Structural Health Monitoring (SHM)
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Lecture – 50
Sensing requirement in special structures

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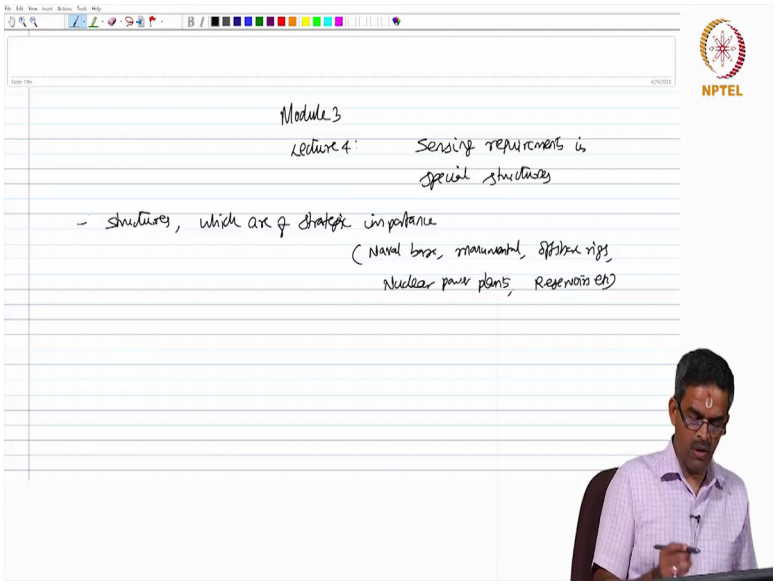

Friends, welcome to the next lecture in module-3 which is lecture-4 where we will talk about the sensing requirements in special structures. The question is we are interested to know why health monitoring is important in certain structures and we will try to link this with the use of smart sensors in these structures.

The moment we say special structures, structures which are of strategic importance like naval base, monumental structures, offshore platforms, nuclear power plants, let say big reservoirs etcetera. These are all special structures because of various reasons let us pick up one specific example one classification and see.

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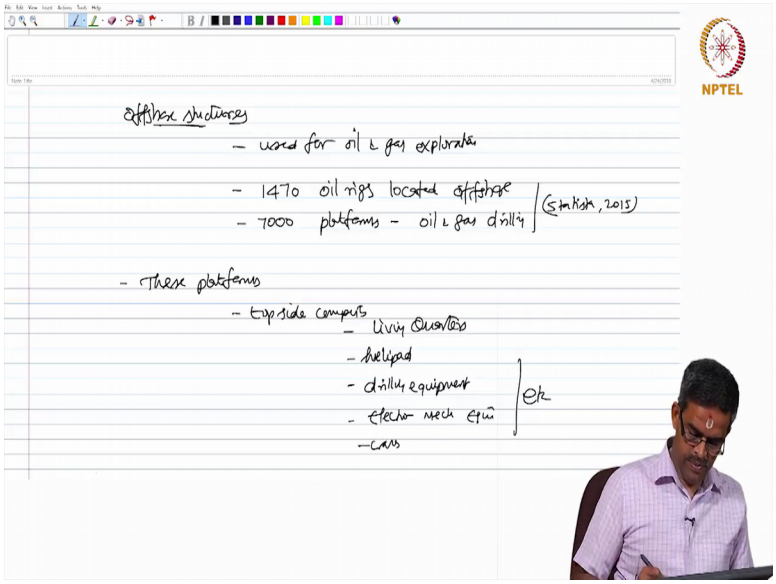

Let us talk about offshore structures they are essentially used for oil and gas exploration to have a statistics. There are about 1470 oil rigs located offshore; offshore means away from the coast; offshore and about 7000 platforms which perform oil and gas drilling in the world ok. Statista, 2015 verifies this fact. These platforms have top side components which include living quarters, helipad, just to give an idea of the requirements drilling equipments, electro mechanical equipments, cranes, etcetera.

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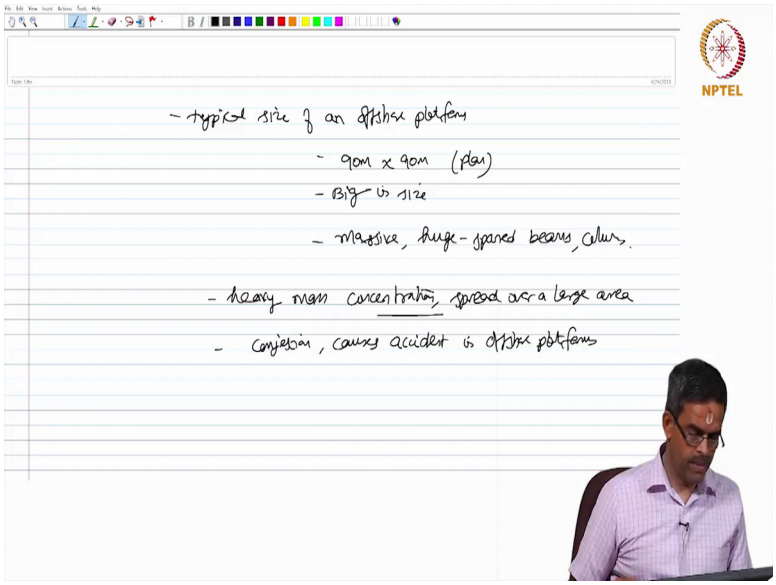

Your typical size of a platform is about 90 meters by 90 meters in plan which is quite big. And they are massive huge spanned structures. They have heavy mass concentration spread over a large area that is one of the important congestion which causes accident. So, I should say this is a congestion which causes accident in offshore platforms.

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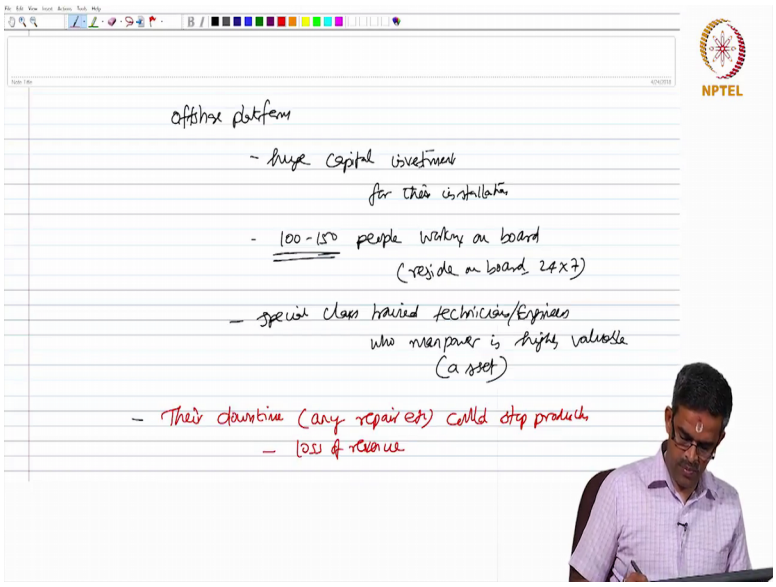

In addition offshore platforms have huge capital investment for their installation, even before it operates to start earn revenue. It has about 100 to 150 people working on board or I should say at least reside on board 24 into 7.

Now, this 150 people is a special class trained technicians and engineers whose manpower is highly valuable that is very important that is an asset to the platform. Therefore, interestingly their downtime because of any repair etcetera could stop production which results in loss of revenue.

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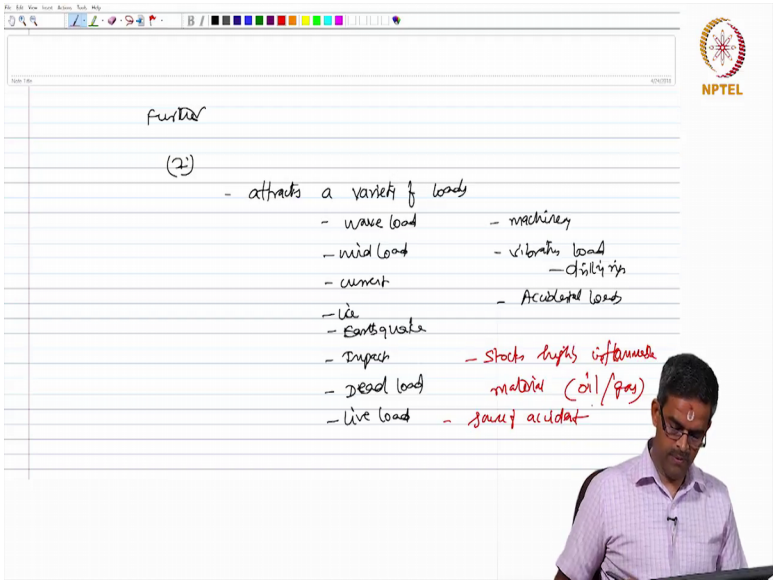

Further, that is one level of complication, the second level of complication is it attracts a variety of loads, wave load, wind load, load from current, load from ice, load from seismic activities, load because of impact, of course dead load and live load are very common, then machinery loads, vibration loads because of drilling rigs, it also has accidental class loads. Moreover, it stocks highly inflammable material that is oil and gas crude oil and gas which is the primary source of accident ok.

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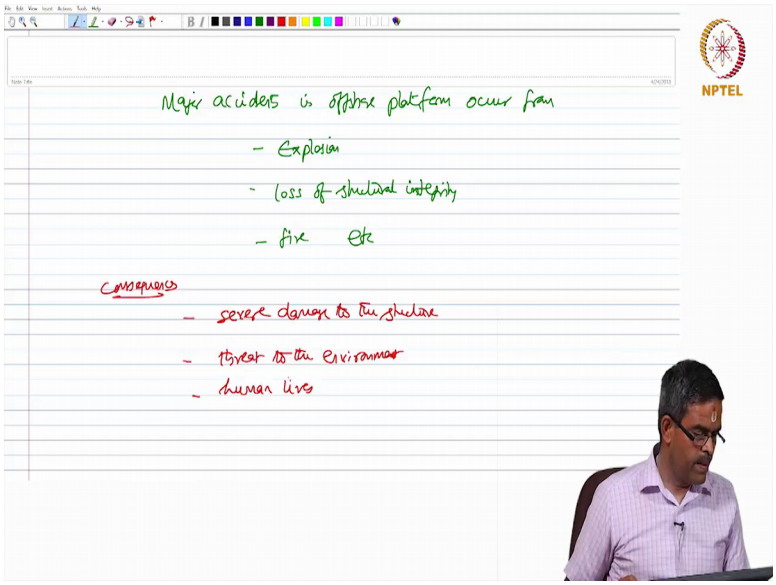

If you look at the statistics major accidents in offshore platforms occur from explosion, loss of structural integrity, and of course, due to fire. The consequences are very severe. There is a severe damage to the structure. There is a threat to the environment and human lives.

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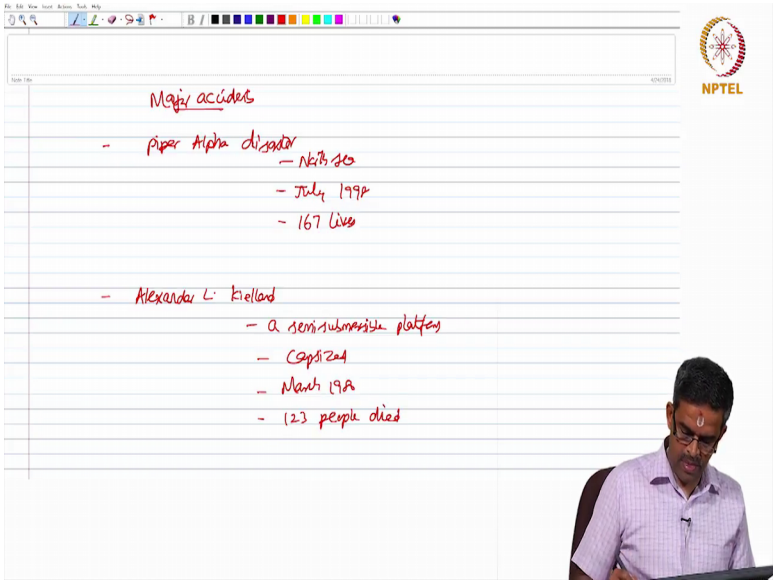

Offshore platforms handle hazardous chemicals like petroleum products, oil and gas which have the potential to cause major accidents. Therefore, one can say risk is implicit in oil and gas exploration activity.

There are a few major accidents which occurred in offshore Piper Alpha disaster occurred in North Sea in July 1998 lost about 167 lives. The next is Alexander Kielland a semi submersible platform; the platform capsized happened in March 1980 killed about 123 people died.

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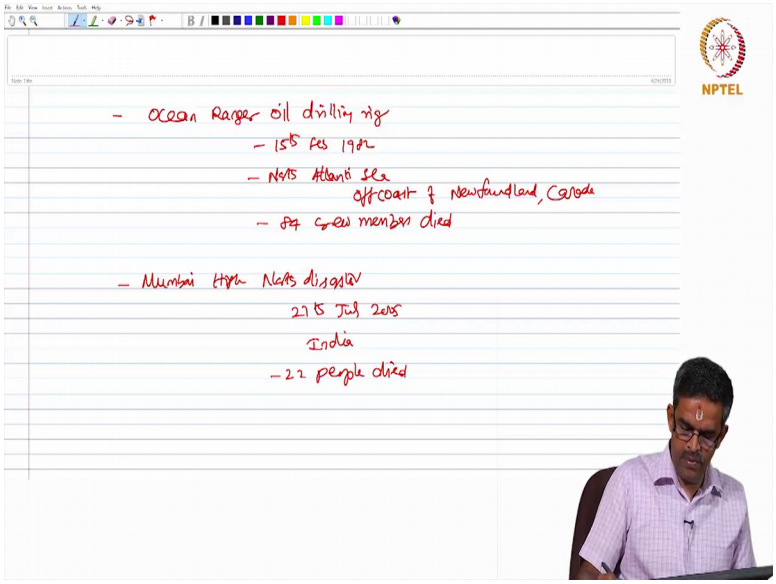

The third one is Ocean Ranger oil drilling rig occurred in 15th February 1982 in North Atlantic Sea located off coast of New Found Land, Canada, 84 crewmembers died. The next one is Mumbai High North disaster occurred in 27th July 2005 in India 22 people died.

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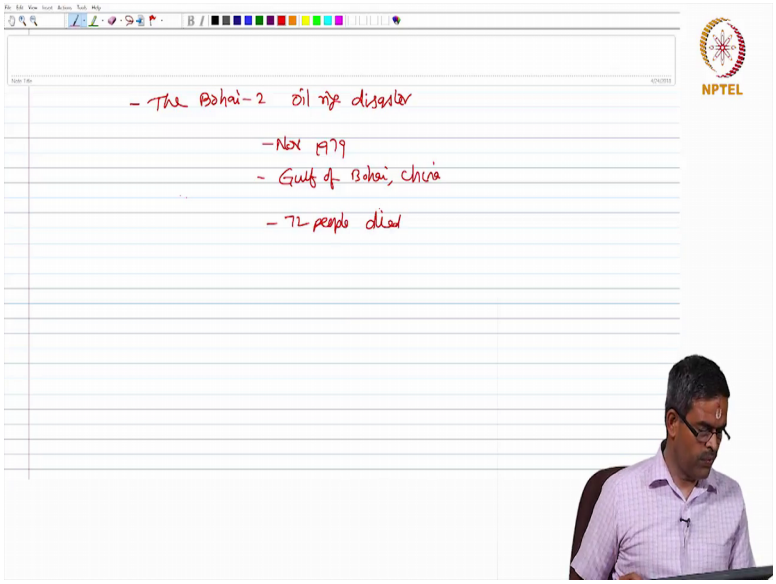

The next one is the Bohai-2 oil rig disaster occurred in November, 1979 in Gulf of Bohai, China 72 people died.

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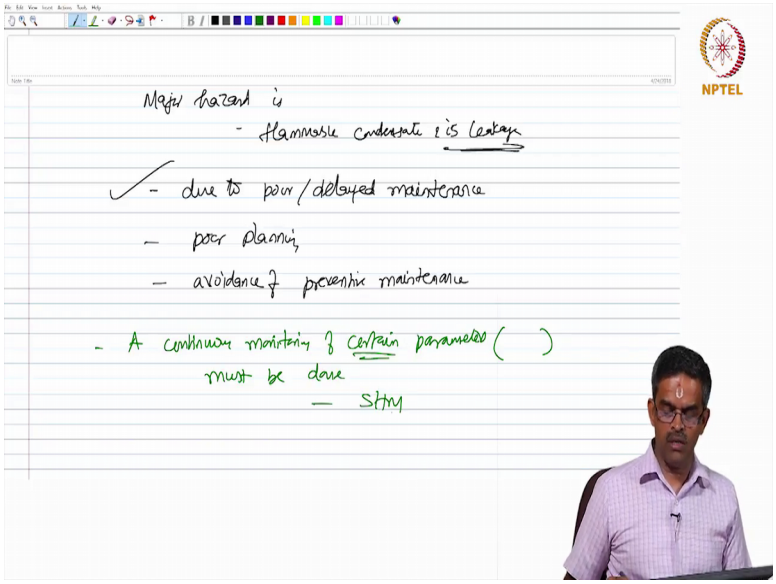

So, friends the major hazard in all above accidents is the flammable condensate and its leakage. This is essentially due to poor or delayed maintenance, because leakage occurs whenever there is a crack in pipe, when the system is fault or when the damages occurred on the mechanical electrical systems which are not monitored continuously.

So, delay or poor maintenance and very poor planning, and avoidance of preventive maintenance; so, the essential solution must have been a continuous monitoring of certain parameters not necessarily the structural parameters, there are many parameters which are monitored. Temperature is one, humidity, stress on the board or on the deck etcetera, certain parameters must be done which needs a healthy structural health monitoring.

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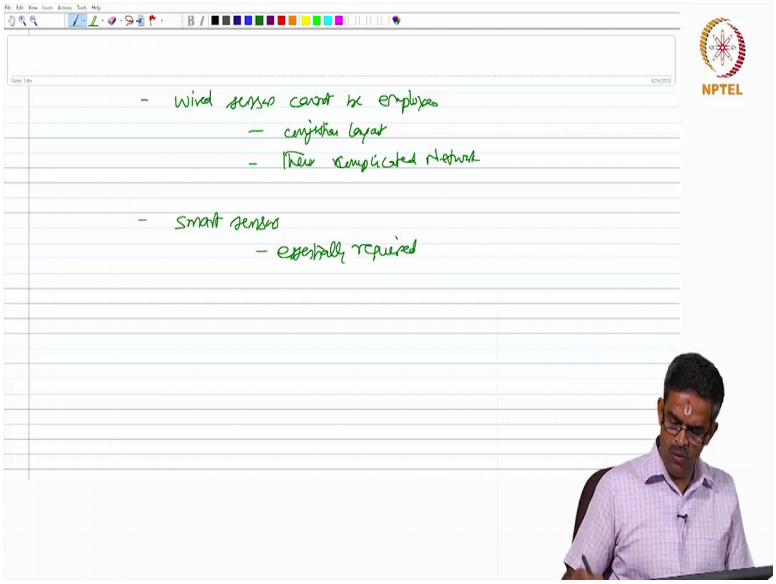

And now the question is why are sensors cannot be employed because of their congestion layout, and they are complicated network. Now, we need to go for smart sensors which are essentially required under such situation.

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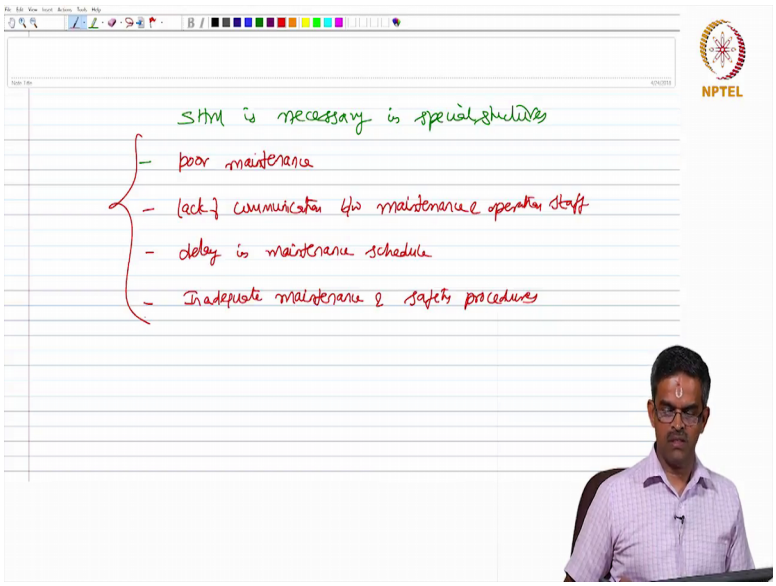

So, now we can say that structural health monitoring is necessary in special structures due to various reasons because these structures have shown poor maintenance. Next, there is a lack of communication between the maintenance staff and operational staff. In many cases this was one of the reasons for the cause of accidents. There has been a delay

in the maintenance schedule there were records of inadequate maintenance and not following safety procedures.

If I put across these as important reasons for these accidents which are occurred sequentially in various parts of the world on special structures like offshore structures where the revenue is lost because the downtime has happened, and they are naval structures by their geometrical formation, and their location importance which are very necessary for the economic strength of the respective countries and nation.

So, health monitoring investment is actually not a liability, but an asset to activate a preventive maintenance and improve safety and strengthen the economy of these kind of structures and the country where they are located.

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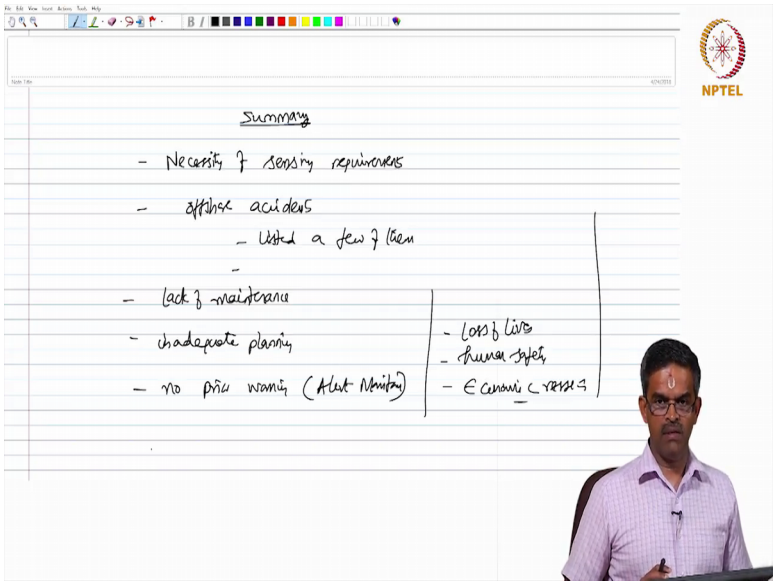

So, friends we have slowly understood the necessity of sensing requirements. We have understood what are the major causes for offshore accidents. We have listed a few of them, which can indicate that lack of maintenance, inadequate planning, and no prior warning that is called alert monitoring was available which resulted in loss of lives and challenged the human safety and also causes the economic recession.

So, health monitoring using smart sensors could be one of the alternate solutions to improvised safety and to strengthen economy through maintaining this kind of strategic structures. We will understand how the sensor networking can be modified and adapted

the suit to the offshore structural requirements. Then we will discuss about the case studies where we have done at IIT Madras to show on the lab scale how wireless sensor networking can be useful in case of structural health monitoring of offshore platforms.

Thank you very much and bye.