regulatory compliance in that particular paraphernalia.

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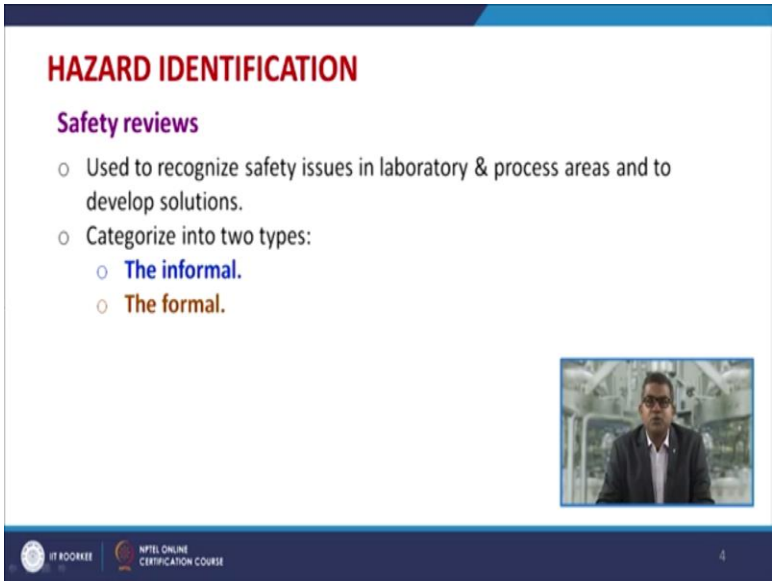


Now this safety review they used to recognized the various safety issues in either laboratory or process plant areas or any kind of situation or environment that may be thereof. Now this safety reviews develop the various solutions if any kind of challenge arises due to any malfunctioning or due to any regulatory requirement. Now these safety reviews are categorized into 2 types one is the informal one and second one is the formal one.

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So, let us have a look that what is the informal safety review. Now this is used for small changes to existing processes and for the bench scale or a laboratory process or a quality assurance etc. Now to perform these kind of informal safety review a committee should be formed, the committee may consist of only 2 - 3 people and generally individual those who are responsible for the process 1 or 2 others not directly attributed or associated with the process but they are well acquainted or well experience with the proper safer safety protocols or a procedures. Now the idea is to provide a lively dialogue where the ideas can be exchanged and safety improvement can be achieved or developed in due course of time.

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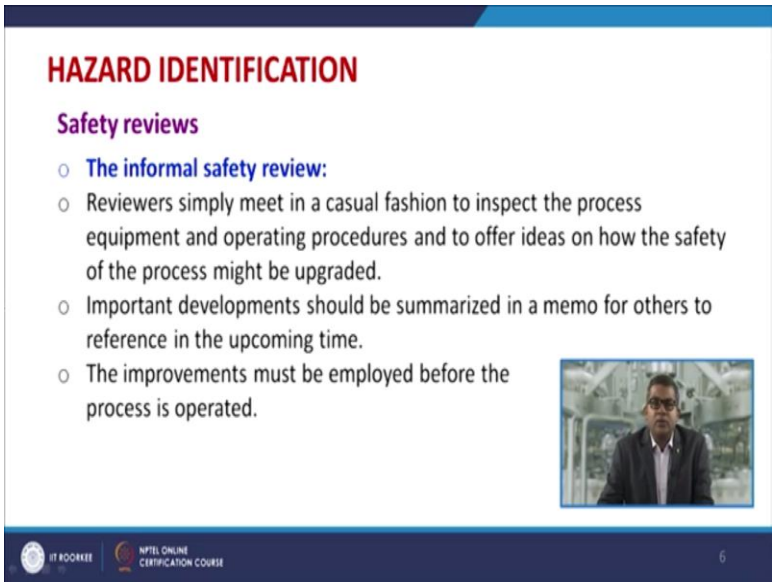


Now, the reviewers they simply meet in a casual fashion to inspect the process equipment and operating procedures and to offer ideas and how the safety of the process might be upgraded, that means by changing their ideas, by sharing their views, they can approve or they can upgrade the safety protocols. The important development should be summarized in a memo for others to reference in the upcoming time. The improvement must be employed before the process is operated. So, that any kind of short comings, etc. can be removed in the course of time.

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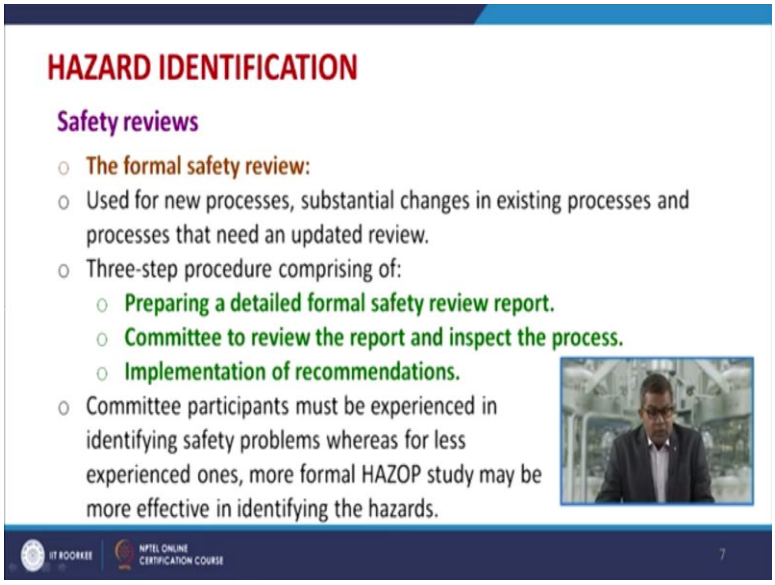


Now the formal safety review this is used for a new processes substantial changes in any kind of existing processes and the process that need to be an updated or they need an updated review, so usually this consist of 3 steps. One is that preparing a detailed formal safety review report you must have all these things with you. The committee is to review the report which is being prepared and inspect the process and they implement to whatever recommendations being given by the safety review committee they ensures that those recommendations are properly implemented.

So the committee participants they must be experienced in identifying the safety problems whereas for the less experienced one more formal HAZOP study may be more effective in identifying the various kind of hazards those were applicable to the work place. Now, this they used almost immediately or relatively easy to apply and is known to provide the good result.

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Now this includes various sections so those important sections are enlisted in this particular slide. The first section deals with the introduction that is the general overview of the process, the plant, the process overview, the complete process that what kind of such things are involved? What kind of reaction involved? What are the different perimeters involved? Stoichiometric conditions and all the relevant engineering data that includes a thermodynamic data etc. whatever being required for that particular process.

The second is the raw material and the products. Now the starting point at this juncture should be the material safety data sheet because raw information of the material is extremely important whether there is any contamination, what is the minimum SA of the particular raw material because sometimes any kind of contamination any kind of adulteration any kind of undesired product may lead to any thermal or a chemical.

So you must aware about the hazard associated with these kind of scenario and what are the handling problems may arise in due course online shopping time while handling such a raw material or a product. So this type of information must be available further ready reference, then you must have a knowledge about the equipment setup the proper complete description is essential with all kind of specification what is the length? What is the height? And what is the operating protocol, etc.

Then the fourth point is the procedure that is what is the normal operating procedure remember thermodynamically there are only 3 things which you can control that is pressure

volume and temperature. So you must know that what are the normal operating procedures are inherent in that particular process. Then safety, the waste disposal protocol and the cleanup procedure because sometimes it you may experience may be a generation of waste then how to clean that particular thing. Suppose a solvent is being produced or a solvent is being in access than you cannot drain it as such then what is the cleanup protocol.

On the basis of the all the 4 point which are enlisted above you may prepare a safety checklist this includes all the critical area, all the crucial areas. Now, to supplement all those things you must know that what is the material safety data sheet. We have gone through the material safety data sheet in the earlier modules so this material safety data sheet provides a very vital information, that may be useful for the point number 2 that is the raw material product that may be useful for the procedure even it is related to the handling hazards problem. Now, let us have look that what is risk assessment.

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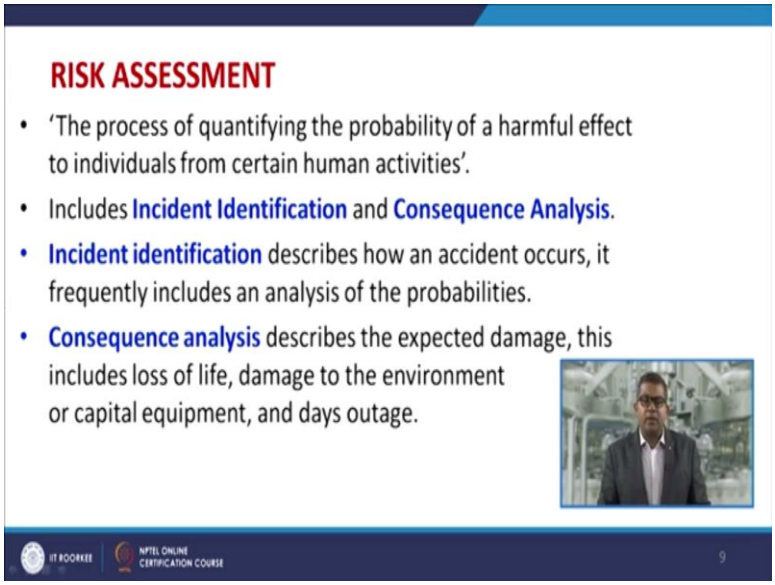


Now risk assessment that is the process of quantifying the probability of harmful effect to individual from a certain human activities, this is the broad spectrum of assessment, this includes the incident identification and Consequence Analysis. Now this incident identification this describes how an incident occurs, it frequently includes an analysis of various kind of probabilities sometimes the chair may be broken on which you are sitting.

So, you need to enlist all kind of probabilities that may happen. Then the Consequence Analysis, this describes the expected damage, this includes the loss of life, damage to the

environment or the capital investment or the capital equipment and the days outage means in terms of somebody is having occupational injury, occupational illness. etc. So it includes all these consequences that may happen due to that particular incident.

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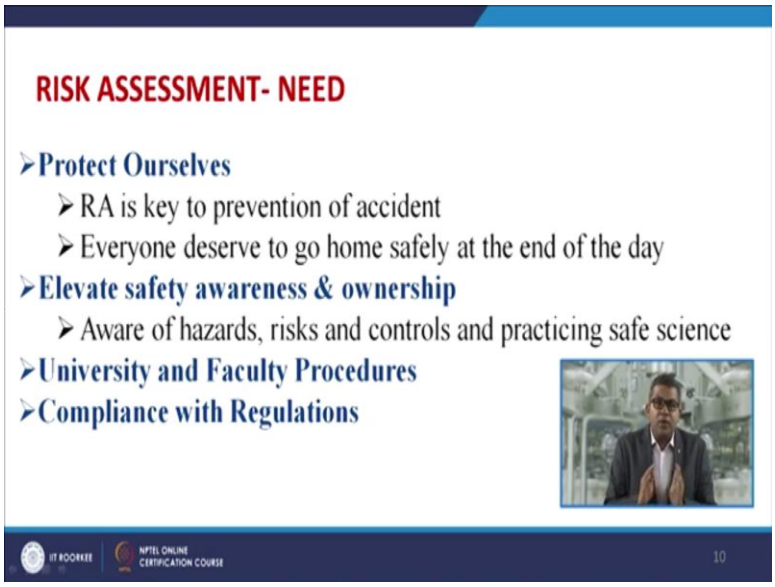


Now why there is a need of this risk assessment the first thing is that to protect our self because the risk assessment is the key to prevention of accident .So everyone deserve to go home safely at the end of the day at the end of the shift and if he or she is not then that means something is wrong with respect to the process, so you need to protect yourself or our self.

Then elevate safety aware ness and ownership. So you must aware about the various kind of hazards, risk and control and practicing safe science because unhealthy practice, hazardous practice may not only create a problem to yourself but to the environment or nearby vicinity. Then university and faculty procedures they also play a very vital role through their research protocols, through their research outcomes they may guide, they may assist their regulatory bodies as well as the users that there is an up most need of risk assessment.

Then based on all kind of safety reviews based on all kind of guide lines there is a provision of a different regulations as led down by the different regulatory bodies, remember all those regulations are for to protect yourself as well as to protect the environment. So this you must ensure that based on your knowledge on risk assessment you must comply with the all the regulations as led down by the local body as well as the central body.

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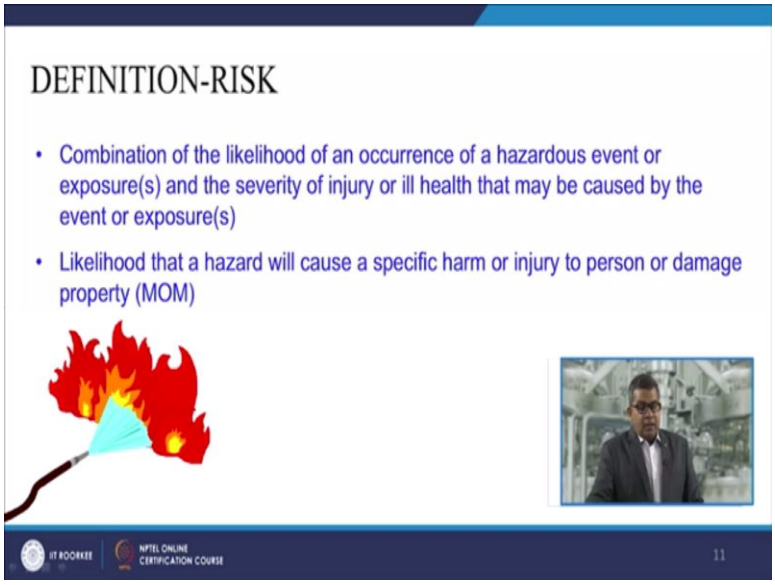


So based on this particular aspect, let us have a proper definition of risk that is the combination of likely hood of an occurrence of a hazard event or exposure and the severity of injury or ill health or fatality that may be caused by the event or exposure that is the likely hood that hazard will cause a specific harm or injury to person or a damage properties. So this is you can say broad spectrum of the definition of risk.

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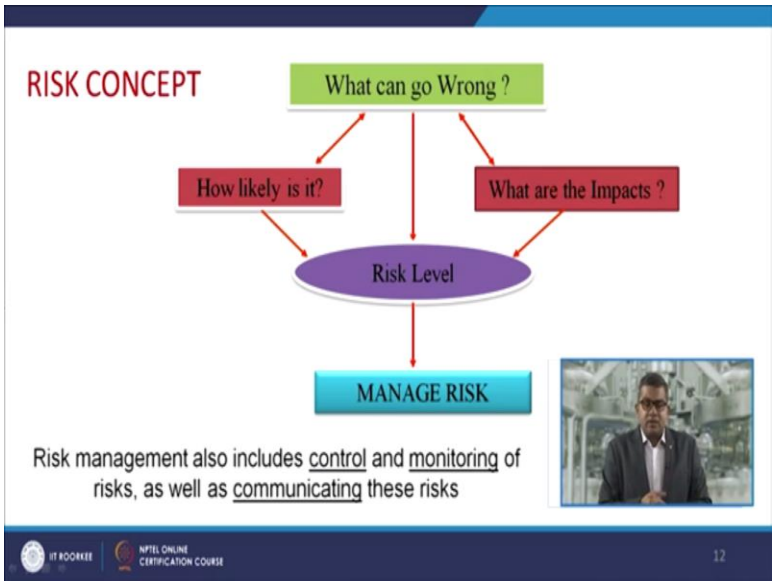


Now, whenever we discuss about the concept of risk then we must know or we must aware about this type of flowsheet you must know that what can go wrong and if something goes wrong then what are the impacts that wrong happening. Now if you annualize this then what

is the level of risk. How much it will imparts or what is the consequences of that particular risk. Another aspect is that how likely it is how much what the frequency is.

Then again non the basis of that particular you analyze that what is the risk level now if it is acceptable then go ahead if it is not then you need to manage that particular risk. So risk management this also includes the control and monitoring of risk as well as the communicating those risk to the nearby people or those who may get affected with that particular type of risk.

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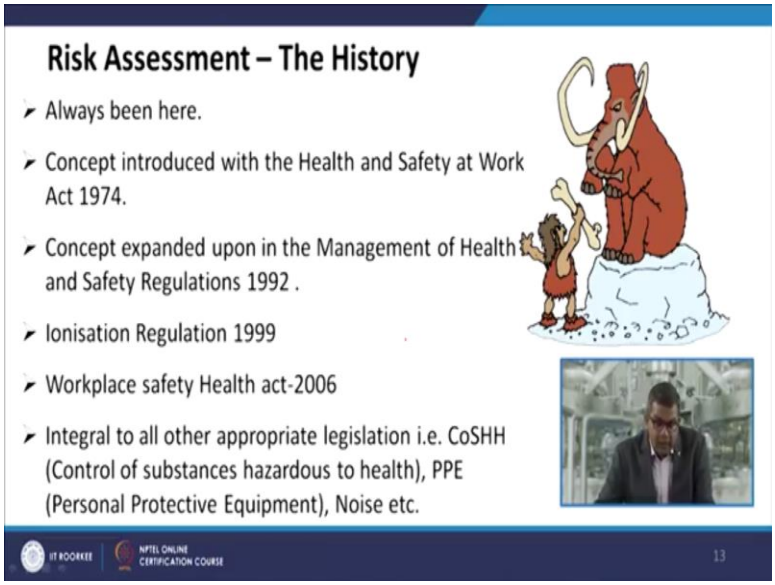


Now there is a brief history of risk assessment remember like hazard risk is always there, you cannot avoid the risk. We have already discussed that sometimes in a room where you are sitting right now the roof may collapse, the chair may destroyed, so risk is always there. So, concept of this risk assessment was introduced with the health and Safety at Work act in 1974. This was the first time when a synchronized risk assessment protocol was introduced and that was in United Kingdom then the concept expended upon the Management of Health and Safety Regulations in 1992.

Then there was a protocol related to the Ionization Regulation in 1999. Then the Workplace Safety Health act was introduced in 2006. Remember these by enlarge all these act or all these regulation are applicable globally. So integral to all other appropriate legislation that is CoSHH that is the control of substances hazardous to health, personal protective equipment PPE Noise etc.

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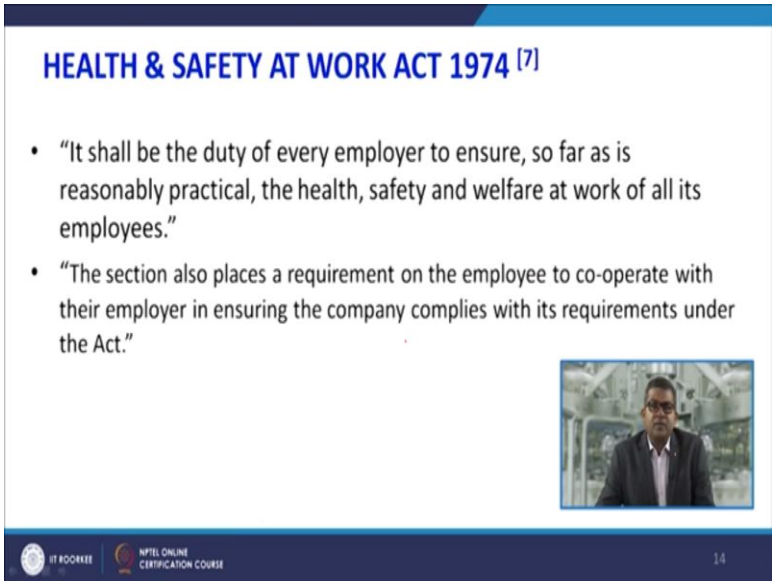


Now, let us have a brief look about the Health and Safety at Work ACT 1974 applicable in United Kingdom. Now it shall be the duty of every employee to ensure so far as it reasonably practical the health safety and fell ware at work of all it is employees. This is extremely important because ultimately the employer who is basic sufferer of any kind of economic loss.

Now the section also places a requirement on the employee to cooperate with their employer in ensuring the company complies with all kind of requirement under that particular Act. So it is not the employer responsibility alone it is simultaneously it is the responsibility of the employee that he or she should help the employer to work upon under the paraphernalia of these particular Act.

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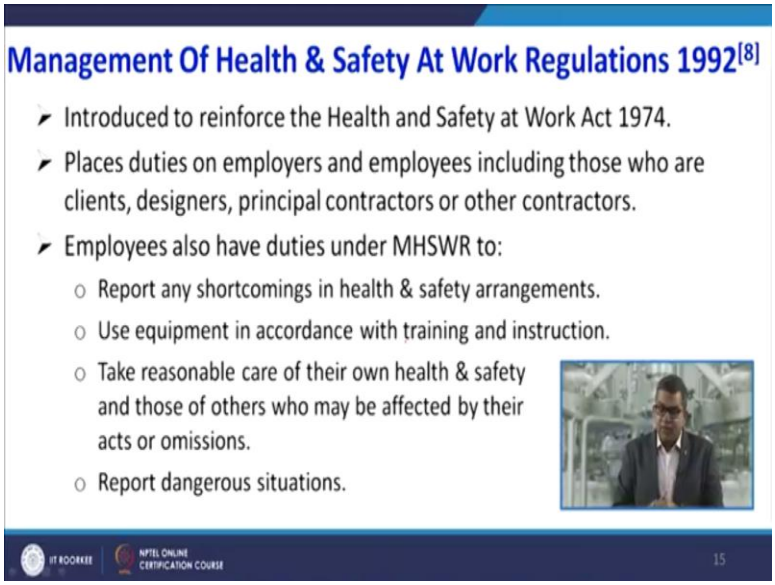


Another act that is the management of Health and Safety at Work Regulation 1992. This introduced to reinforce the Health and Safety at Work 1974 because there may be some short coming or because of the technological advancement from 1974 to 1992 there may be a chance that something may be missed due to course of time.

So places duties on employers and employees including those who are clients designers principle contractors and other things so they expended their horizon. Now employees also have their duties under this act to report any kind of short coming in the health and safety arrangement of that particular industry. So it is a responsibility of employees that something if malfunctioning or something is missing so they must report they should report.

Use all those equipments in accordance with the training and instructions so you must use because the training and instructions they are the integral part of any kind of safety protocol so they are bond to use the equipment use of the equipment in accordance with what for which they are trained and they are given the instructions. So it gives, in another words they have the full right to refuse to use that particular equipment for which they are not trained.

Now take reasonable care of their own health and safety and those of others who may be affected by their acts or omissions that is again very important thing. Now they are responsibility to report the any kind of dangerous situation sometimes it may happen the temperature may be on the higher side that means that may lead to the thermal run away

reactions or even there may be a chance that pressure may be built up and the safety devices may fail. So any kind of dangerous situation they should report to the competent authority.

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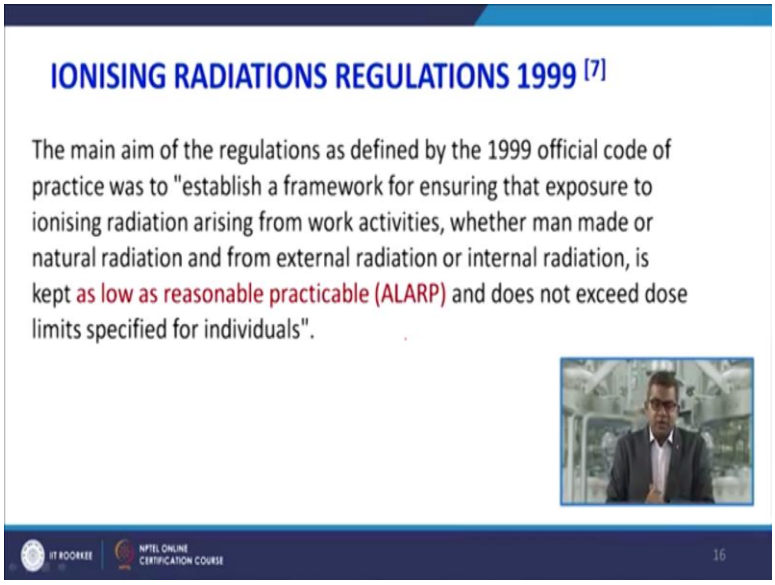


Now, because of the day by day using of different ionized radiative equipments like UV, IR etc. So UK government they propose the ionizing radiation regulation 1999 act the main aim of the regulation is to define by 1999 official code of practice was to establish frame work for ensuring that exposal to ionizing radiation arising from the work activities whether man made or natural radiation and from the external radiation or internal radiation that is kept as low as reasonable practicable.

Sometimes laser may create a problem, so it is the duty of the employee that the internal radiation should be kept as low as reasonable practicable that is ALARP and does not exceed close dose limit specified for that particular individual so the dose versus response prevails so this should not exceed as per the beyond specified limit.

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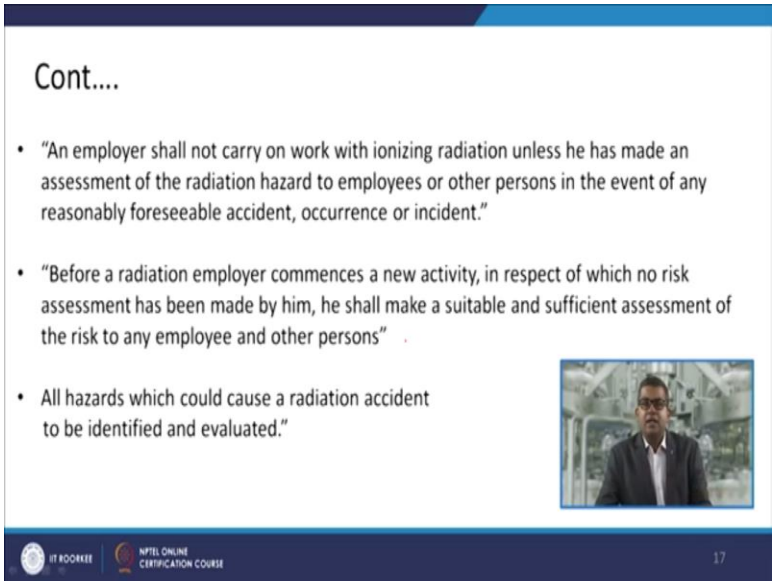


So in this particular protocol an employee shall not carry on work with ionizing radiation unless he has made an assessment of the radiation hazard to employees or other person in the event of any reasonably forcible accident occurrence or incident that is say very crucial thing. Now before a radiation employer commences a new activity, in respect which no risk assessment has been made by him.

He or she shall make all suitable and sufficient assessment of the risk to any employee at other persons. That is the responsibility of the employer and all hazard which could cause a radiation accident to be identified and evaluated. So and apart from this a proper information should be given to all employees weather this type of hazard is present at the work place.

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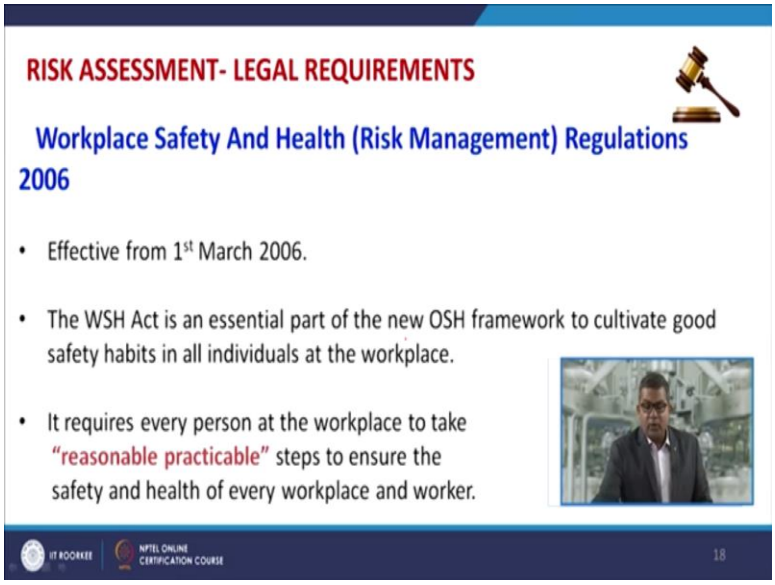


Now there are certain legal requirements. So the first and for most legal requirement that is based on the Workplace Safety and Health that is Risk Management Regulation 2006. This is effective from 1st March 2006. Now, this Workplace Safety and Health Act is an essential part of new occupational safety and health framework to cultivate good safety habits in all individual at the work place. Remember this is the habit not the trained things. So the safety habit is a crucial part. Now this requires every person at the work place to take reasonable practicable step to ensure the safety and health of every work place and worker. Remember the safety is everyone's responsibility.

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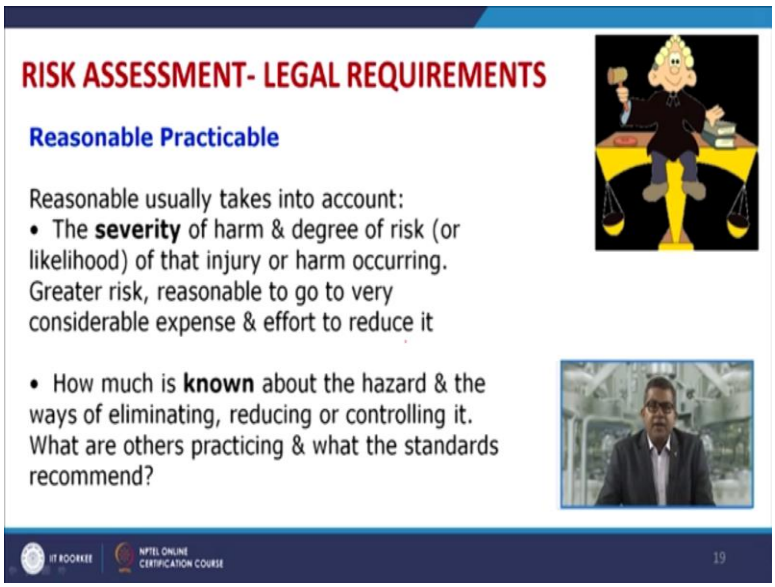

Now what is this Reasonable Practicable? Now reasonably usually takes into account the severity of harm and degree of risk or maybe sometimes likelihood of that injury or harm occurring. Now, the greater the risk reasonable to go to a very considerable expense and effort to reduce it.

So how much is known about the hazard and the ways of elimination that is the reducing or controlling it what are the other practicing and what are the standard recommendation. So we must know all kind of this thing before applying this risk assessment. Now, whenever there is a legal requirement then definitely those who violate all those legal requirement there is a concept of penalties.

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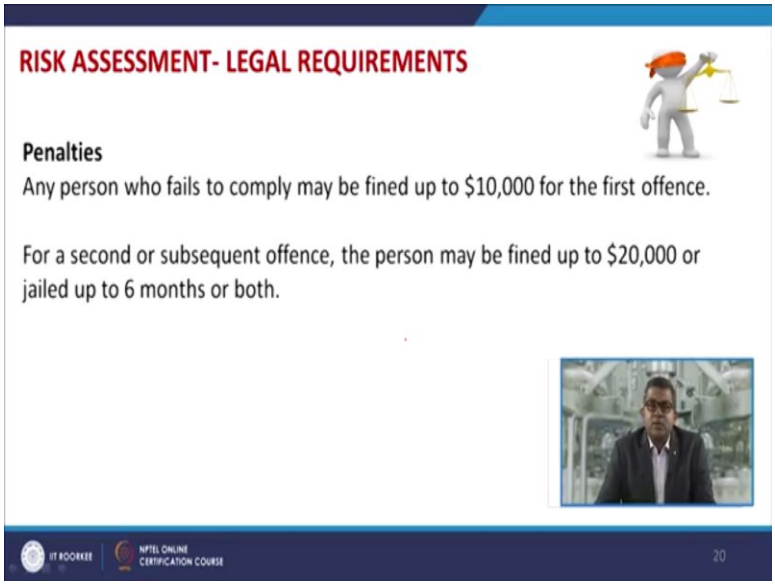


So, any person who fails to comply may be fined up to say 10,000 dollars or it depends on country to country for first offence and for the second or subsequent offence a person may be fined up to 20,000 or she may be jailed up to 6month or both. So, penalties this particular slide is for reference, in Indian context we do have such kind of severe penalties including the monitory penalty as well as the imprisonment penalties. So, we have gone through this brief assessment of risk.

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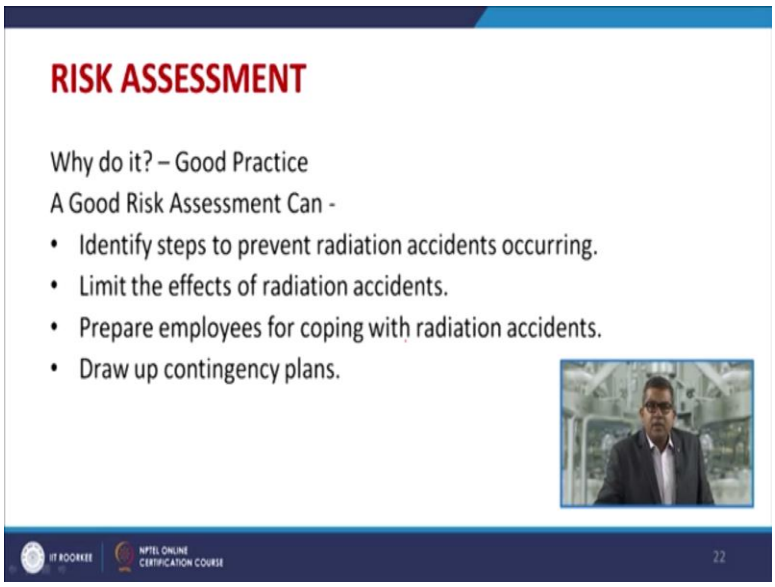


Now, why we are intended, why do it? Now obviously based on the previous discussion it is a very good practice. Now a good risk assessment can identify the step to prevent the radiative accident occurring limit the effect of any kind of radiation accident. They prepare the employee for coping up with any kind of radiating accident.

They drop the contingency plan. Now if you replace the radiation aspect with all kind generalize things then they identify any kind of hazardous things then they limit the effect of those hazardous things then prepare or train the employees for coping up with the such kind of any untoward incident and then they draw based on their knowledge competency they draw any kind of emergency or contingency plan.

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So in nutshell the risk management can be defined as eradication or minimization of the adverse effect of risk to which an organization is exposed.

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Now, the question arises that why there is a need of proper risk management regulations. The one thing is that to hold the stake holder accountable for managing the risk they create and second thing is that to reduce the risk at source. Remember everywhere whenever we are regulating or we are framing these risk management or risk assessment then definitely our basic moto is to reduce the economic loses because in case you fail in the risk management fatality may happen than you need to pay the compensation if there is an illness or injury than

again you need to pay the compensation if there is an illness or injury than again you need to pay the compensation or you need to add for the medical treatment which may again cost.

Simultaneously it is equally true for any kind of property loss within the plant periphery than again you may suffer a production loss again you may have to go for the modification repairing etc. Then ultimately it may lead to the economic losses. So that is why these two points are extremely beneficial not only for the employee but also for the employer.

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So the risk assessment can be very straight forward process based on judgement requiring no specialist skill or complicated techniques. Now this approach is commonly known as the qualitative or subjective risk assessment.

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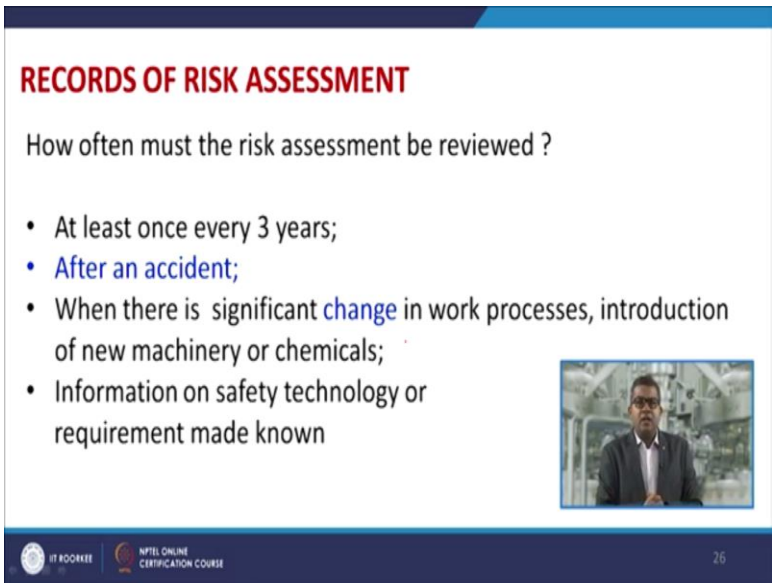


Now there is a concept of record of risk assessment. So first thing before we go into detail how often must the risk assessment may be reviewed the question must be asked. Maybe at least once in every three years maybe within six years maybe within six months maybe monthly maybe weakly etc. Sometimes it may happen after an accident so that we can analyze that what went wrong. Another thing is that when there is a significant change in the work process introduction of a new machinery or a chemical sometimes it may happen that industry may go ahead with process modification modernization etc.

Then again there is a need to go for this risk assessment than information of safety technology or requirement made known sometimes it may happen because of the safety development safety technological development sometimes it may happen that new tool for safer technology new tool for environmental technology may be developed. Than if your industry is willing to adopt that particular technology than definitely go for the risk assessment.

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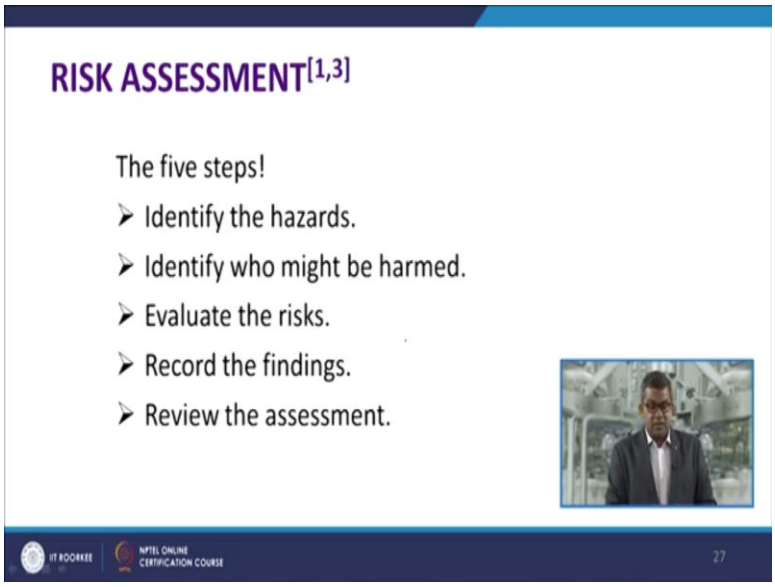


So, there are 5 step process for the risk assessment need to identify. Identify who might be harmed you need to evaluate the risk we have already done all these five aspects in the previous module so in summary you need to record the finding because these recordings may be useful for further safety review and safety auditing and then you review what kind of the assessment you had carried out whether it is good or wrong weather it is ok. So this type of things you need to perform So first step that we are carrying out that you need to identify the hazards.

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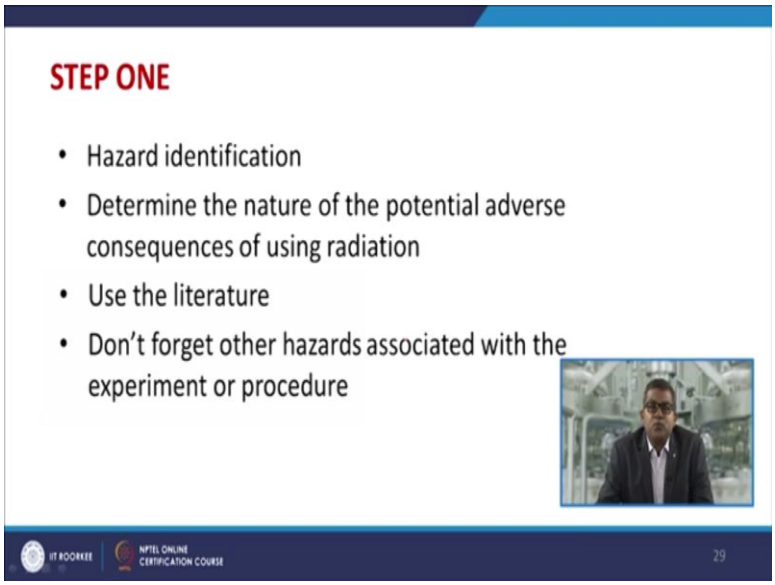

One hazard identification we have already covered determine the nature of the potential adverse consequences maybe using radiation maybe using any kind of fire and explosion etc. Go ahead with the literature available because literature may have various safety reviews literature may have the different type of safety auditing reports etc. and don't forget other hazard associated with the experiment or process because in past several accidents in the history they took place just because of omission this particular aspect. That is the other hazard associated with the experimental or protocol.

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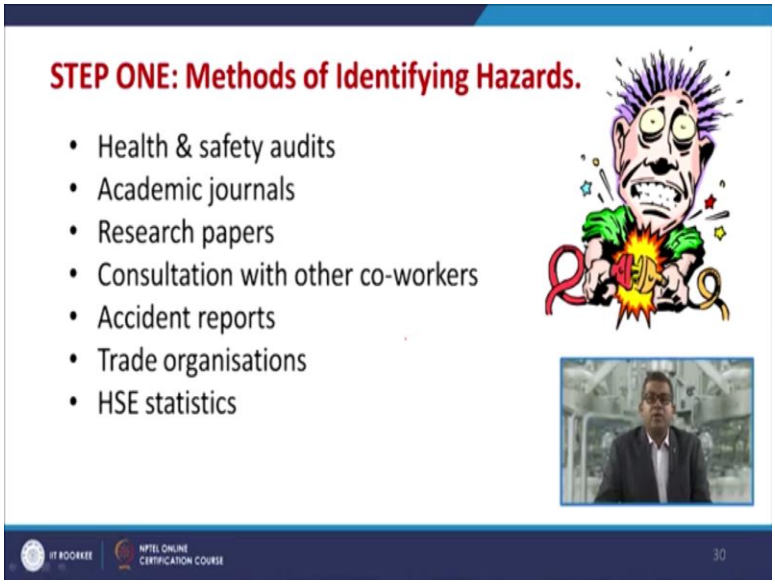


So how we can identify the things that is first is you have to be well acquainted with all kind of health and safety audits you go through the academic journals because there are so many journals because there are so many journals as on date they are attributed to the hazard and safety. You must be aware of the various kind of research papers available as on date because it is a key interest issue of various researcher that how to improvise the process and by the improvisation of the process they develop various safety protocol.

So you go and you must read all those research papers you must have a consultation with other coworkers because they are on sight they feel that what may go wrong what went wrong and what are the deficiencies in that particular system. You must go for all kind of accident report so that you must aware that what may be wrong in that particular process, how you can deal it upon.

You go for the various reports being published by various kind of trade organization because these trade organization provides a very vital road that what is the requirement of the society?

What is the requirement of the consumer? So sometimes you may need to incorporate all those type of requirement to the process and once you are incorporating those type of thing in your process then definitely process modification may take place based on the process modification protocol requirement.

You need to review those safety protocols which had earlier been applicable in your plant. So these trade organizational reports they play very vital role in that kind of safety hazard and some trade organization they are very particular to ensure that weather you have followed the safety protocol or not if you are not following that safety protocol as lead down by their governmental organization or regulatory body then definitely they may refuse to purchase or they may refuse to have any kind of trade arrangement with your industry.

Then health safety environment statistics because this gives you a proper information that what kind of a emission what kind of radiative problems what kind of fire and explosion data may take place in your plant maybe facilities. So you must aware about these type of methods for identifying the hazard.

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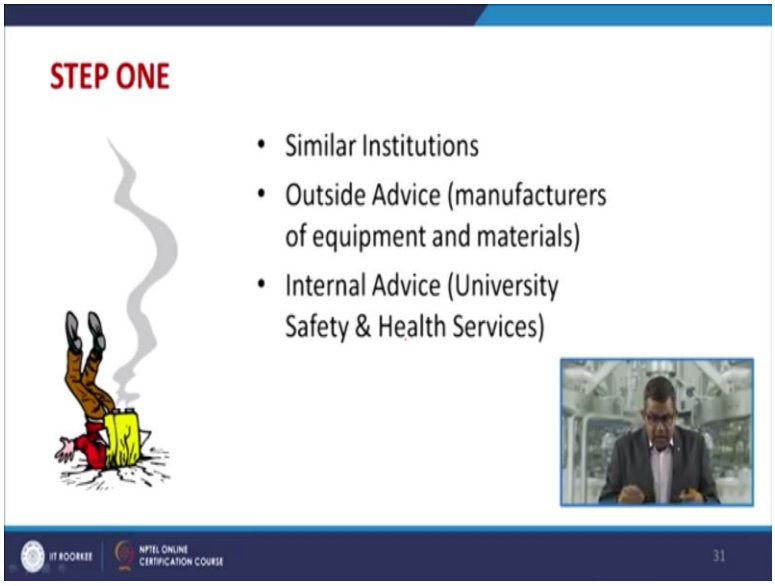


Now this type of things are very similar for various kind of institutions sometimes the outside advice that is manufacturer of the equipment and material is very useful for performing this type of assessment because whenever you are procuring any raw material from any kind of supplier they used to supply the proper information either handling storage etc.

Sometimes the equipment because just for the sake of an example if you are using the pressure vessel the manufacturer they supply an information that what is the bursting pressure what is the design pressure so what should be the operating condition. So this type of information is sometimes is extremely crucial.

Sometimes internal advice maybe by any university or institution because they are continuously working on the process development they are continuously working on the chemical kinetically aspect etc. So they may provide sometimes of it useful information for the safer process.

So in this particular module we have studied about the various tools for hazards we have discussed various regulations applicable for different type of hazards. We have gone through about the history of hazards. We are in the process of discussing the various protocols for risk assessment risk management etc. In the subsequent module we are going to discuss this risk management protocol further. Thank you very much.