Health, Safety and Environmental Management in Offshore and Petroleum Engineering

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Module – 01
Environmental Issues and Management
Lecture – 01
Introduction

Welcome friends, to the online course title; Health Safety and Environmental Management, which we call as HSE in offshore and Petroleum Engineering.

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This lecture will be covered in 3 modules, as you saw in the introductory web page of the course, in module 1: we are going to discuss environmental issues and their management. This is going to be the first lecture in module 1, where we will talk about introduction to problems related to environmental issues which arise because of offshore and Petroleum Industries. In module 1, we are going to cover the following topics.

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We will talk about the environmental impact and management; we will talk about impact of oil and gas industries which has caused in marine environment. We will discuss about oil hydrocarbons and their effects in Marine Environment. Let us say oil spills and their effects in marine environment. We will talk about chemical disposal of offshore industries, and their consequences in terms of Environmental Management, then we will talk about variety of dispersion models, we will talk about atmospheric pollution, and we will also talk about hazard assessment which is caused due to environmental impact on offshore and oil industries.

Ladies and gentleman; let us first quickly ask the question; what are the primary environmental issues which bothers the environmental management, which arise essentially from oil and gas industries. So, let us talk about Primary Issues.

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We must realize that there is a huge impact caused by the oil and gas industry on the shelf ecosystems and marine biological resources. So, there is a huge impact, which is caused on 2 sectors by oil and gas industries; one is on the shelf ecosystems, the other is on the marine biological resources, essentially it disturbs the life hierarchy at different levels in Ocean Environments. The life hierarchy at different levels in ocean environment it significantly influences the marine ecosystem.

The biological consequences which arise from accidental oil spills, at oil spills though they are occurred because of accidents, result in serious biological consequences and the most important issue related to this is, the cause what is called Irreversible Impact. I mean they cannot be corrected that is very, very important. They cause irreversible effects on the ecosystem, which are very serious issues. So, that is the one of the most primary concern, what we have when we talk about environmental issues or factors influencing environmental management, which exclusively arise from oil and gas industries, there are of course certain visible consequences, one which one can see which arise as a result from oil production.

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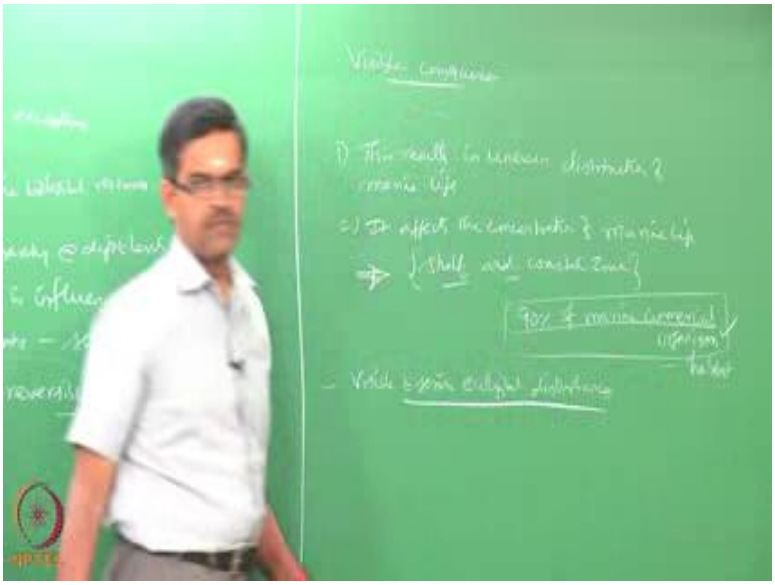

So, if ask me, what are the visible consequences which rise from the oil and gas production. Let us quickly list them; what they are the environmental pollution which is caused marine ecosystem creates complexities. Firstly, this results in uneven distribution of marine life in a marine life, which has got a balanced geographical distribution is now disturbed, and it affects the concentration of the marine life especially in shelf and coastal zones, because interestingly these are 2 areas now where people are focusing more on oil and gas production.

Also more interestingly these are the 2 zones where, 90 percent of the marine organisms actually habitat, actually they habitat here, therefore, if you disturb this particular area, because of the activities resulting from oil gas production. You are contributing or influencing majority of the marine commercial organisms, which are living in this specific sector. Interestingly ladies and gentleman most of the oil and gas fields are also located in the zone.

Therefore, they cause visible and serious ecological disturbances to understand this further, let us try to understand what recent trends in oil and gas resources? I mean earlier where they have been deployed the oil platforms and production units have been deployed. Now what is a current trend what is the research and development happening

in terms of oil and gas resource, identifications to understand this let us try to revisit the trends in oil and gas resources.

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Now, we are trying to address the oil and gas resource trend itself. We all know crude oil and natural gas, 2 things are playing major role in contributing to the total energy produced in the world. This is still increasing due to the high demand and increase consumption of this energy. So, there historical development is remarkable in terms of high dynamics. So, they have got or they have got to catered to high dynamics in demand. Therefore, they have to grow, there is a rapid technological progress, which is happening in terms of exploiting the resources of crude oil and natural gas, we have also seen there is a wide geographic of exploration going, which is taking place and this resulted in very wide production activities, ladies and gentleman it is important for us to know that oil and gas production or resource identification is not concentrated only on certain segments of the world geographically.

Now, in the present trend, you can see that there is a good wide variety of geographical distribution of exploration happening. That is resulted in lot of production activities in a wider range that is a recent trend, what we should understand from the economical growth of the world. So, let us try to categorize this in a better understanding let us see

what are difference source of energy we have.

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What are the difference source of energy which we try to exploit, and let say till about 1900s or 1990s or early 2000, what was the trend and what is going to happen optimally in another let us say 20 years. So, the essential source of energy could from oil, it could come from coal, it could come from natural gas can also come from renewable sources. Wave energy, wind energy etcetera, they can also of course, come from nuclear power. If you look at this trend very briefly, let us say a good amount of percentage comes from oil and coal and of course, a very feeble percentage from gas and expected to have a good contribution about 40 to 45 percent.

Let us say 40 to 45, which come from nuclear power and renewable sources that is, expected to happen, but looking at the recent trend and some of the inventions and some of the consequences of certain source of energy, which has been seen. It is projected in the literature that oil source will get depleted coal will also get defeated further gas is remained to say almost constant consistent, where as the focus is towards increase in renewable energy and with lower focus to nuclear power.

So, looking at this renewable sources, getting more importance in the future optimization

of energy development, energy resource identification, it is very clear that people have realized as on today that the consequences caused by the resources, what you have depleted from various geographical explorations has caused serious consequences environmentally to both mankind and to ecosystems. So, we can see the reference here my own book 2016b, please look at the reference list available in the NPTEL website of this course, you will be able to get the detail of this and try to see the authenticity of this specific report available from this text book. So, this table gives us very important information that there has been a significant growth and relative stabilization in the recent past of these resources there is also projection notice by William 1992, that there is going to be decrease in oil production.

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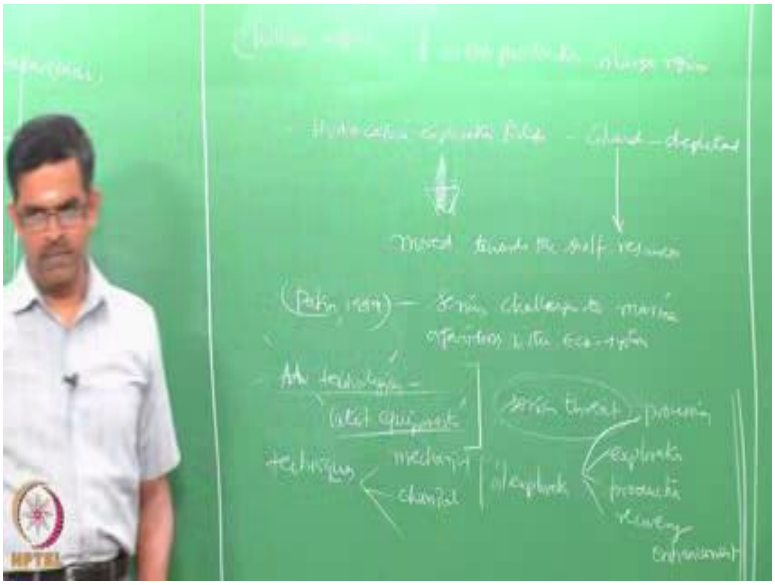

In large reasons, So, therefore, as a result of which hydrocarbon exploring fields located inland or now getting depleted the hydrocarbon exploration fields, which were located inland are now getting depleted because there is no oil reserve available and dangerously this shift has move or getting move towards the shelf resources, from the inland it is moving towards the continental shelf. So, this shift from the inland towards continental shelf is seen as one of the significant affect, which is going to cause ecological disturbance of marine organisms. So, if you look at Patin in 1999 in his report he stated that the shift from the Inland towards continental shelf will cause serious challenges to

marine organisms and the ecosystem. On the whole; one can ask me a question, what would be the technological no how which is going to be improve for oil exploration from that of the inland waters to that of continental shelf.

So, we should say that thanks to new technologies in drilling. Drilling is forcing to become possible even in Polar Regions. So, the advanced technologies which has been which are being planned to use for drilling in Polar Regions and the latest equipments because, the conventional equipments which we have been using in Inland is no more sufficient to use the continental shelf. So, the advanced technologies and the latest equipments which have been planed and developed for developing offshore hydrate resources are considered to be a serious threat to marine organisms or in general to the marine environment, many of the technical mechanical and chemical techniques, that have been followed for oil exploration production enhancement and processing are responsible for environmental issues.

So, there are techniques which people follow by mechanical means by chemical means in oil exploration in different sector, starting from exploration production recovery and processing or recovery enhancement and processing in all these sectors. Where there has been substantial advancement used in technologies and equipments took together, create serious threat to the marine environment in general. So, these are reasons why environmental issues as become a predominant talk of the day. When we talk about oil and gas industries we can give some examples on this.

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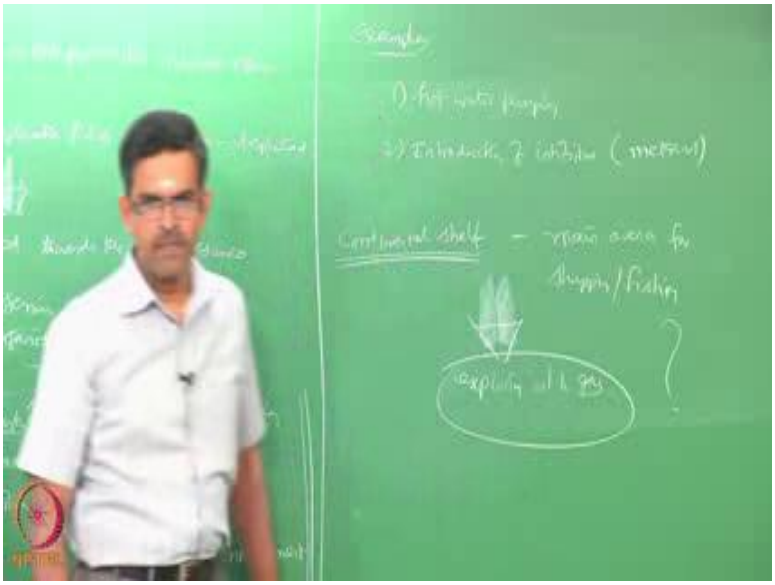

Let us list some examples; which are responsible or which expected to be responsible are good contributors for environmental issues which exclusively arise only from oil and gas industries, hot water pumping, introduction of inhibitors. For example, methanol we have been identified by the researchers as serious challenges to the marine environment.

Now, let see how we have disturb the total marine ecosystem by introducing or by over loading the exploratory measures in the continental shelf. The continental shelf which used to be the main arena for shipping and fishing is now transferred to a main resource for exploring oil and gas. So, this is a very interesting shift which mankind had done in the thirst of increasing and meeting the demand for oil and gas sector, which has moved the exploration essentially from the inland to the continental shelf areas which, predominantly used to be a main arena for shipping and fishing.

If you look at literature in the recent trends, you will come to know that the prospective location of oil and gas fields in the shelf zones have started over lapping the regions with high biological productivity. Wherever there has been good amount of fishing production happening these fields, these areas geographically has been now over lapped by oil and gas exploration sector, which is one of the important concern on environmental issues which arise essentially from this industry adding to this the recent exploration of gas

hydrates which has become a very promising area is unfortunately I should say is also found in the marine regions. So, exploration of gas hydrates is also being found in the marine regions is an added threat now.

So, their developments in terms of gas hydrate fields are presently seen as a potential threat to the marine environment. Now let us ask a question anthropogenic impact of hydrosphere which has caused by oil and gas industries.

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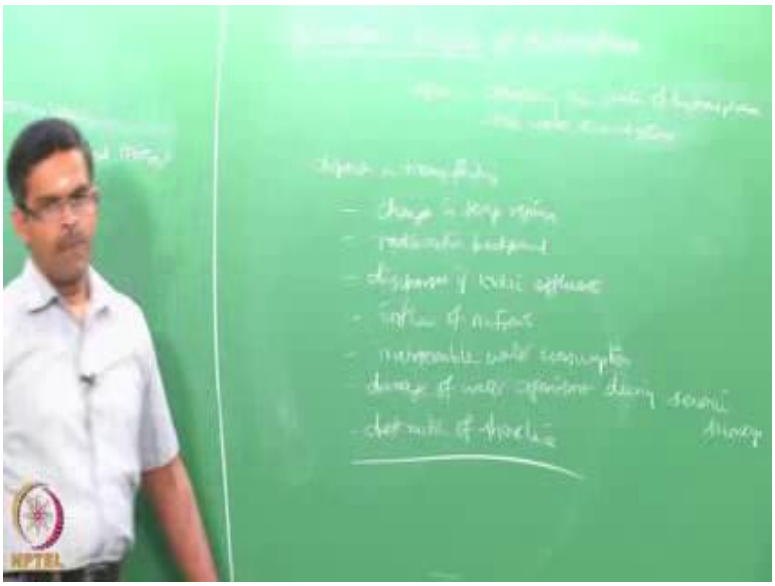

So, I am talking about anthropogenic impact caused impact of hydrosphere caused by oil and gas industries anthropogenic impact refers to assessing the state of hydrosphere and water ecosystems. So, if you want to analyze and assess the condition of the existing hydrosphere water ecosystem, I call that as anthropogenic assessment. Now I am looking at the impact caused on the hydrosphere because of oil and gas industries. So, to understand this, let us try to know what those factors which influence such impact analysis are. So, anthropogenic impact essentially depends on many factors, it causes changes in temperate regime it creates a radioactive background, it discharges toxic effluents. Discharges of toxic effluents inflow of nutrients irretrievable, water consumption, damage of water organisms during seismic surveys landing of commercial pieces in their cultivation and destruction of shoreline. Let us try to understand how this

impact is analyzed and studied in different sector.

Let us divide the different region geographically into three parts; a local regional and global let us divide the impact assessment in three parts.

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Let us say local regional and global, let us talk about different activities which are present during hydrocarbon exploration. Let us take the first activity, let us say liquid and waste and solid waste discharged as one of the activity, which use to happen which very common in case of hydrocarbon exploration. Let us try to see, what the influence of this is in terms of ecological and fishery and sanitary hygienic point. Let us say hygienic point ecological, point and in fisheries point of view, locally they are weakly represented there is no impact in the regional level again there is weak of course, the discharge is completely local.

Therefore, there is no global effect is of set in terms of ecological impact if you look at fisheries again there is a weak representation because the liquid and solid waste discharge, which happens from the drilling system or from the oil exploration production system is highly local and this also weakly represented. So, it is concentrated where as if look at the subsea pipeline is another activity, which may essentially cause chemical

pollution it is responsible for chemical pollution in the local sector, it has a very considerable impact.

So, the high volume of chemical may be discharged from the leak pipes which are very important and in the fisheries sector regionally it causes very high impact, the next activity which is also bothering is the offshore structure abandonment, let us say the offshore structure if want to abandonment structure, want to discard a structure. For example, the structure located in a specific space is of no use because; oil exploration is completely exploited and completed there. You have to get rid of the system what we call decommissioning or abandonment. So, the abandonment causes a very considerable impact both in local and regional level for fisheries.

The fourth could be accidents, which do happen in oil gas industries they also cause chemical pollution. They also cause chemical pollution, they create a very hygienic impact in the local sector significantly, the ecological disturbance is very high in the local sector, where as in regional and global they are not represented and in the fisheries sector in the local sector they have a very high impact.

So, different activities start from liquid and solid waste discharge laying maintaining subsea pipelines offshore structures, discarding or abandonment and accidents. They have different impact in ecosystems which is divided into three regions or three sectors, which is local regional and global and we studied this we understood that effect on 3 different levels that is in hygienic perspective in ecological perspective in fisheries perspective, where we have summarized that these are the impacts caused by these activities which essentially arise only from oil and gas exploration or hydrocarbon production systems.

If you now consider the anthropogenic impact on hydrosphere by land oil and gas production. So, far we have been seen the offshore part of it if we really wanted to see what is the effect of the land oil and gas production on anthropogenic effect or impact on hydrosphere.

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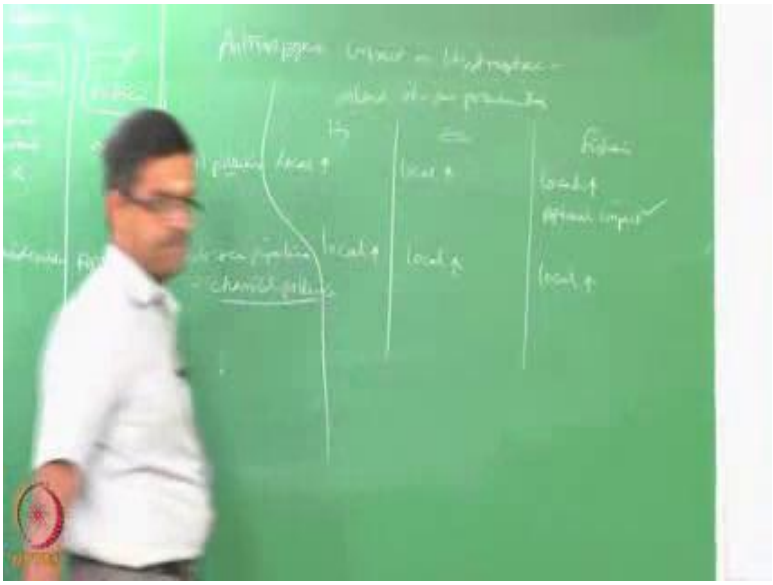

Anthropogenic impact on hydrosphere caused by on land oil and gas productions of that, the earlier one what we saw was the offshore production system. So, now this can activity can be oil pollution, which can have in the hygienic perspective or in the ecological perspective or in the fisheries perspective. Locally the damage is very high, where the oil pollution is being notified it affects locally the ecological disturbance of the system very high significantly it does not spread to the region, it does not spread globally at all; however, in the fisheries sector the local impact is significant, it also has a regional impact subsea pipelines are also lead for oil and gas production, which results in chemical pollution their local impact in hygienic perspective is very high, their local impact in ecological perspective is very high and the local impact in fisheries perspective is also very high.

So, there are different areas both show an onland oil and gas production different activities contribute to different levels of hygiene ecological and fisheries disturbances cause a 3 levels, local regional and global. So, of course, this comparative discussion tells you only a qualitative value or comparable value between these in terms of different perspectives quantitatively. These values are also be discussed in a subsequent lectures, but it is very important note that how the activities of oil and gas industries start affecting from the local to that of global or regional in different perspectives, it affect the manual

culture it disturbs the ecological system it also affects the hygienic and social systems and sanitary system, very seriously in different activities what we just now discussed in the black board.

So, ladies and gentleman, we are trying to identify different causes for environmental management or crises, which is arising from exclusively oil and gas industries are from hydrocarbon production systems. We are trying to see what are the factors which influences the ecological disturbances, which pick and choosing arise only from hydrocarbon production systems, we will also discuss in later part of the lectures how they can be managed how they can be modeled, how they can be controlled, how they can be assessed, which we will discuss in subsequent lectures in this module.

In the first module we are taking about environmental management issues in the first lecture, we just introduced what are factors that are responsible for ecological disturbances that essentially arise from oil and gas production systems.

Thank you very much.