

EVALUATION ON COST AND RISK ASSESSMENT OF OFFSHORE DRILLING WASTE DISPOSAL TECHNIQUES

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ABSTRACT

The offshore drilling industries has been facing litigations and down time in operations due to non-compliance to regulatory measures as well as applying inadequate friendly and cost-effective offshore disposal techniques. This has affected drilling operations in many ways such as impacting water ways disastrously with various contents of drilling wastes from their operations of inadequate disposal techniques, morally affecting personnels as a result of financial hardship due to disengagement at difficult times inappropriately and most importantly affecting the organizations business due to pressures from government environmental agencies, litigating and terminating operations for not operating on best practiced engineering techniques. This has made this journal essentially important for organizations to carry out more studies on the best offshore drilling waste disposal technique to avert aforementioned disadvantages and thereby operate on a more guided profitable and risk-free procedures. In this paper, I therefore evaluate three organizations operation performance on offshore drilling waste disposal techniques by raising questioners and assessing organizational reports (e.g. Litigation report) and the risk in operation. The Organizations are Shell development Company (Snepco), Transocean and Baker Hughes all of Nigeria operations on offshore drilling waste reduction and disposal techniques. These techniques include zero policy, Seabed injection and Bioremediation techniques which are majorly world best practice. The intent of this journal is mainly aimed at comparing and evaluating, Zero discharge policy, Subsea injection and Bioremediation technique on their economic and risk impact as objective of identifying the importance of each, assessing the positive impact and profitability on a measurement of strength and weakness. The sample size for each organization cut-across four sources on average of 10 personnel from production superintendent, Chief driller, Safety superintendent and Deric Operator in accordance to each organization as stipulated in the questionnaire for three years (2018 – 2020). Primary and secondary data indicating Zero policy disposal techniques response from the three organizations (Shell, Transocean and Baker Hughes) as having number of personnel response on Economic cost low 86 and high 34 while on Risk is having personnel on low response number 84 and high response 36; Seabed Injection personnel number response on Economic cost low 22 and high cost 98 while Risk is low 48 and high number response as 72 while Bioremediation Economic cost low response 26 and high 94 while number responses on low Risk is 48 and high as 72. These results indicates that Zero policy of offshore drilling waste disposal both on economic cost and risk to Organizations is better operated with minimal challenge of compliance without compromise to rules and regulations. In conclusion, synergizing with literature reviews such as Norwegian oil company Equinor implemented zero policy Technique and achieved a 99.9% reduction in offshore waste disposal and Nigeria enforcement and monitoring forcing most offshore companies to comply to Zero policy technique by Nigerian Marine time administration and Safety agency (NIMASA) making zero policy techniques as best in control of offshore waste disposal.

Key words: Disposal techniques, Bioremediation, Subsea injection, Economic cost and Risk

INTRODUCTION

A variety of physical, chemical and biological disposal technical methods have been employed in disposal of offshore drilling waste. Information obtained from the Web of Science database was selected the most relevant treatment methodologies that have published papers applied in the disposal of offshore drilling wastes studied by researchers around the world, to enable a better discussion of each of them. I looked at both Theoretical and Conceptual frameworks of literatures to select most suitable in Risk management, cost and widely published as well as adherence to policy on disposal of offshore drilling wastes but with a gap in Compromise to regulatory bodies and in knowledge for others to examine. More also, some Authors uses both Theoretical and Conceptual frame works for emphasis. In the West, oil and gas corporations have generally co-operated with the regulatory process and have to some extent co-opted the regulators. They have influenced governments to modify the rules so that they take into account corporate financial concerns as much as, or more than, what independent environmental scientists would recommend, if not constrained by financial considerations. The Western oil and gas corporations operating in the Russian Federation may be expected to attempt to do the same - and will also exert political influence at a very high level to subvert the efforts by honest public servants to protect the environment. Russian officials, non-governmental organizations and the general public should be aware of and resist this insidious process of compromise, which can delay and weaken environmental legislation and enforcement.

Jonathan wills (2000) states proven technology exists to re-inject and contain contaminated drill cuttings in underground reservoirs, either by installing equipment on each rig, platform or drillship, or by shipping the wastes to a port for onshore re-injection. Alternative disposal methods are available, such as treatment, recycling, incineration and/or landfill onshore. Sea dumping is environmentally damaging, technically unnecessary and, because of unquantified, long-term liabilities may even be more expensive than offshore re-injection or onshore disposal. Produced water from oil and gas installations can be a significant source of chronic oil pollution and usually also contains heavy metals, low-level radioactivity, traces of drilling fluid additives and poly-aromatic hydrocarbons. Its toxicity to sea life is proven and should be of at least equal concern to WBM-contaminated drill cuttings.

Area of study: Location and Extent



Technical Interview: Interview method is adopted alongside observation. The interviews were conducted from several (10) sources at management and managerial level according to each organization as stipulated in the questionnaire. Types and sources of Data both secondary and primary sources of data are deployed to address the research questions. The primary source of data included the use of structured questionnaire, interview and in-depth interview methods to collect

data from the field. The instruments shall be designed to cover the objectives of the study. Secondary data shall be sourced from information that is secondary in nature and will be derived from official publication, sighting Organization report, Journals etc.

Primary Data: Table 3.1 Level and number of staff interviewed in the three Organizations

Parameter	Shell Nigeria	Transocean Nigeria	Baker Hughes Nigeria
Production Superintendent	10	10	10
Chief Driller	10	10	10
Safety Superintendent	10	10	10
Drilling Operator	10	10	10

Table 3.2 Result of responses in each Organization to Zero policy technique.

Verbal Questions on Objectives	Shell Nig.ltd				Trans.offshore Nig.ltd				Baker Hughes Nig.ltd				Total
Production Superintendent, Chief Driller, Safety superintendent, drilling Operator	S	C	H	O	S	C	H	O	S	C	H	O	Total
	u	h	S	p	u	h	S	p	u	h	S	p	
	p	f	E	t	p	f	E	t	p	f	E	t	
High Importance or benefit of Zero policy techniques disposal of offshore drilling waste- human, community, business	7	7	6	6	7	6	7	5	6	6	6	7	76
Low Importance or benefit of Subsea injection disposal of offshore drilling waste	3	3	4	4	3	4	3	5	4	4	4	3	44
High Cost effect of Subsea injection disposal techniques of offshore drilling waste – Equipment, transportation, treatment	8	9	8	8	9	8	8	7	8	8	9	8	98
Low Cost effect of Subsea injection disposal techniques of offshore drilling waste – Equipment, transportation, treatment	2	1	2	2	1	2	2	3	2	2	1	2	22
High Operational effectiveness and efficiency of Subsea injection disposal techniques – friendliness, awareness, training	6	7	6	7	8	6	7	8	6	7	7	7	82
Low Operational effectiveness and efficiency of Subsea injection disposal techniques – friendliness, awareness, training	4	3	4	3	2	4	3	2	4	3	3	3	38
High Risk in Subsea injection disposal techniques – human, environment, community	6	6	7	5	4	6	7	6	7	6	6	6	72
Low Risk in Subsea injection disposal techniques – human, environment, community	4	4	3	5	6	4	3	4	3	4	4	4	48

Table 3.3 Result of responses in each Organization to Subsea injection technique.

Verbal Questions on Objectives	Shell Nig.ltd				Trans.offshore Nig.ltd				Baker Hughes Nig. ltd				Total
Production Superintendent, Chief Driller, Safety superintendent, drilling Operator	S u p	C h f	H S E	O p t	S u p	C h f	H S E	O p t	S u p	C h f	H S E	O p t	Total
High Importance or benefit of Subsea injection disposal techniques of offshore drilling waste- human, community, business	7	7	6	6	7	6	7	5	6	6	6	7	76
Low Importance or benefit of Zero policy techniques of offshore drilling waste	3	3	4	4	3	4	3	5	4	4	4	3	44
High Cost effect of Zero policy techniques of offshore drilling waste –Equipment, transportation, treatment	8	9	8	8	9	8	8	7	8	8	9	8	98
Low-Cost effect of Zero policy techniques of offshore drilling waste – Equipment, transportation, treatment	2	1	2	2	1	2	2	3	2	2	1	2	22
High Operational effectiveness and efficiency of Zero policy techniques – friendliness, awareness, training	6	7	6	7	8	6	7	8	6	7	7	7	82
Low Operational effectiveness and efficiency of Zero policy techniques s – friendliness, awareness, training	4	3	4	3	2	4	3	2	4	3	3	3	38
High Risk in Zero policy techniques – human, environment, community	6	6	7	5	4	6	7	6	7	6	6	6	72
Low Risk in Zero policy techniques – human, environment, community	4	4	3	5	6	4	3	4	3	4	4	4	48

Table 3.4 Result of responses in each Organization to Bioremediation technique.

Verbal Questions on Objectives	Shell Nig.ltd				Trans.offshore Nig.ltd				Baker Hughes Nig. ltd				Total
Production Superintendent, Chief Driller, Safety superintendent, drilling Operator	S u p	C h f	H S E	O p t	S u p	C h f	H S E	O p t	S u p	C h f	H S E	O p t	Total
High Importance or benefit of Bioremediation techniques disposal of offshore drilling waste- human, community, business	7	7	6	6	-	-	7	5	6	6	6	7	63
Low Importance or benefit of Bioremediation techniques disposal of offshore drilling waste	3	3	4	4	-	-	3	5	4	4	4	3	47
High-Cost effect of Bioremediation disposal techniques of offshore drilling waste –Equipment, transportation, treatment	8	7	8	8	7	8	8	7	8	8	9	8	94
Low Cost effect of Bioremediation disposal techniques of offshore drilling waste – Equipment, transportation, treatment	2	3	2	2	3	2	2	3	2	2	1	2	26

High Operational effectiveness and efficiency of Bioremediation disposal techniques – friendliness, awareness, training	6	8	6	7	8	7	7	8	6	7	8	7	85
Low Operational effectiveness and efficiency of Bioremediation disposal techniques – friendliness, awareness, training	4	2	4	3	2	3	3	2	4	3	2	3	35
High Risk in Bioremediation disposal techniques – human, environment, community	6	6	7	5	4	6	7	6	7	6	6	6	72
Low Risk in Bioremediation disposal techniques – human, environment, community	4	4	3	5	6	4	3	4	3	4	4	4	48

Secondary data: They are derived from organizational sighted reports such as meetings, weekly and monthly operational reports, journals and Bulleting's.

Adopting a zero-discharge policy for offshore drilling waste disposal, can lead to significant economic costs for drilling companies due to the need for specialized equipment, increased operational complexity, and potential delays. A breakdown of the potential economic costs is:

Capital Costs (CAPEX):

1. Equipment Investment:

Implementing zero-discharge technologies, such as advanced waste treatment systems and re-injection technologies, requires substantial upfront investment in equipment and infrastructure.

2. Facility Modifications:

Existing drilling platforms and vessels may need significant modifications or upgrades to accommodate the new waste management systems.

Operational Costs (OPEX):

1. Increased Labor:

Operating and maintaining the new waste management systems may require specialized personnel and additional training, leading to higher labor costs.

2. Higher Energy Consumption:

Some zero-discharge technologies, like thermal treatment, can be energy-intensive, increasing operational costs.

3. Increased Maintenance:

The complex equipment involved in zero-discharge systems can require more frequent and specialized maintenance, leading to higher maintenance costs.

4. Waste Volume Reduction:

While zero-discharge aims to reduce waste, it may also require more frequent disposal of treated solids or other byproducts, which can increase disposal costs.

Indirect Costs:

1. Regulatory Compliance:

Zero-discharge policies may require companies to comply with stricter environmental regulations, leading to higher compliance costs and potential penalties for non-compliance.

2. Project Delays:

Implementing new waste management systems can lead to project delays, potentially impacting profitability.

3. Reputational Risk:

While zero-discharge is environmentally positive, it can also be seen as a cost-cutting measure, potentially damaging a company's reputation if not implemented effectively.

Examples of Zero-Discharge Technologies and Costs:

1. Drill Cuttings Re-injection:

This involves injecting treated drill cuttings back into the well, which can be a cost-effective option but requires specialized equipment and infrastructure.

2. Drilling Fluid Recovery and Reuse:

Recovering and reusing drilling fluids can significantly reduce waste volumes and disposal costs, but requires specialized equipment and processes.

3. Onshore Waste Treatment:

Transporting offshore waste to onshore treatment facilities can be costly, but it may be necessary for certain types of waste or if zero-discharge technologies are not feasible.

4. Waste Conversion:

Converting drilling waste into usable materials, such as construction materials or energy, can be a sustainable option but requires significant investment and research.

SUBSEA INJECTION TECHNIQUE ECONOMIC COST

Implementing subsea waste injection for offshore drilling operations, while environmentally beneficial, can be expensive, involving significant capital expenditures for infrastructure and ongoing operational costs, potentially reaching millions for setup and thousands per day for operation. A breakdown includes:

Capital Costs (CAPEX):

1. Infrastructure: Setting up a subsea injection system requires substantial investment, including dedicated pipelines for waste transport from the rig to the seabed, specialized injection pumps, and potentially, a dedicated umbilical running from the surface to the seabed.

2. Rig Upgrades: Modifications to the drilling rig might be necessary to accommodate the new waste management system, adding to the initial capital expenditure.

3. Installation: The cost of installing the subsea infrastructure can be significant, potentially reaching millions of dollars.

Operational Costs (OPEX):

1. Daily Costs: Once the system is operational, there are ongoing costs associated with running the injection pumps, maintaining the infrastructure, and potentially, the disposal of any residual waste.

2. Maintenance: Subsea equipment requires regular maintenance and potential repairs, adding to the operational expenses.

3. Personnel: Specialized personnel might be needed to operate and maintain the subsea injection system.

Examples and Estimates:

1. Umbilical Costs: A dedicated umbilical for cuttings injection in deepwater can cost millions.

2. Daily Costs: Cuttings re-injection can cost thousands of dollars per day.

3. Ship to Shore Disposal: Shipping waste to shore for disposal can cost \$500K+ per well.

4. Onshore Disposal Costs: Onshore disposal can be expensive, and effective offshore waste treatment can reduce these costs significantly.

Firstly, there is the cost of drilling the injection well, which may not be in the same area as the production risers. Then there is the cost of the subsea umbilical that connect the platform or FPSO to the wellhead, which depend on the depth of the water - in some cases over 2000m depth. Then comes the water injection pump set - these are extremely expensive as they are high pressure pumps - around 300bar on my last job I seem to remember, but in any case, over 200bar, and the flow rate can vary up to 80,000 or more barrels per day, depending on the water production rate. In some cases, the water (or gas) injection is required to force the oil to the production facility on the surface, in others it's to get rid of the production water rather than risk pollution by discharging it into the sea. Such costs rely on a relatively high oil price, as happened when the price per barrel went to \$150, sparking interest in ever deeper offshore wells. Now the price of oil is less than a bottle of Evian water the costs bite, so the number of new offshore production facilities has waned until the oil price resurges, as it must do once Saudi Arabia, Venezuela, Russia et al find they cannot meet all their infrastructure projects. I believe the low price was an OPEC bid to oust the USA's fracking production, but that seems to have backfired, with the US reducing its reliance on imports from OPEC countries.

BIOREMEDIATION TECHNIQUE- ECONOMIC COST

Implementing bioremediation for offshore waste disposal can be economically viable, offering potential cost savings compared to traditional methods, but the specific costs depend on various factors like waste type, volume, and the chosen bioremediation technique. A breakdown of the economic considerations:

Potential Cost Savings of Bioremediation:

1. Reduced Transportation and Disposal Costs:

Bioremediation can treat waste on-site, eliminating the need for expensive transportation and onshore disposal.

2. Lower Environmental Remediation Costs:

Bioremediation can be a cost-effective way to remediate contaminated soil and water, potentially reducing long-term environmental liabilities.

3. Resource Recovery:

Some bioremediation techniques can recover valuable resources from waste streams, further offsetting costs.

Factors Affecting Costs:

1. Waste Type and Volume:

The type and volume of waste significantly impact the cost of bioremediation, as different techniques are suitable for different materials.

2. The chosen bioremediation method (e.g., biostimulation, bioaugmentation) will influence costs, with some techniques requiring specialized equipment or expertise.

3. Location and Infrastructure:

Offshore operations may have unique logistical challenges and infrastructure requirements that can affect costs.

4. Regulations and Permits:

Compliance with environmental regulations and obtaining necessary permits can add to the overall cost.

Examples of Bioremediation Techniques and Costs:

1. Bio stimulation:

Encouraging naturally occurring microorganisms to degrade contaminants, potentially costing less than other methods.

2. Bioaugmentation:

Introducing specific microorganisms to enhance degradation, which may involve higher initial costs but can lead to faster remediation.

3. Ex-situ bioremediation:

Treating contaminated soil or water off-site, which can involve higher transportation costs but may be necessary for certain types of waste.

4. In-situ bioremediation:

Treating contaminants in place, which can be cost-effective but may require specialized equipment and expertise.

Examples of Disposal Costs for Other E&P Waste Streams:

1. Contaminated soils: \$1–\$22 per barrel
2. NORM (Naturally Occurring Radioactive Materials): \$150–\$300 per barrel
3. Produced water: \$0.30–\$10 per barrel
4. Tank bottoms: \$0.85–\$40 per barrel
5. Water-based muds and cuttings: \$0.50–\$40 per barrel

In summary, while the specific costs of bioremediation can vary, its potential for reducing transportation, disposal, and remediation costs, along with resource recovery, makes it a viable and increasingly attractive option for offshore waste management.

RISK ON BIOREMEDIATION TECHNIQUE

Implementing bioremediation for offshore drilling waste disposal carries risks including potential for unintended environmental impacts, operational challenges, and uncertainty in the long-term effectiveness of the treatment.

1. Unintended Ecological Effects:

Bioremediation processes, while aiming to degrade pollutants, could inadvertently harm or benefit other organisms in the marine environment.

2. Nutrient Overload:

The introduction of microorganisms and nutrients to the marine environment could lead to eutrophication, potentially causing harmful algal blooms and oxygen depletion.

3. Bioaccumulation:

Some pollutants might not be fully degraded by bioremediation and could accumulate in marine organisms, leading to health problems for both marine life and humans.

4. Dispersal of Microorganisms:

The release of engineered or naturally occurring microorganisms into the environment could lead to the spread of disease or the disruption of existing microbial communities.

5. Persistence of Pollutants:

If the bioremediation process is not effective or if the pollutants are not completely degraded, they could persist in the environment for extended periods, causing long-term harm.

Operational Risks:

1. Logistical Challenges:

Implementing bioremediation techniques offshore requires specialized equipment and expertise, which can be difficult and costly to deploy and maintain in a challenging environment.

2. Safety Concerns:

Working with microorganisms and chemicals involved in bioremediation can pose safety risks to workers, requiring careful handling and monitoring.

3. Unpredictability of Results:

The effectiveness of bioremediation can vary depending on environmental conditions, the type of pollutants, and the characteristics of the microorganisms used.

4. Monitoring and Evaluation:

Monitoring the effectiveness of bioremediation and ensuring that it doesn't cause unintended harm can be challenging and resource-intensive.

5. Cost and Time:

Bioremediation techniques can be expensive and time-consuming, potentially delaying the remediation process and increasing costs.

6. Disruption of Marine Ecosystems:

The introduction of bioremediation agents or the disturbance of the seabed during implementation can disrupt marine ecosystems.

Uncertainty and Long-Term Effects:

7. Long-Term Effects:

The long-term effects of bioremediation on marine ecosystems are not always well understood, and there is a risk of unforeseen consequences.

8. Resistance and Adaptation:

Microorganisms used in bioremediation could develop resistance to the chemicals or pollutants they are designed to degrade, reducing their effectiveness.

9. Uncertainty in Modeling:

Predicting the fate and effects of bioremediation in the complex marine environment can be challenging, leading to uncertainty in the outcome.

10. Lack of Data:

There may be limited data available on the effectiveness of bioremediation techniques in specific offshore environments, making it difficult to assess the risks and benefits.

RISK IN SUBSEA INJECTION TECHNIQUE

Subsea waste injection, while offering an alternative to surface disposal, poses risks including environmental damage, potential for micro seismic activity, and operational challenges, requiring careful planning and monitoring. A breakdown of the risks associated with subsea injection of offshore drilling waste:

Environmental Risks:

1. Seafloor Habitat Disturbance:

Discharge of drilling fluids and cuttings, even in subsea locations, can cover the seafloor, impacting benthic organisms and their habitats.

2. Heavy Metal Contamination:

Drilling fluids can contain heavy metals that, if discharged, could lead to bioaccumulation in aquatic organisms.

3. Chemical Contamination:

The chemicals used in drilling fluids can persist in the environment and potentially harm marine life.

4. Disruption of Marine Ecosystems:

The introduction of foreign materials and chemicals can disrupt the delicate balance of marine ecosystems.

Operational Risks:

1. Equipment Failure:

Subsea injection systems are complex and require specialized equipment that is prone to failure, leading to costly repairs and potential environmental incidents.

2. Pipeline Integrity:

Subsea pipelines used for waste injection can be vulnerable to damage from seabed conditions, storms, or other factors, potentially leading to leaks or spills.

3. Injection Site Selection:

Not all geological formations are suitable for waste injection, and improper site selection can lead to environmental problems or operational failures.

4. Monitoring Challenges:

Monitoring the effectiveness of subsea injection and ensuring that no environmental damage is occurring can be difficult and costly.

Micro seismic Activity:

1. Stress and Pressure Changes:

Injecting fluids into the subsurface can alter the stress and pressure within the geological formations, potentially triggering micro seismic activity.

2. Fracture Development:

The injection process can create or expand fractures in the subsurface, which could lead to unintended consequences.

3. Induced Seismicity:

In some cases, micro seismic activity can lead to larger earthquakes, although this is a rare occurrence.

Mitigation Strategies:

1. Thorough Site Characterization:

Conducting comprehensive geological and environmental studies to determine the suitability of the injection site.

2. Advanced Monitoring Technologies:

Using advanced monitoring systems to track the injection process and detect any potential problems.

3. Practices and Regulations:

Adhering to industry best practices and regulatory requirements for subsea waste injection.

4. Waste Minimization:

Implementing strategies to reduce the volume and toxicity of drilling waste generated.

RISK IN ZERO POLICY TECHNIQUE

A drilling company implementing a "zero waste" policy for offshore waste disposal, while environmentally beneficial, carries risks such as high costs, potential for technological challenges, and the need for robust waste management infrastructure and expertise. A breakdown of the risks:

High Costs and Technological Challenges:

1. Advanced Technology and Infrastructure:

Implementing a zero-discharge system often requires sophisticated technologies for waste treatment, recycling, and disposal, which can be expensive to acquire and maintain.

2. Energy Consumption:

Some zero-discharge technologies, like incineration or deep-well injection, can be energy-intensive, increasing operational costs.

3. Research and Development:

Developing and implementing new waste management techniques can require significant investment in research and development.

4. Technological Limitations:

Certain waste streams might be difficult or impossible to treat effectively with current technologies, leading to potential environmental problems.

Operational and Environmental Risks:

1. Spills and Leaks:

Even with advanced systems, there's a risk of spills or leaks during waste transport, storage, or treatment, leading to environmental contamination.

2. Secondary Waste:

Waste treatment processes can generate secondary waste streams (e.g., sludge from filtration), which also need to be managed responsibly.

3. Environmental Impact of Treatment:

Some treatment methods, like incineration, can release pollutants into the atmosphere, potentially causing air pollution.

4. Bioaccumulation:

Even with zero-discharge policies, there's a risk of pollutants bioaccumulating in the marine environment, potentially harming marine life.

Regulatory and Legal Challenges:

1. Compliance Costs:

Meeting increasingly stringent environmental regulations can be costly, requiring significant investment in waste management infrastructure and monitoring.

2. Legal Liability:

Failure to properly manage waste can result in fines, lawsuits, and damage to corporate reputation.

Public Perception:

Implementing a zero-discharge policy can attract public scrutiny, requiring companies to demonstrate their commitment to environmental responsibility.

Operational Challenges:

1. Waste Management Expertise:

Implementing a zero-discharge policy requires a highly skilled workforce with expertise in waste management technologies and regulations.

2. Logistical Challenges:

Managing waste streams effectively, especially in remote offshore locations, can be logistically challenging.

3. Coordination and Collaboration:

Effective waste management requires close coordination between different departments and stakeholders, including regulatory agencies and local communities.

DISCUSSION AND RESULTS:

Table 4.1 Percentage of response in strength and weakness to Zero discharge techniques

Objectives	RESULT	
	Strengths	Weakness
High Importance or benefit of zero techniques disposal of offshore drilling waste- - human, community, business, environment	90	
Low Importance or benefit of zero techniques disposal of offshore drilling waste		30
High Cost effect of zero disposal techniques of offshore drilling waste –Equipment, transportation, treatment		32
Low Cost effect of zero disposal techniques of offshore drilling waste – Equipment, transportation, treatment	86	
High Operational effectiveness and efficiency of zero disposal techniques – friendliness, awareness, training	84	

Low Operational effectiveness and efficiency of zero disposal techniques – friendliness, awareness, training		36
High Risk in zero disposal techniques – human, environment, community	36	
Low Risk in zero disposal techniques – human, environment, community		84

Table 4.1 Percentage Result of response in strength and weakness to Subsea injection techniques

Objectives	RESULT	
	Strengths	Weakness
High Importance or benefit of Subsea injection techniques on disposal of offshore drilling waste- - human, community, business, environment	90	
Low Importance or benefit of Subsea injection techniques on disposal of offshore drilling waste		30
High-Cost effect of Subsea injection disposal techniques on offshore drilling waste – Equipment, transportation, treatment, labour	34	
Low-Cost effect of Subsea injection techniques on offshore drilling waste disposal– Equipment, transportation, treatment, labour		86
High Operational effectiveness and efficiency of Subsea injection disposal techniques – friendliness, awareness, training, community	88	
Low Operational effectiveness and efficiency of Subsea injection drilling waste disposal techniques – friendliness, awareness, training		32
High Risk in Subsea injection disposal techniques – human, environment, community, business	36	
Low Risk in Subsea injection disposal techniques – human, environment, community, business		84

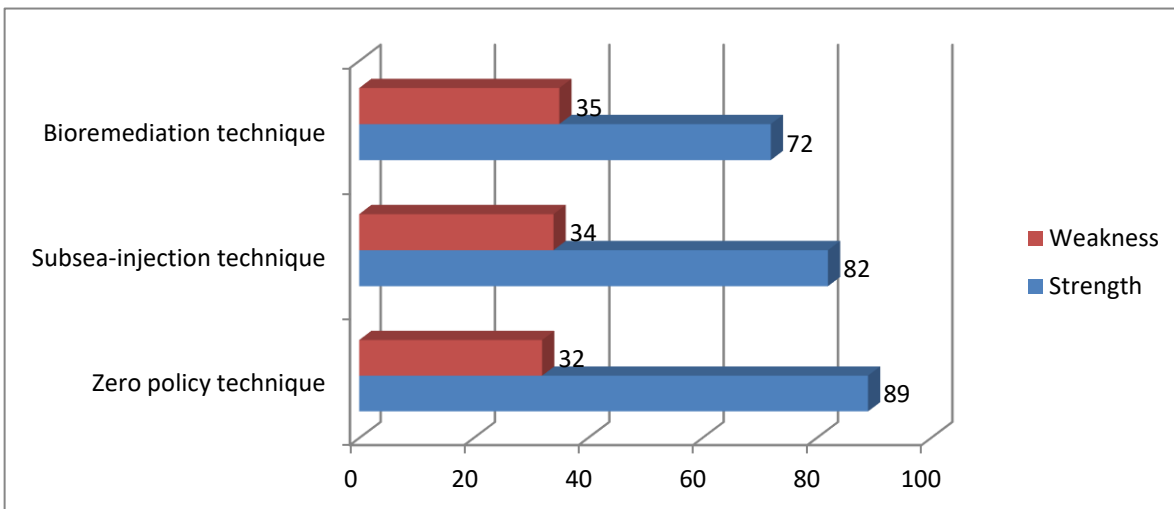
Table 4.3 Percentage Result of response in strength and weakness to Bioremediation techniques

Objectives	RESULT	
	Strengths	Weakness
High Importance or benefit of Bioremediation techniques disposal of offshore drilling waste- - human, community, business, environment	90	
Low Importance or benefit of Bioremediation disposal techniques of offshore drilling waste - Business, human, environment, community.		30
High-Cost effect of Bioremediation disposal techniques of offshore drilling waste – Equipment, transportation, treatment		86
Low-Cost effect of Bioremediation disposal techniques of offshore drilling waste – Equipment, transportation, treatment	34	
High Operational effectiveness and efficiency of zero disposal techniques – friendliness, awareness, training, business	88	

Low Operational effectiveness and efficiency of Bioremediation disposal techniques – friendliness, awareness, training , business		32
High Risk in Bioremediation disposal techniques – human, environment, community, business	84	
Low Risk in Bioremediation disposal techniques – human, environment, community		36

4.3.2 Total response result on the ideology of SWOT (strength, weakness, Opportunity and Threat)

Techniques	Streng th	Weakne ss
Zero policy technique	89	32
Subsea-injection technique	82	34
Bioremediation technique	72	35



CONCLUSION:

In conclusion judging from both primary and secondary data assessment results on Cost and Risk of offshore drilling waste disposal techniques responses from Shell, Trans Ocean and Baker Hughes organizations are all on empirical reasoning gathered through experience to support or refute claims. Primary data results on the techniques with Zero policy having 89, Seabed injection having 82 and Bioremediation having 72 as strength, thereby suggest that Zero policy offshore drilling waste disposal is advantages and more friendly to operate because it is has less cost and less risk but in operation should be strictly adhered to without compromise. Secondary data on the other hand are subjective and objective based on personal perspective or preferences or objective based on personal view point or on analysis of an object of observation thereby suggesting preferably on Bioremediation offshore drilling waste disposal techniques as the best and practicable if the procedures and standards with adequate awareness and knowledge are applied.

Conclusively synergizing both views tilting to adherence, compliance to regulations, procedures standard and performance which are subject to policies may objectively prove Zero policy as economical, profitable and friendly to operate.

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