

## EXPLOITATION OF ENERGY RESOURCES OFF SHORE AND ON SHORE DRILLING IMPACT ON MARINE ENVIRONMENT

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### ABSTRACT

*The demand for energy resources is enhancing worldwide, offshore oil drilling is viewed by some as a lucrative solution to rising oil process. Offshore drilling is already being explored in several regions around the world, while offshore drilling may provide additional fuel for the world's growing appetite for oil, there are several environmental impacts to consider. They include Oil Discharges/Spills wherein most oil spills take place when oil is being transported via tanker and not during actual offshore drilling. Drilling Fluid Discharges where in Drilling mud and cuttings can contain toxins and radioactive materials from underground which have to be handled carefully to prevent pollution of the outside environment. This paper will address an extensive coverage on the exploitation of Energy Resources, off shore and on shore drilling impact on marine environment and case laws.*

**Keywords:** Oil Drilling, Marine Environment, Energy Resources, Drilling Muds, Offshore Drilling.

### Introduction

Oceans have historically played a significant role in shaping global history.<sup>1</sup> About seventy percent of the earth's surface is covered by water. As a medium of navigation and travel, the sea has long facilitated world exploration and trade. As a source of immense resources, it has been the lifeblood of human communities from time immemorial<sup>2</sup>. Marine pollution is a world problem in several senses. It affects the health of oceans in all parts of the world, it affects all nations, both developing and developed and all countries contribute to some aspects of the problem<sup>3</sup>.

The constant demand for oil means that the discovery of offshore oil in a developing country is usually perceived to bring an economic bonanza and Ghana's discovery of Oil and Gas in its continental shelf has raised a lot of considerable expectation both at home and abroad. Offshore Oil and Gas extraction takes place in a complex web of ships, structures, installations, and people all interacting with one another. It also involves a multiple use of sea environment involving existing sea lanes for commercial and military vessels, productive fishing grounds, with countless number of fishing vessels and marine mammal interactions.

### Various Concepts

- **Energy Resources:** Energy is a fundamental component to our daily lives, and every day we use energy in some form or another. The law of conservation of energy emphasizes that energy can neither be created nor destroyed, this means that as energy is used, it does not disappear, but rather, is converted into another form of energy. For example, automobiles use energy from gas that is converted into chemical energy which is further converted into mechanical energy. Thus, energy is all about performing work. Animals and humans require energy resources in order to function, and machines do not function any differently, they require energy resources to work as well.

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<sup>1</sup> Naidu, G.V. C. *India and Indian Ocean*. Edited by Ajaya Kumar Das, S.Rajaratnam School of International Studies, 2013, pp.236-259, India Asean Defence Relations, www.jstor.org/stable/resrep05896.13. Accessed 19 Oct. 2020.

<sup>2</sup> Sam Blay, Ryszard Piotrowicz, et al. (eds.), *Public International Law an Australian perspective*, 324, Oxford University Press, New York, second edition 2005.

<sup>3</sup> Oscar Schachter and Daniel Serwer, *Marine Pollution Problems and Remedies*, 65 Am.J.Int L. 84 1971, <http://heinonline.org/HOL/LandingPage?handle=hein.journals/ajil65&id=&page>.

- **Renewable Energy Resources:** The Renewable energy resources are energy resources that are directly available, immediately accessed, and can be consistently replaced. In other words, renewable energy resources are energy resources that replace, or renew themselves and that will never run out. Solar energy, energy that is harnessed from the sun, is a good example of one of many renewable energy resources, because we will never run out of the sun's rays or its power. Other eg. of renewable energy sources include wind energy, water energy, and wave energy.
- **Offshore Drilling:** Offshore drilling is mechanical process where a wellbore is drilled through the seabed. It is carried out in order to explore for and subsequently extract petroleum which lies in the rock formations beneath the seabed. Most commonly, the term is been used to describe the drilling activities on towards the continental shelf, though the term can be applied to the drilling in lakes, inland seas, and inshore waters.
- **Onshore Drilling:** There are two important types of onshore drilling. Percussion, or 'cable tool' drilling, which consists of raising and dropping a heavy metal bit into the ground, effectively punching of a hole down through the earth. Cable tool drilling is usually used for shallow, low pressure formations. The second drilling method is known as rotary drilling, and consists of sharp, rotating metal bit used to drill through the Earth's crust. This type of drilling is used basically for the deeper wells, which may be under high pressure.<sup>1</sup> Drilling into Earth in the hope of uncovering valuable resources is not new. In fact, the digging of water and irrigation wells dates back to beginning of recorded history. At first, these wells were basically dug by hand, then by the crude stone or wood tools.
- **Cable Tool Drilling:** Percussion drilling or cable tool, is recognized by many as the first drilling method employed to the dig wells into the earth for the purpose of reaching the petroleum deposits and water. This method is still in use in some of the shallow wells in the Appalachian Basin, although the rotary drilling has taken over the bulk of modern drilling activities.
- **Horizontal Drilling:** Horizontal drilling is flexible, and it allows for extraction of natural gas that has previously not been feasible. Although on the surface it resembles like a vertical well, beneath the surface, the well inclines so that it runs parallel to the natural gas formation. Horizontal drilling allows one surface well to branch out the underground and tap many different natural gas resources. It also allows the well to make the contact with larger areas within productive formations. Horizontal drilling is a type of directional drilling. Horizontal drilling uses a technique known as the hydraulic fracturing in order to extract natural gas from geologic formations.<sup>2</sup>
- **The Environmental Impact on Oil Drilling:** Every stage of oil drilling from finding oil reserves to its waste disposal affects the environment every day. Due to oil drilling marine life, birds, terrestrial wildlife, workers, as well as the scenery itself are all affected.

There are various stages of oil drilling and each stage will affect the environment as following:

- **Oil Exploration:** One type of seismic waves is sent into the ground of sea to investigate offshore oil reserves. This type of investigation disorients marine life. For example, this investigation can lead to beaching for whales.
- **Infrastructure:** Extensive infrastructure is required for oil drilling which includes roads, jet-landing strips and pipelines etc. This type of infrastructure can disrupt wildlife and also it can grind down plants. Such infrastructures can terrorize the breeding grounds of caribou and polar bears nearest to the Arctic National Wildlife Refuge.
- **Risk of Spills:** It is very difficult to clean up oil which is spilled. Spills are common; about 300 to 500 occur each year, on various scales. On water, oil spreads quickly and makes a layer. The oil slicks are fatal to birds, marine life and other wildlife.
- **Waste Water:** As a by product of oil drilling, water is produced this contains polycyclic aromatic hydrocarbons in high concentrations. These aromatic compounds are lethal to marine life and in low concentrations it cause birth defects or impaired growth.
- **Sludge:** Mud, Slimes and Sludge are the another by product of oil drilling which contain TENORM (technologically enhanced naturally occurring radioactive material). By two methods the sludge is disposed off. This method includes land-farming and tailing ponds, which can be fatal to migratory birds.<sup>3</sup>

<sup>1</sup> [http://.answers.com/Q/What\\_is\\_onshore\\_drilling](http://.answers.com/Q/What_is_onshore_drilling).

<sup>2</sup> [http://www.naturalgas.org/naturalgas/extraction\\_onshore.asp](http://www.naturalgas.org/naturalgas/extraction_onshore.asp).

<sup>3</sup> <http://letmeget.com/blog/offshore-oil-drilling-environmental-impact>.

### Impacts of Offshore Drilling

Offshore drilling operations create different forms of pollution that have considerable negative impact on marine and other wildlife. It covers brine wastes, drilling muds, flowline, pipeline leaks deck and runoff water. Blowouts and Catastrophic spills are also a severe threat from offshore drilling operations. Drilling of muds and produced water are disposed of daily by the offshore rigs. offshore rigs can pile tons of drilling fluid, including toxic metals, such as and mercury and chromium, as well as the carcinogens, like the benzene, in ocean.

### Effects of the Drilling Muds

Drilling muds are used for lubrication and cooling of drill bit and pipe. The muds remove the cuttings that come from the bottom of the oil well and help prevent blowouts by acting as a sealant. One drilling platform can normally drill between seventy to one hundred wells and discharges equal to or more than 90,000 metric ton of drilling fluid and metal cutting into ocean.

### The Effect of Produced Water

Produced water is a fluid trapped underground and brought up with oil and gas. It makes upto about 20 percent of the waste associated with offshore drilling. The Produced waters usually have an oil content of 30 to 40 parts per million. Thus as a result nearly 2 billion gallons of produced water is released into the Cook Inlet in Alaska each year containing 70,000 gallons of oil.

- **Effects of Exploration:** Factors other than the pollutants can affect marine wildlife as well. Exploration for offshore oil involve firing air guns which tend to send a strong shock across the seabed that may decrease fish catch, damage the hearing capacity of various marine species and may lead to marine mammal strandings. The drilling waste including the metal cuttings from exploratory drilling are hereby generally dumped in ocean, rather than been brought back up to the platform.
- **The Effects of Offshore Oil Rigs:** Offshore oil rigs may attract the seabirds at the night due to the lighting and flaring and because the fish aggregate near them. Bird mortality has been associated with the physical collision with rigs and as well as the incineration by flare and the oil from leaks, The drilling activity around the oil rigs is suspected of contributing to the elevated levels of mercury in Gulf of Mexico fish.<sup>1</sup>
- **Oil Drilling on Land and Sea:** Drilling for oil involves penetrating through various layers of the earth surface to reach, deposits of hydrocarbons. Drilling goes on both below the subsoil on land or below the seabed.<sup>2</sup>
- **Onshore:** A surface hole is drilled down to a pre-set depth, which is somewhere above where the oil trap is located. This assembly and the drill-string is suspended and manipulated from the derrick, the working area on the rig.
- **Rotary Movement:** Depending on type of well rotary movement will be generated mainly by three ways.
  - The transmission of the rotary motion by pipe, called the Kelly which is generated at surface by the rotary table.
  - By the power swivel which is connected directly to last drill pipe
  - By the drilling turbine or engine at the bottom of the well itself. (turbo-drilling)<sup>3</sup>
- **Circulating Drilling mud:** The Drilling mud is pumped, using mud pump, through the core of drill-string and comes out to surface passing through the space between the drill pipes and the well. Drilling mud performs these five essential functions namely
  - Cools drilling bit,
  - Lubricate drilling bit,
  - To consolidate walls of well-bore,
  - Exercise the pressure such as to contain the flow of oil, gas or water from a drilled formation,
  - Cleans the bottom of the well.

<sup>1</sup> <http://oceana.org/en/our-work/stop-ocean-pollution/oil-pollution/learn-act/impacts-of-offshore-drilling>

<sup>2</sup> <http://www.offshore-environment.com/anthropogenicimpact.html>

<sup>3</sup> E&P Forum/ UNEP technical Publication, . Environmental Management in oil & gas exploration and Production: An overview of issues and management approaches. UNEPIE/PAC Technical Report 37.

When the drilling has reached to a certain depth a new drill-pipe will be added to the drill-string, this procedure is then repeated until a preset depth is thereby reached, then twell-bore is cased using the steel casing which are lowered into well-bore and cemented in place to control fluids emitted from well.<sup>1</sup>

For next drilling stage a drill bit of smaller diameter is lowered into bore inside the surface casing, and operations proceed in same manner as before. The drilling bit needs to be replaced regularly, which involves with drawing entire drill-string. As drilling advances there is a drilling log which is maintained in regards to drilled depth, the nature of the rock and fluids encountered. This log is of a great value to geologists and geophysicists.<sup>2</sup>

- **Offshore Drilling:** The offshore drilling has some additional constraints in regards to the depth of water, climatic conditions and the remoteness from the logistical base. The main difference between onshore and offshore drilling is related to the way in which the rig is supported. Offshore operations are conducted from platforms which either float or are fixed to the sea bed. In addition to the functions carried out at an onshore drilling site, offshore drilling rig has diver support and a meteorology station.<sup>3</sup>

### Impacton Marine Environment

The entire globe depend on the trade or production of oil to fuel its economies, these activities can harm severe damage to the environment. Oil production and/or transportation can disrupt the human population and animal and fish life. Oil waste dumping, spills wreak havoc and production pollution on the surrounding habitat and wildlife. It causes severe threat to the extinction of several plants and has already harmed many land, air and sea animals and plant species. There percussion of oil on marine life are caused by either chemical components (toxic effects and accumulation leading to tainting) or by physical nature of the oil (physical contamination and smothering). Further, marine life may also be affected indirectly through physical damage or by clean-up operations to the habitats in which the plants and animals live. The plants and animals most at risk are those that come into close contact with a contaminated sea surface; marine animals and reptiles; form flock on the sea or birds that feed by diving; marine life on shorelines; and animals and plants in marine facilities. Tons of toxic wastes can be dumped into nearby waters from runoffs from petroleum processing plants and petrochemical plants. Entire bays and lagoons along coast can be fouled by oil spills and runoffs of toxic chemicals.<sup>4</sup>

The ecosystem damage is a result of oil retraction and production can also directly affect human life. Damage covers pollution of water resources and contamination of the soil. Humans are affected by environmental devastation because it is damaging to vegetation, livestock and the health of the human body itself. Oil spills affects marine life and sea birds as well as exposing the coastal belt and the entire ecology to all forms of dangers. Spills requires huge financial commitment and highly trained professional to clean up which takes months or even years.<sup>5</sup>

One of the most crucial human-caused environmental disasters, the Exxon Valdez oil spill which occurred in Alaska in March 1989, spilled 10.8 million gallons of Prudhoe Bay crude oil into the sea and eventually covered 11,000 square miles. Clean up cost alone was about US \$2.5 billion and total cost (including fines, penalties and claims settlements) was about US \$7 billion (Evans 2009).

The protection of the world's oceans from pollution is an environmental issue of immense international concern. Waste management planning and its implementation is an important economic, environmental, technical and administrative issue for national and international agendas. The most considerable purpose of waste management plans and reception facilities is to reduce and eliminate dumping of wastes illegally in to the sea environment.

One of the crucial challenges facing Ghana is ensuring that our environment is not polluted in the discharge of waste from the activities of the oil and gas industry, hence the need for environmental guidelines. The government of Ghana has emphasized that it will not compromise on any activity that will affect the safety and economic lives of the local fishing communities and the country as a whole.

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<sup>1</sup> Seismic Environmental Statement: Forth Approaches. Shell U.K. Exploration & Production, 69 pp  
<sup>2</sup> Garrity, S., Levings, S., Burns, K.A., . The Galeta oil spill I, long term effects on the structure of the mangrove fringe. Estuarine, Coastal and Shelf Science 38: 327-348.  
<sup>3</sup> <http://www.brighthubengineering.com/fluid-mechanics-hydraulics/4705-oil-drilling-on-land-and-sea>.  
<sup>4</sup> Shimamura, Y., FPSO/FSO: State of the art. Journal of Marine Science and Technology, 7: 59-70.  
<sup>5</sup> <http://globallast.imo.org> Greenpeace UK, Amendments to the London Convention: Discharges from the offshore industry: The environmental effects of oil and gas exploration and production. London: Greenpeace.

The oil and gas industry affects on people and the environment in three ways; through climate change, operations on land and sea and through positive or negative impacts on national economies. Unregulated actions by the oil industry destroy habitats and damage biodiversity. Oil spills at sea can damage mangrove forest, coral reefs and fisheries, both through major accidents and regular leakage from tankers, loading buoys and drilling rigs and platforms. Transport of oil is also implicated in ecological damage. However, offshore exploration and production activities are not without disadvantages. Offshore development, especially deepwater development, requires a significant technological investment. All these risk must be properly managed in accordance with the international and national regulations to ensure that the country benefits from the oil find.<sup>1</sup>

### Marine Boundary Disputes

- **India and Bangladesh:** Bangladesh went for arbitration over delimitation of the maritime boundary under United Nations convention on law of sea on October 8 2009, the court also concluded the hearings on Dec.18, 2013 in the Hague, the argument highlighted on key points including the location of the land boundary terminus, delimitation of territorial sea, exclusive economic zone, and the continental shelf within and beyond 200 nautical miles, The judgement was delivered with the united nations awarding to Bangladesh 19,467 sq. kms of the total 25,602 sq. kms. of area of Bay of Bengal. The UN Tribunal's award has delineated the course of maritime boundary line between the India and the Bangladesh in the territorial sea, Exclusive Economic Zone (EEZ) and continental shelf within and beyond 200 nautical miles (nm)<sup>2</sup>.
- **India and Srilanka Maritime Dispute:** The boundaries of Sri Lanka and India<sup>3</sup> are separated by sea waters. Despite existence of two maritime agreements of 1974 and 1976 with Sri Lanka, maritime issues stills persists. The important maritime issue with Sri Lanka is that of status of Kachchativu, a small barren island in the Palk Bay area. Though, India consented on Srilankan sovereignty over the area but due to certain reservations for the Indian fishermen which were agreed by both nations have been permitted to have restricted access to Kachchativu island with the object of fishing.
- **The Chinese Objection to Indian Naval Presence and Oil Exploration:** On the 22nd July, 2011, the INS Airavat, an Indian amphibious assault vessel on a visit to Vietnam, was reportedly contacted around 45 nautical miles from Vietnamese coast in the disputed South China Sea by a party identifying as Chinese Navy and stating that the ship was entering Chinese waters<sup>4</sup>. Further, a spokesperson for the Indian Navy described that as no aircraft or ship is visible, the INS Airavat then proceeded on her onward journey as per scheduled. The Indian Navy clarified that there was no confrontation involving INS Airavat, India supports freedom of navigation in the international waters, including in the South China Sea, and the right of passage in accordance with accepted principles of the International law and these principles should be respected by all<sup>5</sup>.

### Recommendations

While promoting the economic progress of offshore gas and oil reserves, all activities undertaken by the industry in the Exclusive Economic Zone and Continental Shelf beyond the manner.

Operators undertake to organise all activities to the standard of a genuine and prudent operator, and undertake to ensure such standards extend to all aspect of their operations including environmental management principles, Continental Shelf beyond the Territorial Sea and practices pertaining to the Exclusive Economic Zone. While undertaking petroleum exploration, development and production activities, industry should adopt and apply the best practicable options to minimize adverse effects on the marine environment, including marine habitats and communities. However, consideration should be given to:

<sup>1</sup> Al-Hadhrani, M.N., Lappin-Scott, H.M., Fisher, P.J. Bacterial survival and n-alkane degradation within Oman crude oil and mousse. *Marine Pollution Bulletin* 30(6): 403-408.

<sup>2</sup> Kush Kumar Gayasen, "India's Maritime Strategy and the Sino-India Interface N Sathiya Moorthy, "Contextualizing India-Sri Lanka Relations: Present and the Future", *Journal of Indian Ocean Studies*, vol 2, (2014): 201

<sup>3</sup> Smruti S. Pattanaik, "India –Sri Lanka Fishermen Problem", IDSA, [www.idsa.in/idsacomments /India SriLanka FishermenProblem\\_gsen\\_180614.html](http://www.idsa.in/idsacomments/India_SriLanka_FishermenProblem_gsen_180614.html).

<sup>4</sup> Tanvi Mathur, *International Maritime Disputes Of India*, <http://legalserviceindia.com/legal/article.html>

<sup>5</sup> Section 2(e), Piracy Bill, 2012.

- Water materials and transport, the efficient use of energy,
- Appropriate waste management procedure for the prevention, minimization, recycling, treatment and disposal of waste.
- Life-cycle impacts procurement decision
- Appropriate procedures to avoid offshore installations introducing exotic organisms by fouling and ballast water
- Appropriate procedures to avoid any exotic organisms being transferred around by hull fouling on service vessels.<sup>1</sup>

### **Conclusion**

The offshore oil and gas will be a blessing rather than a curse if the country is capable of managing the challenges it presents. One of the challenges is the environmental protection, which must be the concern of both government and operators in the industry in order to minimize the rate of pollution from the activities of the industry. All offshore oil and gas installations, including the exploration drilling and the production facilities need to have discharge management plan which is approved by the Ghana Maritime Authority in line with generally accepted international practice for environmental performance. Further there is a need to focus on marine biodiversity which is considered to be gray area now and requires urgent attention. The present legal regime is not in a position to make proper mechanism, hence at the national level and international level effective marine protection should be given.



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<sup>1</sup> *Supranote* 15, pp. 408-410