Analysing the need for arctic oil environmental sciences essay

Business, Industries

Global demand for energy has quickly increased as populations have increased and the demands of developing states have increased. Some estimations claim that demand for energy could increase by every bit much as 50 % by 2030 (Hunter 2007) . This possible addition has every state scrambling for a stable beginning of oil and natural gas. The traditional beginnings of oil and natural gas have become less dependable. Instability in the Middle East has many states looking for new beginnings of oil, but this has become harder to happen. Many states that were one time spouses to big oil companies such as Russia and Venezuela have become less dependable as beginnings for oil (Appenzellar 2004) . In 1960 85 % of known reservoirs were accessible to oil companies but now merely 16 % of reservoirs are accessible (Rowell 2007) . New countries need to be opened up and explored in order to happen dependable beginnings of oil. The Arctic appears to be one of the most promising countries.

History of Arctic oil

In the 1970 's and 1980 's onshore crude oil roars took topographic point in Siberia and Alaska (Funk 2009) . Alaska 's roar began in 1967 when oil workers for Atlantic Richfield Corporation discovered the largest oil reservoir in North America on Alaska 's North Slope near Prudhoe Bay (Coppock 2004) . Thousands of work forces moved to Alaska trusting to do their wealths boring and edifice the monolithic grapevines necessary to travel the oil to the Continental United States. Billions of dollars were pumped into a antecedently quiet country. This one time great part is in diminution. Siberia had a similar roar in the 1970 's but they are get downing to see a diminution similar to Alaska 's. Siberia 's oil Fieldss, which presently make

Russia the largest manufacturer of oil, are expected to run out in the following 10 old ages (Appenzeller 2004) .

Future of Arctic Oil

Surveies show that the Arctic Ocean may incorporate a big sum of recoverable oil and natural gas. This includes non merely the land contained by the Arctic Circle, but besides the Arctic Ocean, which is considered to be the largest prospective beginning of oil and natural gas for the hereafter (Gautier 2004) .

Measure of Oil and Natural gas

The United States Geological Survey has predicted that about 30 % of the universe 's undiscovered gas and 13 % of the universe 's undiscovered oil is under the surface of the Arctic Ocean (Gautier 2004) . The sum of gas in merely one of the major reservoirs is estimated to be the full gas militias of the United States (Moran 2006) .

Location of oil

Good oil and gas reservoirs are so rare for a big portion because of the alone types of stone formations that can incorporate natural gas. The stone formation must be porous plenty to keep natural gas and oil and the formation must besides be permeable plenty for oil and natural gas to flux through the formation in order for oil to be recoverable. Porosity and permeableness are the grounds that reservoirs are found about entirely in sedimentary stones.

The bulk of crude oil bearing formations are contained in the huge Continental shelves of the Arctic Ocean. These shelves take up more than half of the Arctic Ocean, as shown by the lighter shadiness of bluish in Figure 2. These shelves by and large lie in less than 160 metres of H2O, a deepness that current boring engineering can easy bring forth (Harrison 1979) . Arctic map

Figure 2: Depth of the Arctic Ocean (hypertext transfer protocol: //gdr. nrcan. gc. ca) Sedimentary stone formations have besides been found in deeper H2O. A recent coring expedition found sedimentary stone formations in 1100 metres of H2O. This coring expedition drilled into The Lomonosov ridge, which is indicated by the pointer in Figure 2 (Moran 2006) .

Regulating THE ARCTIC OCEAN

United Nations Convention on the Law of the Sea

The current opinion organic structure in the Arctic Ocean is the United Nations Convention on the Law of the Sea (UNCLOS) . Russia, Norway, Canada, and Denmark all border the Arctic Ocean and have all ratified this pact, go forthing the United States as the lone state that borders the Arctic Ocean that has non.

Claiming Land

UNCLOS regulations say that a state may exert control within 200 maritime stat mis from a state 's shoreline (Holmes 2008) . In order to claim land beyond this 200 stat mi grade a state must turn out that the seafloor is an extension of the state 's Continental shelf (Underhill 2005) . The states involved have begun passing 1000000s of dollars in order to map the ocean floor utilizing high tech echo sounder devices. Mapping is a good start but the lone existent manner to happen where a shelf ends is by happening the exact point where stone types alteration, which can merely be done by boring for samples of the seafloor (Underhill 2005) . The logistics of boring for samples in the Arctic Ocean is a really hard and expensive undertaking.

Major Disputes

There are several parts of major difference over the Arctic Ocean. The most of import difference is the dissension between Russia, Denmark, and Canada over who has the rights to the Lomonosov Ridge, The Barents Sea Loop Hole, and the Western Nansen Basin. The Lomosov Ridge is seen as the stepping rock for Denmark, Canada and Russia to claim the Arctic. Each has claimed that the ridge is in fact an extension of their Continental shelf.

The Barents Sea is located North of Russia and Norway, and both states have submitted overlapping claims for sovereignty in this country. The two most relevant differences in The Barents Sea are over the Loop Hole and the Western Nansen Basin (Holmes 2008) . Both Norway and Russia appear to be negociating a pact on their ain, so it does non look that the UNCLOS will necessitate them to do a determination.

Figure 1: Diagram Lomonosov Ridge (benmuse. typepad. com) Russia has been the most aggressive in claiming this ridge. Russia has already submitted a claim excessively much of the ocean floor utilizing the ridge as the ground tackle of their claim s (McKenzie 2009) . Canada and Denmark

have been making extended seismal studies to turn out that the ridge is in fact a portion of their several Continental shelves in order to challenge Russia 's claim. The Lomonosov Ridge is really of import to all states involved because boring has proven that there is natural gas underneath the ridge (Underhill 2009) . http: //benmuse. typepad. com/ben_muse/images/2007/08/08/lomonosov_ridge_2_2. gif

Deciding Disputes Under UNCLOS

The simplest solution for deciding differences is for parties involved to settle the difference informally, but if states are unable to make so there are several other ways of settling differences (Holmes 2008) . Other possibilities include the International Tribunal for the Law of the Sea, the International Court of Justice, or an arbitrary court. Whenever a state ratifies the convention, the state chooses what forum they would prefer to work out any differences, but jobs arise when the disputing states can non hold on a forum. UNCLOS does non hold compulsory forum for challenging claims when states can non hold on a forum, so sometimes it can be really hard to happen a solution to a difference (Holmes 2008) .

Other Governments

The UNCLOS is chiefly concerned with the spliting up of the sea bed under the Arctic Ocean, instead than with regulations and ordinances to protect transportation involvements and environmental protection. To get by with this many other organisations have been trying to make full the nothingness by doing suggestions and guidelines to guarantee that states are guaranting safety for both workers and theenvironment(Berkman 2009) .

Geneva Convention

The Geneva Convention consists of a series of pacts made after World War II to set up `` regulations of war '' (Homes 2008) . The 1958 Geneva Convention said that in Continental shelf differences for states with next seashores should be determined by pulling a average line between the two seashores if no other understanding can be made (Holmes 2008) . Although this understanding predates the UNCLOS, every state involved in the Arctic has ratified the convention, so the convention would be used if the UNCLOS could non convert the involved states to hold.

International Maritime Organization

The International Maritime Organization may non hold any official power, yet they still adopted a set of guidelines for transporting operations in the Arctic Ocean called Guidelines for Ships Operating in Ice Covered Arctic Waters (Berkman 2009) . These guidelines are followed by every major state involved in transporting in the Arctic, but an international government organic structure needs to put official ordinances for the Arctic, because deficiency of ordinance is certain to go a job as traffic additions.

Northeast Atlantic Fisheries Commission

The Northeast Atlantic Fisheries Commission regional piscary direction organisation 's is a regional understanding whose range is wide plenty for their understandings to cover a big part of the Arctic Basin. It is the lone official international organisation that coverspollutioncriterions in any portion of the Arctic (Berkman 2009) . A development of this kind is needed to protect the big and alone ecosystem of the Arctic.

ENVIRONMENTAL RISKS

Offshore oil and gas geographic expedition in the Arctic Ocean poses several of import environmental hazards particularly in such a sensitive environment as the Arctic. Positioned at the top of the universe, the Arctic part provides many valuable natural resources such as fresh H2O, fishing, and rare home grounds for endangered species. The Arctic Archipelago is besides place to scarce populations of Eskimos and other colonists. The hazards chiefly associated with offshore boring in the part involve possible oil spills and the pollutants generated during production operations. These factors can take to rough effects on homo and wildlife wellness along with the wellness of the environment.

Oil Spills

Due to the recent BP calamity in the Gulf of Mexico in early 2010 and other memorable rig calamities, apprehensiveness about the oil and gas industry 's impact on the planet has grown. Production companies have become a mark of environmental groups all over the universe as they drill into the land and run out the Earth 's non-renewable resources. A immense consideration into prospective boring in the Arctic Ocean is the possibility of an oil spill, which could be particularly unsafe to the sensitive wildlife of the part. With the tough climatic and icy conditions of the Arctic, a big oil spill in the part could be a logistical incubus. The surveies and research about possible oil clean up in the Arctic focal points on the behaviour of oil in the cold clime to happen methods of remotion and simulation trials to analyse response times.

Cold Temperatures and Ice Barriers

Research shows that the cold Arctic temperatures and presence of ice can assist to cut down environmental impacts and increase response effectivity. The cold Arctic Ocean changes the physical features and behaviour of oil in H2O. The equilibrium thickness of oil is greater in cold H2O intending the oil will remain centralized in a smaller country and spread less quickly. This benefits recovery by leting longer response times and raising removal per centums. Assorted hydrocarbons ' vaporization rates are reduced in low temperatures, giving response squads a greater opportunity to take more oil before these constituents disappear into the ambiance. Although the huge sum of ice in the Arctic Ocean hinders human mobilisation, blocks of ice can move as barriers to halt the oil from distributing, hence doing unmoved combustion and surface skimmers more effectual. High ice concentrations may besides encapsulate the spilled oil, maintaining the oil isolated from ecosystems until the toxic hydrocarbons are removed. Each of these features helps to better the effectivity of an oil spill killing (Velez et al. 2010) .

Response Simulation Surveies

Companies and industry leaders have conducted several simulation undertakings to prove response times and killing processs given different variables and conditions. In their article, G. M. Skeie et Al. outlined a simulation survey to prove 1800 possible scenarios that could happen in the field. The research workers designed the survey to turn to possible results of an oil spill and analyse the effectivity of different responses. The scenarios featured variables such as `` starting clip, shortest impetus clip to shore, weave conditions, and stranded oil sums '' (Skeie et al. 2006) . The squad calculated the environmental hazards and sum of oil stranded after fake response steps and used this information to compare the different response schemes. Several research plans and simulation surveies like this have been funded by `` oil companies every bit good as other organisations, either independently, through Joint Industry Projects (JIP) , or as portion of an industry association '' (Velez et al. 2010) to better response methods and fix for these exigencies.

Recovery Schemes

The possible oil spill recovery schemes are mechanical recovery, chemical dispersant applications and controlled combustion. Mechanical recovery methods deploy big oil-skimming vass that skim the oil off the ocean 's surface and utilize containment roars to forestall oil from distributing. Mechanical recovery is the most common and practical solution used in oil spill responses in the yesteryear ; nevertheless this method will confront challenges during periods of high ice concentrations in the Arctic Ocean. On the other manus, chemical dispersants, which have been `` recognized worldwide as an environmentally acceptable and extremely efficient agencies of quickly extinguishing spilled oil offshore, '' (Velez et al. 2010) can be applied aerially and distribute by strong air currents and beckon action. Research and field trials have proven these dispersants to be effectual in the rough Arctic conditions, despite misconceptions. In-situ (Latin for `` in topographic point '') combustion besides offers another valuable option to mechanical recovery that can take spilled oil rapidly and expeditiously. Burning techniques are besides really effectual for scenarios with high ice concentrations or when big sums of oil are trapped in ice. By-products of firing oil have minimal harmful aquatic effects.

Research shows that although the Arctic is a extremely sensitive and ambitious environment, the idea of cleaning up an oil spill in the Arctic Ocean is non hideous despite popular public sentiment. Companies and industry leaders have devoted clip and support to fix for an exigency and to analyze the environmental hazards of an oil spill in the Arctic.

Operational Pollutants

Large volumes of waste merchandises and risky air pollutants are generated during seaward production operations. This subdivision identifies the environmental menaces associated with these pollutants.

Drilling Wastes

As Eia and Hernandez province in their article, `` A major issue facing operators today is the big volume of greasy waste liquids produced during well operations '' (Eia and Hernandez 2006) . The waste watercourse excreted by production operations includes boring clay or fluids, produced Waterss, and bore film editings. Each of these merchandises contains variable composings of toxic chemicals that can infect the environment and harm aquatic life. Technologybetterments in boring and production processs have greatly decreased boring waste volumes, `` as today, industry adds 2 to 4 times more oil and gas to the US modesty base per good than in the 1980saˆ¦with 65 per centum less waste being generated '' (Rana 2008) .

However, the environmental impact due to each production Wellss ' waste watercourse, irrespective of the concentration of scarce toxic stuff, can non be ignored because on a expansive graduated table, these pollutants combine to bring forth a huge environmental footmark.

Drilling claies are an indispensable portion of the boring and production procedure because the fluids lubricate and chill the drill spot and pipe, take drill film editings, and command bottom-hole force per unit areas. These fluids can either be water-based, oil-based, or man-made oil-based depending on the boring scenario, with oil-based fluids being the most toxic. The boring clay can incorporate many harmful chemical compounds and toxic stuffs, such as additives, oil, lubricating oil, and many radioactive elements. The waste fluids can respond with the environment through groundwater or surface H2O reservoirs, inadvertent release from intervention installations, soaking up into the dirt, or vaporisation of volatile constituents. The United States Environmental Protection Agency requires that boring claies transcending certain degrees of chemical concentrations are disposed of in onshore waste disposal installations or deep injection Wellss. However, boring wastes that do non run into this standard can either be taken to a landfill or released into the organic structure of H2O where the toxic stuff can respond with the environment (Rana 2008) . Several companies have worked towards `` boring and completion fluids that are greener and more biodegradable '' (Eia, Hernandez 2006) . One such company is M-I SWACO, which invents boring and environmental solutions for Schlumberger, a big boring service company.

During the oil and gas production procedure, produced Waterss such as formation H2O, injection H2O, or other industrial Waterss are generated in the well-hole with changing degrees of hydrocarbon concentrations. These Waterss besides contain hints of heavy metals and other chemical solutions, such as inhibitors and biocides, which prevent micro-organisms from moving of course. On site separation methods aim to take oil and toxic chemicals from the produced Waterss, nevertheless fractional composings remain irrespective of separation effectivity. The staying dissolved hydrocarbons and other chemicals become pollutants when the produced Waterss are discharged into the organic structure of H2O, `` volumes of such discharges reach 1000s of dozenss of oil a twelvemonth, '' (Rana 2008) on a world-wide graduated table. Companies frequently dispose of produced H2O with potentially unsafe composings in deep aquifers isolated from groundwater reservoirs, nevertheless inadvertent release is still a menace to be considered.

Gas Emissions

Natural gas sedimentations normally contain unsafe gases such as methane, H sulphide, and other volatile organic compounds. When reservoir force per unit areas are high, which is surely possible in the deep militias of the Arctic Ocean, runawaies and detonations become unsafe environmental menaces because of gas emanations. Flaring is another procedure that can let go of unsafe compounds into the ambiance ; flaring is utilised to command force per unit area malfunctions and to divide oil and gas composings by firing off and let go ofing extra reservoir gases. The gases released during flame uping can include sulfur dioxide, benzine, nitrogen oxide and methylbenzene, which are responsible for several human wellness jobs. S. Rana predicts that `` a individual offshore rig emits the same measure of pollution as 7000 autos driving 80 kilometres a twenty-four hours. ''

Another fright related to gas emanations is the add-on of harmful chemical compounds to the planet 's agony atmosphere and ozone bed. All the recent attending to planetary heating and the Arctic 's runing ice caps raises consciousness of gas emanations. Future production undertakings in the Arctic Ocean are traveling to be watched acutely for environmental errors and operational impacts. Before mass boring in the Arctic can take topographic point, gas emanations have to be reduced or eliminated wholly, or the liquescent ice conditions will decline.

There are a few chief environmental hazards associated with Arctic boring: the impact on the environing environment ; the danger for the endangered and sensitive wildlife of the part ; and the hazard of harming human populations. Large volumes of toxic chemicals can organize in the Arctic if careful environmental protection programs are non taken to cut down toxicity degrees and to forestall oil spills. High concentrations of toxic chemicals can turn throughout the nutrient concatenation, jeopardizing wildlife and aquatic species, and finally endangering human populations. If gas emanations are non cut off wholly, the ambiance will endure from increasing nursery gases taking to human wellness jeopardies and endangering planetary heating conditions.

Drilling IN THE ARCTIC

Historically, boring economically executable Wellss in the Arctic was hard due to extreme conditions conditions, environmental concerns, and the deficiency of boring engineering. However, technological promotions have created several feasible chances to bore Wellss in countries of the Arctic that were ab initio seen as wasteful due to the high costs of boring and production operations.

Onshore Drilling in the Arctic

One of the chief jobs with boring and finishing an onshore well in the Arctic is happening a manner for the rig and its workers to execute at a high degree while covering with the utmost conditions conditions and clip restraints. The Alaskan boring season was comprised of 130 available boring yearss, get downing in late December and normally go oning through late April, doing finishing a well from start to complete really hard. Access to the Arctic tundra is non possible until around mid - December, hence rig can non get down boring until late December and so normally finish boring about May 1st, which is the cause for the short boring season. The mean onshore good in the Arctic, get downing with the mobilisation of the rig and coating with the demobilisation of the rig, requires 90 yearss to finish which allows for about one well, per rig, per season to be drilled. The bulk of those 90 yearss were used in set uping up and set uping down on the well site and non the existent boring of the well (Shafer 2007) . Besides, highly cold temperatures pose one of the largest menaces to set up in the Arctic, because the ability of a rig to execute in highly cold conditions and trade with onsite jobs is indispensable to the boring operation being successful. Low temperatures and ice can decelerate, or even halt, all boring on a well site and waste big sums ofmoneybecause no work is being done (Keener and Allan 2009) .

Hybrid Coil Tubing Drilling Rig

One proposed thought to rush up good completion clip was to utilize a intercrossed spiral tubing boring rig (CTD rig) that was smaller and quicker to set up up and set up down. A CTD rig has the ability to bore conventionally, bore utilizing a rotary drill, and bore utilizing coiled tubing doing a CTD rig an effectual option in several different conditions environments (Shafer 2007) . Furthermore, extinguishing the sum of truck tonss traveling back and Forth from drill sites to refineries more than 50 stat mis is indispensable because day-to-day transit costs could sometimes be the day-to-day boring costs (Keener and Allan 2009) . A CTD rig significantly reduces the sum of tonss needed to finish a well because the rig has fewer parts and can be operational in less than an hr after geting onsite.

There are downsides to the CTD rig nevertheless ; CTD rigs were non originally designed for the Arctic, lack some of the protection a larger rig provides to it workers and do non hold the ability to bore past 7200 pess. The CTD rig has yet to happen a solution to covering with the cold temperatures while remaining operational. If the temperature drops below -350F, so all the Cranes will be shut down because the Cranes become brickle due to the cold. This job has troubled oil and gas geographic expedition in the Arctic throughout history and still causes job today. During the 2006

Alaskan boring season, from January to February, the mean temperature was -350F and the maximal temperature was -150F, which lowered the possible productiveness of Wellss while increasing the cost. While these challenges are important, overall the CTD rig could be a utile solution to happening an efficient rig to bore in the Arctic (Shafer 2007) .

Offshore Drilling in the Arctic

While boring a good onshore on the Arctic ice is a dashing undertaking, successfully boring an offshore well in the close - stop deading cold H2O is an even harder undertaking. Ice direction, limited boring deepness ranges, ice - filled Waterss, limited boring seasons, and exposure to severe conditions are merely some of the major jobs that offshore boring units must fact to be successful.

Offshore Boring Unit of measurements in the Arctic

The Arctic conditions are so rough that new boring units must be designed specifically for the rough Arctic conditions. The new designs must non merely be efficient, but besides economical for the company boring the well. Several different types of boring units were examined such as semisubmersible boring units, doodly-squat - up boring units, and drillships. The semisubmersible boring units were rapidly ousted because the riser column had jobs with ice buildup, several infrastructures were left unfastened to the harsh conditions, and the unit took to hanker to transport. The doodly-squat - up rig was besides deemed as unacceptable because its lattice legs were unfastened to the environment and had major ice buildup jobs. In add-on, transit of the unit took excessively much clip. Evaluation of the drillship showed that its capablenesss make the drillship the most logical pick as a possible solution. The drillship has a big hull that protects the riser column from ice buildup, and is able to transport itself expeditiously. The drillship solution besides offers self sufficiency for periods up to 8 months (Keener and Allan 2009) .

Logisticss of Drillships

There were several facets that were considered in the designs for a new drill drillship. The first job that interior decorators dealt with was the structural design. The bulk of conventional drillships had antecedently had their infrastructure and topside constructions, such as the derrick, made individually from the remainder of the ship and so loaded on the ship once its building was finished. Most of the individually constructed pieces needed extra conditions coverings to protect the ship 's workers, but the coverings added important sums of weight to the ship and took up unneeded infinite (Keener and Allan 2009) . Another issue taken into consideration is the altering ice conditions, which lead to the demand for a drillship that had a manner to cover with ice rapidly plenty to transport itself expeditiously while minimising transit costs. Additionally, there is a demand for a system that could maintain the ship accurately onsite while besides covering with the environmental conditions (Allan et al. 2009) . While there are many logistical jobs that drillships brush with boring Wellss in the Arctic, we will concentrate on the stated jobs because they are the most relevant to the proposed solution.

The Arctic Class MODU Drillship

After all the different jobs and possible boring reverses in the Arctic were taken into consideration, the Arctic Class Mobile Offshore Drilling Unit (MODU) Drillship was proposed as a solution (Allan et al. 2009) .

Structural Design

The interior decorators constructed the MODU Drillship to include the individually constructed infrastructures and topside constructions and by incorporating these constructions into the hull off the ship and around a cardinal well building country (Keener and Allan 2009) . By incorporating the infrastructures and topside constructions into the hull, interior decorators greatly increased the hull 's cardinal hull lading ability and structural unity. This design besides eliminated the demand for many of the dearly-won conditions protection constructions because the constructions were now protected by the hull (Allan et al. 2009) .

Ice Management and Transportation

The following component interior decorators dealt with was the drillships transit capablenesss and ice direction scheme. The hull of the MODU Drillship, combined with pod - pushers to impel the ship, proved to be strong plenty to interrupt through the bulk of the ice necessary to acquire to boring locations. Risk appraisal shortly showed that non utilizing an iceboat bodyguard would be an ailment advised determination. Therefore the usage of ice ledgeman bodyguards determined the drillships ability to hasten the transit clip to location in ice filled Waterss (Allan et al. 2009) .

Keeping the Drillship Onsite

Several different types of positioning systems were evaluated for the MODU Drillship. A moorage system proved to be the lone type that would work efficaciously. A big part of the Arctic Waterss are considered to be shallow H2O boring locations and a dynamic placement system, in shallow H2O, could non supply plenty truth for the drillship to be effectual. After several surveies with different types of stuffs used in the moorage system and the constellation of the system, a 12 point moorage system that is arranged in four groups with three lines of ironss per group proved to be the best solution. Several stuffs to utilize for lines were tested and the usage of ironss proved to be the best solution for the MODU Drillship because the drillships could manage heavy tonss, and the environment had the least consequence on the drillship itself. The four groups would so be set up equally spaced around the drillship so that they could work every bit good as possible. While different variables such as H2O deepness and environmental conditions finally determine what the best placement system for the state of affairs, the 12 point moorage system seemed the most logical and effectual for the MODU Drillship (Allan et al. 2009) .