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BIENNIAL CONFERENCE
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INDUSTRY IN NIGERIA

Driving Sustainability in the Oil and Gas Industry through Improved Stakeholders' Environmental Stewardship

BOOK OF ABSTRACTS

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Contents

1 ENVIRONMENT THEME.....	1
1.1 A NEW APPROACH TO ‘ECM’ REPORTING THROUGH QUALITY INDEXING (⁺ Ehi-Douglas, O. M., ⁺ Briggs, A. O., ⁺ Ehimiaghe, M. & [*] Howard, I. C.).....	2
1.2 A SELF-ASSESSMENT OF THE NATIONAL OIL SPILL DETECTION AND RESPONSE AGENCY’S (NOSDRA) MANAGEMENT OF OIL SPILLS (2007-2017) (Idabor, P*, Obanewa, O.A*, Kalgo, A.S* & Olayioye, T.B*).....	3
1.3 CONTINUOUS IMPROVEMENT OF OCCUPATIONAL AND PUBLIC SAFETY IN THE NIGERIAN PETROLEUM INDUSTRY: THE CASE OF NORM WASTE MANAGEMENT (Elegba, S.B*)	4
1.4 CO-PROCESSING IN CEMENT KILNS: A SUSTAINABLE WASTE MANAGEMENT SOLUTION FOR PETROLEUM WASTES (Adedokun, D.*).....	5
1.5 DETERMINATION OF ENVIRONMENTAL IMPACT OF HEAVY METALS CONTENT AT SELECTED MINING LOCATIONS IN EBONYI AND ZAMFARA STATES, NIGERIA (Gbadegesin, Y ^{*l})	6
1.6 ECOSYSTEM SERVICES - AN INTEGRAL INDICATOR FOR BIODIVERSITY ACTION PLANNING BY OIL & GAS MAJORS IN THE NIGER DELTA (Ewolor, A. S* & Adewumi, K. E**)	7
1.7 EFFECTIVE HSE MANAGEMENT SYSTEMS: KEY TO SUSTAINABILITY (Asuku, T.* & Adekoya, O*)	8
1.8 EFFECTS OF DISSOLVED OXYGEN AND PETROLEUM HYDROCARBONS ON THE ABUNDANCE AND SPECIES DIVERSITY OF POLYCHAETE FAUNA OF THE ELECHI CREEK IN THE UPPER BONNY ESTUARY, NIGER DELTA, NIGERIA (Umesì, N ^l , Dike, C. I ² , Ikpe, S. C. ³ , Ogbowuokara, O. ⁴ , Ngah, S. A. ² & Braide, S. A. ⁵)	9
1.9 HARMONIZATION OF ENVIRONMENTAL REPORT STRUCTURES FOR THE OIL AND GAS INDUSTRY IN NIGERIA (Ogbeibu, A.E.* , Zagi, M.M.* & Balogun, A.A*).....	10
1.10 NANOREMEDIATION TECHNOLOGIES FOR OIL SPILL ENVIRONMENT (Nnaji, J. C ^{*l,3} , Amam, S. ³ & Daniel, L. E ^{2,3}).....	11
1.11 PROTECTING PEOPLE & ENVIRONMENT USING GASFIND IR INFRARED CAMERA FOR GAS LEAK DETECTION IN PROCESS FACILITY (Asejeje, G.* & Mustapha, O*).....	12
1.12 PROXIMATE COMPOSITION AND HEAVY METAL CONTENT OF THE CRAB <i>CALLINECTES PALLI</i> OF THE ANDONI RIVER, NIGER DELTA, NIGERIA (Umesì, N ^l , Ikpe, S. C. ² , Wokoma, O. A. F ³).....	13
1.13 RISK BASED APPROACH - A COST EFFECTIVE AND RAPID ALTERNATIVE TO BIOLOGICAL MONITORING OF PRODUCED WATER AND OILY WASTE WATER MANAGEMENT (Odokuma, L.* & Ajuzieogu, C. L*)	14
1.14 SPATIAL INTERPOLATION AND LAND USE REGRESSION MODELLING OF AIR QUALITY IN SELECTED OIL OPERATING AREAS IN RIVERS STATE NIGERIA (Enotoriwa, R. U. ¹ , Nwachukwu, E. O. ² , Ugbebor, J. N ³).....	15

1.15	SPECIFIC CAKE RESISTANCE AS A VITAL INDEX FOR EFFICIENT MEMBRANE FILTRATION SYSTEMS (<i>Amosa, M. K^a, Jami, M. S^b, Majozi, T^c, Adeniyi, A. D^d, Aderibigbe, F. A^d, Abdulkareem, S. A^d</i>)	16
1.16	SUSTAINABILITY REPORTING AND THE SUSTAINABLE DEVELOPMENT GOALS - A REVIEW OF PERFORMANCE AND FUTURE OPPORTUNITIES IN NIGERIAN OIL AND GAS SECTOR (<i>Adewumi, K. E.¹, Oduwefo, C.¹, & Mancilla, N.²</i>).....	17
1.17	THE REALITIES OF DECOMMISSIONING FACILITIES IN NIGERIA: COST AND ENVIRONMENTAL IMPLICATIONS (<i>Ojesanmi, A.¹, Amam, S.¹, Blaise, C.¹ & Ogbanga, B.¹</i>).....	18
2	SAFETY THEME.....	19
2.1	BACK TO BASICS, NOTHING NEW: DRIVING A STEP CHANGE IN PROCESS SAFETY PERFORMANCE USING THE PROCESS SAFETY FUNDAMENTALS (<i>Iloma, I.* & Maduabuchi, E.*</i>)20	
2.2	CHEMICAL RISK MANAGEMENT – THE CHEVRON NIGERIA LIMITED EXPERIENCE (<i>Ayodeji-Fapohunda, G.*</i>).....	21
2.3	COST ENGINEERING, SAFETY PERFORMANCE AND SUSTAINABILITY IN CONSTRUCTION INDUSTRY IN NIGERIA (<i>Awoyomi, J. O.*</i>)	22
2.4	CROSS COUNTRY PIPELINE RISK-BASED FAILURE PREDICTION USING HYBRID FUZZY EVIDENTIAL REASONING IN FMEA (<i>Hassan, S.*</i>)	23
2.5	EMPLOYEES SAFETY CULTURE ON ORGANISATIONAL PERFORMANCE IN THE DOWNSTREAM SECTOR OF THE PETROLEUM INDUSTRY (<i>Obiorah, C. A*, Ugbebor, J. N* & Charles, U. O*</i>).....	24
2.6	INNOVATIVE APPROACH TO MAINTAINING INTEGRITY OF CRUDE EXPORT SYSTEMS TO PREVENT LOSS OF CONTAINMENT AND ENSURE BASE BUSINESS CONTINUITY (<i>Agbakhamen, C.* & Shakioye, S.*</i>).....	25
2.7	INSPECTION DATA HARVESTING AND ANALYSIS - PRACTICAL APPLICATIONS FOR IMPROVED INSPECTION PLANNING, RISK MANAGEMENT & FAILURE PREVENTION (<i>Memon, S.* & Auchterlonie, I.*</i>).....	26
2.8	LEARNING FROM EXPERIENCES – TWO FATALITIES FROM SIMILAR CAUSES; WHY? (<i>Shittu, G.*</i>)	27
2.9	LEARNINGS FROM INDUSTRY INCIDENTS FOR IMPROVING SAFETY PERFORMANCE (<i>Ogionwo, E.*</i>).....	28
2.10	MANAGING PROCESS SAFETY IN A COMPLEX PROCESS FACILITY (<i>Akinfesoye, Y.*</i>)	29
2.11	MOTIVATION AS A TOOL FOR IMPROVING OCCUPATIONAL SAFETY CULTURE IN PETROLEUM INDUSTRY (<i>Obiorah, C. A*, Charles, U. O* & Ugbebor, J. N*</i>).....	30
2.12	OPTIMIZED PROCESS SAFETY VIA ASSET INTEGRITY MANAGEMENT SYSTEM (<i>Akinyemi, E. T*</i>)	31
2.13	RISK ASSESSMENT OF FLOATING, PRODUCTION, STORAGE AND OFFLOADING (FPSO) RISERS USING BOW-TIE METHODOLOGY (<i>Olamigoke, O.^a, Odumade, A.A.^a, Abhulimen, K.E.^a, Ehinmowo, A.B.^a & Orodu, O.D.^b</i>)	32

3	SECURITY THEME	33
3.1	IMPLEMENTING SECURE ARCHITECTURE FOR INDUSTRIAL CONTROL SYSTEMS (<i>Odewale, A.*</i>) 34	
3.2	MANAGING ACCESS CONTROL IN A HIGH TRAFFIC ENVIRONMENT (<i>Obani, A.*</i>).....	35
3.3	VIALE TECHNICAL SOLUTION FOR THE PROTECTION OF REMOTE WELLHEAD EQUIPMENT (<i>Egbuna, C.* & Akwari, I.*</i>).....	36
4	HEALTH THEME.....	37
4.1	A CASE FOR WORKPLACE WELLNESS PROGRAMMES IN NIGERIA: EVALUATION OF NLNG WORKPLACE WELLNESS PROGRAM (<i>Alamina, A.* & Ohiosimuan, O*</i>).....	38
4.2	ADOPTING A NATIONAL GUIDELINE FOR MEDICAL FITNESS TO WORK - A CASE FOR THE NIGERIAN OIL AND GAS SECTOR (<i>Awotula, P.O.*</i>)	39
4.3	DIVING MEDICINE IN NIGERIA: A REVIEW OF WORK REGULATIONS FOR DIVING (<i>Ogunleye, K.*</i>)	40
4.4	EMBEDDING FATIGUE RISK MANAGEMENT IN THE OIL AND GAS INDUSTRY (<i>Nsikak, N.*, Alamina, F.* & Iboh, A.*</i>)	41
4.5	EMPLOYERS AND HEALTHY WORK ENVIRONMENT: IS IT ACHIEVABLE? (<i>Shamsudeen, K.* & Dakwark, L**</i>)	42
4.6	EVALUATION OF ORGANIZATIONAL STRESS IN NLNG (<i>Alamina, A.*</i>).....	43
4.7	INTERMITTENT EXPLOSIVE DISORDER IN THE OIL AND GAS INDUSTRY (<i>Okolo, I.* & Ebeh, C.*</i>) 44	
4.8	OCCUPATIONAL HEALTH (OH) LEGISLATION AND ITS BENEFITS TO NIGERIA (<i>Adeaga, D.*</i>) .	45
4.9	OCCUPATIONAL HEALTH MANAGEMENT OF LOW BACK PAIN: A CASE PRESENTATION (<i>Eruenah, O.*</i>)	46
4.10	PREVALENCE OF CARDIOVASCULAR RISK FACTORS AMONG OFFICE WORKERS IN A MULTI- NATIONAL COMPANY IN THE NIGER-DELTA: IMPACT OF NEW DEFINITION OF HYPERTENSION (<i>Camus, P.*, Ofori, S.* & Obosi, J.*</i>)	47
4.11	PSYCHOSOCIAL EFFECTS OF OFFSHORE OIL AND GAS WORK (<i>Adeaga, D.*</i>).....	48
4.12	TAKING GOAL ZERO BEYOND THE FENCE: LIFESTYLE AND HEALTH INFLUENCES ON TANKER AND COMMERCIAL DRIVERS' PERFORMANCE AND ROAD SAFETY (¹ <i>Fajola A.O,</i> ¹ <i>Ogbimi R.N, ¹Mosuro, O., ¹Ovwigho, U., ^{1,2}Douglas, K. ²Oyo-Ita, A. ¹Amadi, B.).....</i>	49

1 ENVIRONMENT THEME

1.1 A NEW APPROACH TO ‘ECM’ REPORTING THROUGH QUALITY INDEXING (+Ehi-Douglas, O. M., +Briggs, A. O., +Ehimiaghe, M. &*Howard, I. C.)

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A new approach of Environmental Compliance Monitoring (ECM) reporting for management decision to assess compliability instead of the present method of indicating individual parameter approach to acceptable limits was carried out in the ground water and oily wastewater from some flow stations. Water quality index (WQI) which provides a single number that expresses the overall water quality at a certain location and time was determined on the basis of various quality parameters like pH, COD, BOD₅, alkalinity, sulphate, nitrate, salinity as chloride, total hardness etc. The monthly results obtained for the WQI from three different flow stations for ground water was 8.75 (excellent water), 46.57 (good water) and 20.86 (excellent water) while those of the oily wastewater is 13.98, 23.54 and 21.76 (all excellent water). The results indicate that the different ground water samples analysed from each of the flow stations are safe for domestic purposes which implies that the operational activities of the flow stations have not negatively impacted the ground water and the environment of the area under study. This method will be faster for management to review the operations of the stations without necessarily looking at individual parameter for compliance which is a bit cumbersome. We therefore recommend a critical look into and possible adoption of this approach for a better ECM reporting in the industry.

Key words: Environmental Compliance Monitoring, Quality Parameters, Water Quality Index

**1.2 A SELF-ASSESSMENT OF THE NATIONAL OIL SPILL DETECTION AND
RESPONSE AGENCY'S (NOSDRA) MANAGEMENT OF OIL SPILLS (2007-2017)**
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The scourge of Oil spills arising from oil and gas exploration activities in Nigeria has risen in the recent past. Environmental degradation and health hazards from hydrocarbon pollution pose threats to the wellbeing of human and marine life in and around the oil exploration and production areas.

The National Oil Spill Detection and Response Agency (**NOSDRA**) is statutorily mandated to manage and respond to oil spills in the Nigerian Oil and gas Sector. The Agency's tiered spill response and preparedness procedure for management and response to oil spills is presented. Tools available to the Agency in ensuring National and individual facility preparedness are also explained in detail. Individual facility Spill response reporting procedure to NOSDRA is further outlined.

Since its inception in 2006, NOSDRA has also kept data on all reported oil spills by operators. This paper presents the Agency's data on oil spills cause, clean up methods and remediation methods used for impacted sites are also presented.

Pipeline interdictions from third party interference and equipment failure are seen to be primary causes of oil spills in both onshore and offshore locations.

Challenges and bottlenecks to NOSDRA operations are also highlighted while recommendations to improve spill response operations are presented.

1.3 CONTINUOUS IMPROVEMENT OF OCCUPATIONAL AND PUBLIC SAFETY IN THE NIGERIAN PETROLEUM INDUSTRY: THE CASE OF NORM WASTE MANAGEMENT (*Elegba, S.B**)

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Over the past 25 years the Department of Petroleum Resources has devoted substantial resources and effort in emplacing appropriate regulatory framework for protecting the health, and safety of the workers in the petroleum industry and the public at large, vis-à-vis NORM Radioactive Wastes. NORM (Naturally Occurring Radioactive Material) is found in petroleum producing and processing operations since the rock formations that hold the oil and gas also contain natural radioactivity (Uranium-236 and Thorium-232 decay progenies and Potassium-40) which is enhanced by the production and processing operations. The two commonest sources of NORM in the petroleum industry are Radium (Radium-226 and Radium-238) from the production facilities arising from production water, scales and sludge sand Radon (²²²Rn) from natural gas and associated production facilities. Scales and sludges are essentially co-precipitates of calcium and barium carbonates also have associated radium due to their similar chemistry. The precipitates affect piping, sludges, pits, filters, brine disposal, injection wells and do lead to enhanced radioactivity in pipe cleaning yards and environment. Films, coatings or plating, formed during natural gas production and processing contain high concentrations of radon. These are found at gas wellheads, transport piping, headers, treater units and pumps. Radon tends to concentrate in the lighter Natural Gas Liquids (NGL) due to similar boiling point. NORM is radioactive waste and therefore needs to be treated as such. NORM contaminated pipes, machines and equipment are common sight in the workshops and even in junkyards especially in the Niger Delta of Nigeria and with scrap metal dealers nationwide. But there are no baseline data on NORM in the Nigerian petroleum industry. During the 2014 collapse of the oil price, several upstream installations were temporarily abandoned, transferred to new owners or even decommissioned. In all these cases, NORM contamination were not addressed as an integral part of the guidelines for transfer, abandonment or indeed for decommissioning, because there was no regulatory guidance on how to do so. This was actually one of the recommendations in the Communiqué of the 16th International Biennial HSE conference of 2014. This paper proposes a regulatory framework for the management of NORM in the petroleum industry starting from monitoring to decontamination and disposal of the NORM waste.

1.4 CO-PROCESSING IN CEMENT KILNS: A SUSTAINABLE WASTE MANAGEMENT SOLUTION FOR PETROLEUM WASTES (*Adedokun, D.**)

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Historically, the Niger-Delta region of Nigeria has witnessed gradual contamination of its waters as well as the destruction of vegetation and agricultural lands by considerable amounts of wastes generated from activities of the Petroleum industry. The disposal of such waste materials into the environment can be operational or accidental; which in either case can lead to serious environmental degradation problems. Environmental regulatory agencies in Nigeria have attempted to implement different levels of oil pollution cleanup and recovery technologies. However, the existing technologies are still plagued by the possibilities of residual contamination and toxicity.

Based on this premise, the current study explores the possibilities of providing a sustainable technology with the potential of reducing the risk of residual contamination to the barest minimum. The proposed technology will be based on systematically extracting the contaminated solids and polluted fluids, and then co-processing in a cement kiln. The combination of high material temperature (typically 1450°C) and long residence time (about 30 minutes) within the pyro-processing stage ensures complete destruction of waste. Organic contents of the waste are completely destroyed, while the inorganic contents combine with other raw materials in the kiln to form clinker (the main ingredient of cement).

Proven case studies based on the technology described in this study are available for drill cuttings, chemical wastes, sludges, contaminated soil, polluted water and many more material categories; in Chevron Indonesia, Shell Philippines, Halliburton Mexico, Petrobras Argentina, Total USA, Total France etc.

**1.5 DETERMINATION OF ENVIRONMENTAL IMPACT OF HEAVY METALS
CONTENT AT SELECTED MINING LOCATIONS IN EBONYI AND ZAMFARA
STATES, NIGERIA (*Gbadegesin, Y^{*1}*)**

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Mineral resources in Nigeria are available in abundance. However, unregulated mining activities for the minerals have the consequences of land degradation, ecological disruption giving rise to air, land and water pollution and death of flora and fauna. These elements in the soil get accumulated in plants, animals, human, surface and ground water which may cause slow growth rate in plants and respiratory problem, liver and kidney damage in human.

This study therefore focused on the determination of environmental impact of heavy metal content at selected mining locations in Ebonyi and Zamfara states of Nigeria. Field work to observe the mining sites were undertaken and representative soil samples, water samples, vegetation (edible vegetables) were randomly collected from the mine and un-mined areas within the mining sites. The samples were analysed at the Nigerian Institute of Science Laboratory Technology multipurpose laboratory for heavy metals.

Some of the borehole water analysed were heavily contaminated. There was a high total solid in all wells and surface water as well as presence of high organic matter and a total of 70% had very high total hardness and suspended solids. There was presence of cadmium, chloride, lead, Nitrates, phosphates, sulphates with high alkalinity and solids in some samples.

It was recommended that Government at all levels and well spirited individuals should ensure that adequate measures are put in place to check the unwholesome practice of illegal mining activities because of the inherent damage to the environment and humans alike.

Keywords: Heavy Metals, Farmland Contamination, Soil, Water, Vegetables, Health Risks Prevention, Ebonyi and Zamfara States Nigeria

1.6 ECOSYSTEM SERVICES - AN INTEGRAL INDICATOR FOR BIODIVERSITY ACTION PLANNING BY OIL & GAS MAJORS IN THE NIGER DELTA (Ewolor, A. S* & Adewumi, K. E)**

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The sustainability of ecosystems services in the Niger Delta cannot be over emphasized if the region is to experience viable development across environment, social and economic fronts. The decade-long contamination and pollution of the natural forests and wetlands in the Niger Delta has no doubt contributed to decreasing ecosystem services derived from biodiversity within the region.

This paper examines and appraises ecosystem services across natural forests in the Niger Delta using the Millennium Ecosystem Assessment framework and the IFC Performance Standard 6, thus justifying ecosystem services as an integral indicator for Biodiversity Action Planning by oil and gas operators.

The four categories of ecosystem services were weighed and the most preferred and valued service – Provisioning services - for rural communities within the region isolated. To support livelihoods and wellbeing of people living in rural communities and ensure food security within the region, a cursory look at how to sustain the depleting ecosystem services was carried out and it was determined that a biodiversity action plan by operators in the Niger Delta was found necessary and most efficient for conserving and sustaining these services and biodiversity in general.

Standalone Biodiversity Action Plans and implementation of same per operator in a given location, to protect, conserve and ensure sustainability of the ecosystem and the livelihoods of rural communities has been reiterated and the benefits outlined.

The process and details of carrying out a Biodiversity Action Plan were also highlighted in this paper.

Keywords: Biodiversity, Ecosystem Services, IFC, Niger Delta, Oil & Gas, Operators, Sustainability.

1.7 EFFECTIVE HSE MANAGEMENT SYSTEMS: KEY TO SUSTAINABILITY (Asuku, T.* & Adekoya, O*)

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An HSE Management System is a coordinated and systematic approach to managing health and safety risks. It is a comprehensive, collaborative approach that brings management and workforce together to build on existing safety foundation to control risk better, detect and correct safety problems earlier, share and analyze safety data more effectively, and measure safety performance more carefully.

The benefits of an effective HSE Management system cannot be overemphasized. Failures in establishing, implementing and maintaining effective HSE Management systems have resulted in significant incidents in the Oil & gas industry. Typical examples are the, Flixborough incident in 1974, Bhopal incident in 1984, Piper Alpha incident in 1988, Macondo incident 2010, and others notable disasters in the industry. Some of the benefits include:

- Regulatory & Legal Compliance
- Reputation Management
- Safety & Goal Zero – No harm, No spill/leaks
- Workforce motivation
- Productivity & Financial

The success of the HSE management system depends on leadership commitment and participation from all levels and functions of the organization. By promoting a culture that supports effective process(es) for identifying hazards, controlling HSE risks and opportunities and continual performance evaluation and monitoring of the HSE management system; to improve its HSE performance.

With Nigeria LNG Limited as a case study; NLNG has a robust HSE Management system that provides a framework to define and demonstrate that adequate arrangements are in place to identify and eliminate hazards, and manage risks (threats, hazards, events, and effects) to the health, safety, and the environment aspects of NLNG's business in a systematic and structured way and ultimately provide an Incident and Injury free workplace.

To further operationalize the HSE management system Nigeria LNG embarked on several initiatives in Q1 2017. These include; gap analysis of its HSE Management system & HSE Control Framework, Incident management process review, Safety Leadership, HSE Competence assessment for HSE Critical Positions, review of Contractor HSE Management process, and Project Approach (Cadence) etc. The results of these initiatives were evident in NLNG's year-end performance;

- Ended 2017 with one of the best LTIF & TRCF in spite of poor performance in Q1
- Zero Process Safety Tier 1 incidents
- 90% reduction in Road Transport Accidents
- Improved Preventative Reports by 65%
- Improved Management visibility by 11%

These initiatives have been embedded in NLNG's HSE management system and processes to sustain the gains and further improve its HSE Management system.

1.8 EFFECTS OF DISSOLVED OXYGEN AND PETROLEUM HYDROCARBONS ON THE ABUNDANCE AND SPECIES DIVERSITY OF POLYCHAETE FAUNA OF THE ELECHI CREEK IN THE UPPER BONNY ESTUARY, NIGER DELTA, NIGERIA
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A study was conducted to evaluate DO and THC of surface water and their effects on the abundance and species diversity of polychaete fauna around the Elechi Creek in the upper Bonny Estuary. Surface water and benthic samples were collected from five sampling stations for five months (August – January). DO concentrations ranged from 2.85-7.50mg/l while THC varied from 0.04-2.20mg/l. Abundance of polychaetes in the study area fell within the range 31-464 individuals 0.1m² quadrat. Estimates of the Shannon-Weaver diversity index (H') for polychaetes in the area varied from 0.44-2.37. DO concentrations tended to be lower at stations where THC and diversity values were higher. Strong negative correlations which were significant were found between DO and THC ($r = -0.800$, $p < 0.05$) and DO and species diversity ($r = -0.702$, $p < 0.05$). However, higher THC values across sampling stations were accompanied by modest increase in species diversity of polychaete fauna in the study area ($r = 0.662$, $p < 0.05$). Higher THC values of surface waters seemed to favour species diversity of polychaetes in the study area, but lowered DO concentrations considerably. There was no evidence that the variations observed in abundance of polychaetes across sampling stations over the five-month study period were due to changes in THC and DO concentrations.

Keywords: Dissolved Oxygen, Total Hydrocarbon Concentration, Polychaetes, Species Diversity

1.9 HARMONIZATION OF ENVIRONMENTAL REPORT STRUCTURES FOR THE OIL AND GAS INDUSTRY IN NIGERIA (*Ogbeibu, A.E.**, *Zagi, M.M.** & *Balogun, A.A**)

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The objective of this paper is to examine the current state of environmental reports, in terms of structure and format for different categories of environmental studies across companies in Nigeria in conformity with DPR's guidelines. Differences and the probable reasons for the discrepancies in environmental reporting are examined in order to further harmonize the reporting among companies and regulatory agencies. Research method is a case study, which comprises review of 24 Reports including 13 Environmental Impact Assessment (EIA), 6 Environmental Evaluation Study (EES), 3 Preliminary Impact Assessment Study/Environmental Screening Report (PIAR/ESR), and 2 Biological Monitoring (BM) submitted to DPR between 2014 and 2018.

The analysis shows that there are two types of discrepancies within and between companies and study types resulting from structural defects in topics/chapters being addressed, and formatting with respect to pagination style, font size and type, and storage format for archival/retrieval purposes. These obvious differences in the same types of environmental studies reports even from the same companies are traceable to the absence of seasoned environmental safeguard officers in most companies, who are supposed to be in charge of coordinating and/or liaising with consultants for quality check before reports from project coordinators are submitted to regulatory bodies.

This paper presents a harmonized structure and format for presentation of reports for EIA, EES, PIAR/ESR and BM reports to guide oil and gas industries in quality reporting. Detailed Checklists for environmental report reviewers are also presented for report standardization towards quality enhancement.

Key words: Environmental Reports, Structure, Format, Standardization, Quality, Statistics, Safeguard Officers.

1.10 NANOREMEDIATION TECHNOLOGIES FOR OIL SPILL ENVIRONMENT

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Oil spillage in the Niger-Delta area of Nigeria emanating from oil and gas operations is a topical issue currently and has resulted in serious environmental degradation leading to loss of human, material and economic resources. Nigeria has been variously dubbed the oil spill capital of the world and while regulatory agencies and oil and gas companies have shown commendable seriousness in the prevention and clean-up of oils spill areas, the continuous sabotage of oil facilities has exacerbated the problem. Oil polluted soil and water can be remediated with different techniques but the use of existing conventional remediation technologies has limited or partial effectiveness and this has given rise to the integration of these methods in oil spill clean-up. However, more innovative and eco-friendly technologies to enhance clean-up operations especially for major oil spills are also needed. Nanoremediation is one such technology and various nanomaterials are used for the remediation of oil spill polluted soil and waterbodies due to the advantages it has over conventional technologies. This study analysed the extent of oil spill in the Nigerian environment, causes of oil spill and the current remediation technologies used for oil spill clean-up. The characteristics and potential applications of relevant nanoremediation technologies for oil spill impacted soil and waterbodies are presented. These include: nanobioremediation, carbon-based nanomaterials; metal-based nanomaterials (nano-zerovalent iron (nZVI) and Fe₃O₄); nanocomposites (zeolites and magnetic carbon-metal nano-composites). The environmental implications and safeguards for the use of nanomaterials are also considered.

Keywords: Oil spill, Clean-up, Niger Delta, Nanoremediation

1.11 PROTECTING PEOPLE & ENVIRONMENT USING GASFIND IR INFRARED CAMERA FOR GAS LEAK DETECTION IN PROCESS FACILITY (Asejeje, G.* & Mustapha, O*)

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One major challenge of hydrocarbon processing operations is the difficulty in detecting and controlling fugitive emissions (air contaminants other than those from stacks or vents) resulting from equipment leaks through connections (flanges, threaded fittings etc.) or through the moving parts of valves, pumps, compressors, pressure relief devices, and certain types of process equipment in form of gas or vapor that can escape into the atmosphere. In addition to the economic losses, fugitive emissions contribute to air pollution and climate change. As part of ongoing environmental stewardship efforts, the Chevron Air-Environmental Performance Standard (EPS) stipulates the requirements for managing air emissions.

The Air-EPS requires the implementation of a Leak Detection and Repair (LDAR) program to reduce fugitive hydrocarbon (HC) emissions from equipment leaks by monitoring the HC fluid process handling equipment. The program is designed to detect fugitive emissions from process equipment and repair leak sources. This sets down the criteria used for detecting leaks, repair provisions, and record keeping. Chevron Nigeria Limited (CNL) has opted to implement this program by using the infrared (IR) imaging technology for detection of volatile organic compound (VOC) gas leaks.

This involves the use of an infrared imaging camera which detects volatile VOC emissions that are ordinarily invisible to the naked eye. The basic operating principle of the camera is that it uses ambient illumination to detect the difference in heat radiation of the HC cloud from the background.

**1.12 PROXIMATE COMPOSITION AND HEAVY METAL CONTENT OF THE CRAB
CALLINECTES PALLI OF THE ANDONI RIVER, NIGER DELTA, NIGERIA (Umesi,
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The proximate composition and heavy metal content of the blue swimming crab *Callinectes palli* from the Andoni River was investigated. Samples of *C. palli* were categorized into three class sizes: small (<50mm), medium (50-80mm), and large (>80mm) each with 10 sampling units per class size. Mean ash and fiber contents were comparatively higher and fell within the range 25.85-45.92% and 39.35-50.98% respectively. Relatively lower mean values were recorded for protein (9.59-13.68%) and lipid (18.96-23.91%) but were higher than the minimum values obtained for carbohydrates (1.16-1.34%). Among the heavy metals, Cd (0.07-0.13µg/g) and Pb (0.60-0.81 µg/g) were recorded at very low concentrations in tissues of *C. palli*. Concentrations of Zn (3.98-7.09 µg/g) were higher than those recorded for Cd and Pb. The highest concentration of heavy metals was recorded for Cu (152.83-175.96 µg/g). Results of proximate composition are indicative that *C. palli* from the Andoni River is a good source of energy and nutrients and can provide supplementary sources of protein. Mean values of heavy metals recorded were within background levels observed in animal tissues and shows that the crabs are fit for consumption and not contaminated by heavy metals.

Keywords: Proximate, Composition, Heavy Metals, & Crabs

1.13 RISK BASED APPROACH - A COST EFFECTIVE AND RAPID ALTERNATIVE TO BIOLOGICAL MONITORING OF PRODUCED WATER AND OILY WASTE WATER MANAGEMENT (Odokuma, L.* & Ajuzieogu, C. L*)

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The Risk Based Approach (RBA) for the management of Produced water and oily waste water discharges involves assessment of risks associated with effluents discharged into recipient aquatic systems. It employs the Whole Effluent Test (WEFT) Approach and the Substance Based Risk (SBR) Approach. The WEFT involves derivation of a Predicted No Effect Concentration (PNEC) for the whole produced water while the SBR approach involves (a) assessing individual components as they all contributed to the total risk of the produced water and (b) comparing the concentration of the components in the produced water (PEC) to the sensitivity of the receiving environment to determine what risk the produced water poses (PEC: PNEC ratio ≥ 1). Biological Monitoring (BM) involves assessment of the direct effect (acute toxicity) and persistent effect (chronic toxicity and bioaccumulation) of Produced water. Biological Monitoring is a regulatory requirement, is time consuming and laborious. Risk Based Approach incorporates the acute toxicity component of BM so meets regulatory requirements, requires less time and less laborious. When comparing both the BM and the RBA, BM studies revealed that treated produced water was less toxic and more readily bioconcentrated and biomagnified than untreated produced water owing to reduced toxicity. The RBA revealed that the treated produced water posed “High Risk” to the recipient environment, however, this risk was considered “acceptable” because the “risk distance” (4.16 meters) was below 500m. The study revealed that the RBA was less laborious, required shorter time and less expensive than that of Biological Monitoring

1.14 SPATIAL INTERPOLATION AND LAND USE REGRESSION MODELLING OF AIR QUALITY IN SELECTED OIL OPERATING AREAS IN RIVERS STATE NIGERIA (Enotoriuwa, R. U.¹, Nwachukwu, E. O.², Ugbebor, J. N.³)

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This study assessed air quality and meteorological parameters across 30 selected locations in Rivers state Nigeria during the wet and dry seasons (March 2015 to February 2016). The parameters monitored were Nitrogen dioxide (NO₂), Sulphur dioxide (SO₂), Carbon II oxide (CO), particulate matter (PM_{2.5}, and PM₁₀), wind speed, humidity and temperature. Multiple linear regression (MLR), Adjusted R² regression, Stepwise regression, partial least squares regression (PLSR) and Principal component regression (PCR) were used in land use modeling of air quality. Inverse Distance Weighted Interpolation and Kriging interpolation techniques were used in spatial modeling of air quality. Results showed that adjusted R² regression for land use modeling performed relatively better than other models with an R² value of 0.67, 0.60, 0.79, 0.65, 0.58 and 0.67 for SO₂, NO₂, CO, PM_{2.5}, PM₁₀ and AQI respectively. Land use regression proved useful in integration with spatial interpolation models for air quality. Air quality in the modeled locations is poor and the health of the residents are at risk. The results recorded by this study justify the need for formulation of robust policy and the need for government to carry out an epidemiological study to ascertain the health effect of poor air quality on the affected population.

Keywords: Spatial Interpolation, Kriging, Land Use Regression, Air Quality, Particulate Matter, Oil Operating Areas, Rivers State.

1.15 SPECIFIC CAKE RESISTANCE AS A VITAL INDEX FOR EFFICIENT MEMBRANE FILTRATION SYSTEMS (*Amosa, M. K^a, Jami, M. S^b, Majozi, T^c, Adeniyi, A. D^d, Aderibigbe, F. A^d, Abdulkareem, S. A^d*)

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In the calculation of solid-liquid separation processes, the specific cake resistance (α) is always used as a measure of the difficulty of fluid permeation through the filter, hence, a productivity index. In this investigation, the effect of porosity on α from the filtration of the suspended solids-laden wastewater is evaluated. Transmembrane pressures (TMP) of 40, 80 and 120 kPa and microfiltration membranes with porosities of 0.1 and 0.2 μm were employed for the evaluation. α , compressibility factor (γ), and fouling index (ϑ) are evaluated and the data are corrected/modelled with Darcy's cake filtration model. Results revealed close correlations of the model based on the R^2 values. Moreover, the γ values obtained from the slopes of power plots (function of α and pressure gradient) are evaluated. The cakes are observed to be moderately compressible based on the γ values of 0.32 and 0.52 respectively obtained for 0.1 and 0.2 μm MF membranes. Furthermore, ϑ decreases as the porosity increases with the 0.1 and 0.2 μm MF membranes exhibiting ϑ values of 2.88E+09 and 1.44E+09 cm^{-2} , respectively. Physically at each instant of time, the porosity decreases throughout the cake from the cake surface to the membrane septum where it has the lowest value. It could therefore be concluded that the cake layer serves as a reliable and permeable secondary layer that sustains the filtration flux for a longer period and bring about higher and sustainable productivity.

Keywords: Specific Cake Resistance; Compressibility Factor; Fouling Index; Suspended Solids; Microfiltration Membranes; Low-Pressure Membranes (LPM)

1.16 SUSTAINABILITY REPORTING AND THE SUSTAINABLE DEVELOPMENT GOALS - A REVIEW OF PERFORMANCE AND FUTURE OPPORTUNITIES IN NIGERIAN OIL AND GAS SECTOR (Adewumi, K. E. ¹, Oduwefo, C. ¹, & Mancilla, N. ²)

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This paper builds on the international discourse on oil and gas industry and reviews existing sustainability practices as well as reporting performance by companies in the Nigerian Oil and Gas Sector as per their international counterparts. More recently, the introduction of the sustainable development goals has re-directed and streamlined sustainable development to specific goals and objectives which the oil and gas sectors may align and define individual strategic focus on sustainability, such as those set by the global oil and gas industry association for environmental and social issues (IPIECA).

Case study reviewed data sourced from the annual reports of selected oil companies to identify the extent to which their reporting has been in line with global best practices. The GRI Standards help benchmark industry wide practice, while also providing sector specific guidance.

Consequently, this paper has appraised the gaps in reporting and goodwill towards the implementation of the SDGs independently or integrated with the GRI by oil and gas companies and recommends the regulation and administration industry-wide. Regulation and administration will incrementally assure disclosure and guaranty confidence of internal and external stakeholders in activities and performance of the companies towards economic, social and environmental sustainability of their developments.

Keywords: Sustainable Development Goals, Sustainability Reporting, Oil and Gas Industry

1.17 THE REALITIES OF DECOMMISSIONING FACILITIES IN NIGERIA: COST AND ENVIRONMENTAL IMPLICATIONS (Ojesanmi, A.¹, Amam, S.¹, Blaise, C.¹ & Ogbanga, B.¹)

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Decommissioning projects are getting increased focus and visibility due to safety and environmental concerns, local stakeholders – legacy issues and the media. Decommissioning and restoration costs portfolio can require up to an estimated \$3.896 million to be utilised within one to five years, \$3.449 million within six to ten years, and the remainder in later periods. The cost of spending on decommissioning is expected to soar in the future due to inflation, recent learnings from facility installations, additional facilities coming on-stream and learnings from the North Sea and Gulf of Mexico. Proper design, costing and regulator negotiations of a marker scope is an important factor in the efficient and effective delivery of a decommissioning project. While operators seek innovative and strategic ways of decommissioning facilities at the lowest costs, it is important that the outcomes are safe and environmentally responsible. However, the ambiguity in the execution strategy for the decontamination of pipelines and facilities has provided operators opportunities to adopt different strategies based on internal standards and best practices. In selecting appropriate concepts to delivering environmentally safe options, it is important to conduct a quantitative risk assessment to demonstrate to decision makers and stakeholders the net environmental benefits and value of all execution strategies evaluated and potentials for environmental sustainability. There is therefore a need for a renewed synergy between operators and regulators to effectively manage these ‘liabilities’ in a safe and environmentally responsible manner with a ‘zero dollars per barrel mindset’.

Keywords: Decommissioning, Environment, Cost

2 SAFETY THEME

2.1 BACK TO BASICS, NOTHING NEW: DRIVING A STEP CHANGE IN PROCESS SAFETY PERFORMANCE USING THE PROCESS SAFETY FUNDAMENTALS (Iloma, I.* & Maduabuchi, E.*)

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Process Safety (PS) Management in simplest terms is keeping the hazardous materials in the containment systems always. It's about making sure that all physical assets are well designed, safely operated, properly maintained and abandoned, to achieve that over-arching objective of keeping the hazardous materials in containment and this is central to achieving company Goal Zero ambition. Process Safety Management is delivered by a combination of Asset Integrity (AI) principles with Hazard & Effect Management Process (HEMP). Hazard and Effect Management Process (HEMP) is used as an element in the Health Safety and Environment Management System (HSE-MS) to address risk assessment.

Asset Integrity principles define the way to manage an asset throughout its lifecycle to perform its required function effectively and efficiently while safeguarding life and the environment. In HEMP, hazards are identified, associated risks are evaluated and barriers are put in place to help mitigate the possibility of process safety events (PSEs) occurring. Key to the overall HEMP approach is continuous improvement in the management of hardware barriers and the robustness of human barriers.

From Process Safety improvement trends, it was seen that the number of technical integrity related PSEs has significantly reduced over years; operating integrity related incidents have increased. A root cause analysis identified that a small set of human barriers contribute to half of the PSEs and recognized that the potential for these occurrences could have been reduced by people adhering to known good operating practices and techniques – back to basics, nothing new. From this analysis, a set of "PS Fundamentals" were derived.

This paper describes the 10 PS Fundamentals, the roll-out methodology and the challenges / dilemmas encountered.

2.2 CHEMICAL RISK MANAGEMENT – THE CHEVRON NIGERIA LIMITED EXPERIENCE (Ayodeji-Fapohunda, G.*)

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This paper reviews the progress made through the implementation of the hazard communication program (Hazcom) in addressing hazards associated with the storage and usage of chemicals at the work place and the transition to managing chemical hazards through the risk management approach.

Our strategy is to use the risk approach to manage the hazards related to these chemicals. Chemical risk management deals with the life cycle and management of chemicals in our operation, from the point of receipt from the vendor to the point of disposal of the waste streams. Chemical risk management is designed to identify the hazards associated with chemicals, potential consequences from the transportation, storage and use, assessing the risks associated, development of credible safeguards and having the assurance program in place to ensure that safeguards are in place and functioning with the intent of minimizing risk to employees, environment and assets.

Inventory of all chemicals in use in our facilities are maintained, using excel spreadsheets to manage them while ensuring that the Safety Data Sheets (SDS) are up to date. To ensure grass root participation in chemical risk management, HazCom coordinators were nominated to keep the program ever green. The introduction of the chemical compatibility matrix is to ensure that we maintain the desired separation distances between chemicals in order to prevent adverse reactions between incompatible chemicals.

2.3 COST ENGINEERING, SAFETY PERFORMANCE AND SUSTAINABILITY IN CONSTRUCTION INDUSTRY IN NIGERIA (*Awoyomi, J. O.**)

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The drive by current government as contained in the “7 Big Wins” Document launched by Mr. President in 2016 - to reduce crude oil production cost per barrel from \$32.00 to \$15.00 and also reduce the contracting cycle from 24/36 months to not more than 6 months is a welcome idea but will remain an illusion if both cost engineering and safety best practices are ignored.

Cost Engineering, Safety Performance and Profitability in Construction Industry in Nigeria oil sector is a topic borne out of curiosity to x-ray the relationship between cost engineering best practices - (planning/scheduling/cost estimating/cost controls/earned value management/risk analysis) and safety performance and profitability in the construction industry. Both owners and contractors of either large or small construction projects are concerned with costs (direct/indirect) as well as delivery schedules of their projects. The cost engineering professional- (planners/schedulers/cost estimators/cost engineer/risk analysts) has it as his/her primary responsibility as a member of the project team to help control the costs (within budget) and the schedules (zero slippage) and at same time help his company earn a fair profit.

The paper show-cases the benefits of deploying cost engineering best practices in the construction industry evidencing proper linkages between project profitability, safety performance and cost engineering best practices. Driving sustainability in the oil/gas industry entails competitiveness as well as entrenching safety best practices as front-burners; which implies Safe Workplace, Safe Worker, and safe Assets leading to Improved Productivity, Better Profitability and ultimately Great Organizations/Corporations. The paper concludes with a 'To-Do-List' of actions required to have a 'Cost Engineering-HSE-Sustainable-Profitable' Construction Industry in Nigeria.

2.4 CROSS COUNTRY PIPELINE RISK-BASED FAILURE PREDICTION USING HYBRID FUZZY EVIDENTIAL REASONING IN FMEA (*Hassan, S.**)

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Pipeline industry is constantly identifying new powerful techniques for performing a risk-based analysis of cross-country pipeline systems. Traditionally, FMEA technique has been widely applied for pipeline failure prediction. However, number of limitations have been identified with its application especially in developing countries: failure data is often unreliable or not available, therefore identification of risk priority numbers from the three failure factors of failure probability, severity and detection relies on experts' elicitation; experts often provide diverse opinions and knowledge which could produce different assessment ranking and it is often difficult to harmonize that information due to the multidisciplinary nature of the FMEA team; there is no systematic way of accounting for the relative importance of individual failure factors, with the risk of the assessment results not representing the assessed system true risk picture. A proposed hybrid FMEA-fuzzy evidential reasoning technique overcomes these drawbacks, making the new approach more relevant to product pipeline system in geographies with a paucity of, or unreliable, data. The study utilizes the fuzzy theory to account for and integrate the experts' diverse opinions to each assessment factor; these are then used to determine the risk priority and rank the failure modes under different types of conditions. The case study example used has shown its practical application which helps to improve the system's failure prediction, the ranking of the components failure and their importance in decision making under uncertainty for cross-country pipeline integrity inspection and maintenance.

2.5 EMPLOYEES SAFETY CULTURE ON ORGANISATIONAL PERFORMANCE IN THE DOWNSTREAM SECTOR OF THE PETROLEUM INDUSTRY (Obiorah, C. A*, Ugbebor, J. N* & Charles, U. O*)

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The objective of this study is to evaluate the impact of employee safety on organizational performance with focus on the down-stream sector of the petroleum industry. Both indigenous and international oil and gas industries were sampled in this study. The study adopted a cross sectional design using propulsive sampling in the selection of respondents. A five-point Likert scale questionnaire was used as the instrument for data collection along with interviews and on-the-spot assessment. Both descriptive and inferential statistics (t-test and ANOVA) were employed in the analysis of the data. Of the 150 questionnaires distributed, 129 were retrieved while 21 were not retrieved. The questionnaire was structured into four different sections namely, socio-demographic characteristics, employee safety culture, measures of organizational performance and impact of safety culture on organizational performance. Results of respondent's gender showed that, 48.1% were males while 51.9% were females. On educational qualification, 39, 63, 27, 129 and 39 respondents had Diploma, First Degree and M.Sc/PhD respectively. Notably, 68.2% of the respondents were from indigenous oil and gas firms while 31.8% were from International oil and gas firms. 20.2%, 17.8%, 17.8%, 16.3%, 16.3% and 11.6% identified Innovation, Productivity, Profitability, Staff satisfaction, Sales/Market Share and Financial Performance. Notably, 34.9%, 28.7%, 13.2% and 23.3% strongly agree, agree, were undecided and disagreed that they consistently and regularly used personal protective equipment. It was however observed that 59.7% and 40.3% strongly agreed and agreed that they were compliant to organizational safety protocols. The results showed an indication of positive effect of employee safety culture on organizational performance.

2.6 INNOVATIVE APPROACH TO MAINTAINING INTEGRITY OF CRUDE EXPORT SYSTEMS TO PREVENT LOSS OF CONTAINMENT AND ENSURE BASE BUSINESS CONTINUITY (Agbakhamen, C.* & Shakioye, S.*)

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The oil industry across the world is challenged with aging export systems, most of which are pipelines built in the 1960s, that have been utilized beyond their design life. Today, with technological advancements, there are opportunities to maintain pipeline integrity and design an informed mitigation/repair plan for pipelines, to significantly mitigate potential loss of containment events, thereby extending the service lives of such pipelines.

The Escravos Crude Exportability Readiness Project (ECERP) is a pipeline integrity project that utilized a combination of non-invasive modern technology and redirected flow of crude oil to confirm the integrity of the existing pipeline system, while having in place an effective emergency repair plan.

In undertaking the ECERP, we used a specialized “In Line Inspection” (ILI) technology and the associated tools, which were critical in overcoming the challenges associated with a pipeline that is not equipped with a launcher/receiver system, and the impracticability of displacing line-fill crude oil during inspection

This was a significant challenge with conventional pigging. To accomplish our objectives, the following key activities were carried out:

- ✓ Conducted ILIs over distances of 22.2km and 10km respectively, on existing and alternative 26” pipelines, which are typically difficult to inspect;
- ✓ Accelerated holistic reliability assessments: including follow-up repairs, installation of external corrosion coupons, safety/structural modifications, and hydrostatic tests;
- ✓ Integrated leak detection overflight surveillance into daily routine traffic and pilot responsibilities; and pilot responsibilities.

2.7 INSPECTION DATA HARVESTING AND ANALYSIS - PRACTICAL APPLICATIONS FOR IMPROVED INSPECTION PLANNING, RISK MANAGEMENT & FAILURE PREVENTION (*Memon, S.* & Auchterlonie, I.**)

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Poor confidence in the quality of inspection data collected is widely accepted as a persistent problem affecting the entire oil & gas industry and can be a particular issue when managing ageing assets. As a result, preventable failures are often missed, data trending remains the goal but not the reality, failure patterns and hotspots are not identified, and genuine anomalies are often overlooked.

This paper outlines a unique, rapid and cost-effective methodology to restore confidence in inspection data, enabling better evaluation during risk-based assessments and improved integrity management by harvesting, analysing, cleansing and improving the accuracy of data already gathered.

The methodology uses models and algorithms that:

- “Harvests” data from either legacy reports & documents or existing databases
- Identifies the “bad” data
- Does not filter genuine anomalies
- Improves incomplete data sets by introducing gathered data into standard models for greater accuracy
- Determines threat levels and degradation patterns associated with each system with the aid of data visualisation

The paper concludes with case studies from assets where this approach has been applied, showing where analysis has helped integrity managers improve their understanding of asset risks and better target their available resources by:

- Helping to predict potential failures
- Providing accurate corrosion rates & remaining lives
- Improving the understanding of degradation patterns
- Optimising inspection coverage

2.8 LEARNING FROM EXPERIENCES – TWO FATALITIES FROM SIMILAR CAUSES; WHY? (Shittu, G.*)

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Problem/Challenge:

Why do incidents keep reoccurring from similar causes despite all the available tools to ensure that we learn from previous incidents to prevent them from happening again? 25th January, 2012, DIL pile rig operator was preparing with his Supervisor the pile load tester for a pre-mob inspection. During preparation, the pile load tester was put under a pressure 3 times successfully. The 4th one, a declared pressure of 500 bars - flange tester suddenly gave way and caused several serious injuries to him. 15th May, 2017, an analyzer was fatally injured when he removed the cover on an explosion-proof enclosure as part of a routine task. The force was caused by pressure inside the enclosure from leaking sample gas or instrument air components. Two incidents like several others before and after them were caused by the same immediate cause.

Approach to the Solution:

Lean project with the use of DMAIC cycle was launched for a proper diagnosis of reasons for incident recurrence from similar causes.

Findings:

Lean project exercise showed that there are existing processes to ensure that lessons from previous incidents are learned but the gap is that human beings by our nature tend to forget event weeks after it happens until it is refreshed.

Recommendations:

Main recommendation is for organization to have a system in place which allows for review of incidents on similar jobs as close to the job as possible. In the future, as standards improve then accident are reduced and in other cases statistics may well become available for review and lessons learned.

2.9 LEARNINGS FROM INDUSTRY INCIDENTS FOR IMPROVING SAFETY PERFORMANCE (*Ogionwo, E.)**

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The lessons learned from Industry Incidents provide an invaluable foundation for the development and implementation of policies that produce demonstrable positive results. The Nigerian Oil and Gas Industry present unique regulatory challenges that arise due to factors ranging from pipeline vandalism, operational reasons, civil/communal unrest, militancy, general lack of infrastructure, to education and lack of safety awareness.

This paper aims to x-ray the industry by evaluating the safety statistics vis-à-vis some recent preventable fatal incidents while trying to draw valuable lessons that is of benefit to the industry. Four (4) incident case studies, two (2) each from the upstream and downstream sectors, were comprehensively reviewed and discussed by highlighting the major causes, findings and lessons learned.

Also, the recent safety programs of the DPR aimed at reducing accidents and the robust accident database for the Nigerian Oil & Gas Industry, hosted by the DPR, were discussed.

The paper concludes by giving recommendations that is valuable for improved safety performance in the Petroleum Industry from a regulatory perspective.

2.10 MANAGING PROCESS SAFETY IN A COMPLEX PROCESS FACILITY (Akinfesoye, Y.*)

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Process safety incidents across the oil and gas industry have resulted in fatalities, severe or permanent disabilities, asset losses and costly environmental damage. Incidents such as Flixborough (1974), Bophal (1984), Piper Alpha (1988) and Buncefield (2005), remind us of how vulnerable we can be in the business of processing crude oil, gas and chemicals.

The Escravos Gas to Liquid (EGTL) facility is a complex process facility, which uses unique technologies to convert natural gas into liquid fuel (diesel), chemical grade naphtha and liquified petroleum gas (LPG). Key processes include Natural Gas Compression Unit (feedstock supply), Air Separation Unit (nitrogen and oxygen production), Autothermal Reforming Unit (production of synthesis gas), Fischer-Tropsch Unit (conversion of synthesis gas to wax and other hydrocarbons), Wax Treatment Unit (wax impurities removal), Product Work-Up Unit (production of liquid fuels from wax and hydrocarbon condensate).

Process safety refers to management systems and processes intended to reduce the risk of major or catastrophic accidents that typically involve uncontrolled releases of hazardous process materials. How to keep hazardous process materials where they belong in a complex facility comes with lots of challenges which, if not properly managed, have the potential to lead to catastrophic incidents.

2.11 MOTIVATION AS A TOOL FOR IMPROVING OCCUPATIONAL SAFETY CULTURE IN PETROLEUM INDUSTRY (Obiorah, C. A*, Charles, U. O* & Ugbebor, J. N*)

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This study examined the impact of motivation on improving occupational safety culture of workers in oil and gas companies in Rivers State, Nigeria. Three (3) International Oil Companies (IOCs) namely Total E&P Nigeria Limited (TEPNG), Nigerian Agip Oil Company (NAOC) and Shell Petroleum Development Company (SPDC) were surveyed in the study. The instrument for data collection was a closed ended questionnaire. Of the 200 questionnaires distributed to the staff of the IOCs, 174 (87%) were retrieved while 26 (13%) were not retrieved. Notably, 155 (89.1%) of the retrieved questionnaires were valid while 19 (10.9%) were invalid. A five (5) pointer scale of Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree was adopted in the study. On the gender, 62.6% were males while 37.4% were females. On the age range, 4.5%, 27.1%, 35.5%, 21.3% and 11.6% were < 21 years, 21-30 years, 31-40 years, 41-50 years and >51 years respectively. 32.9%, 18.1%, 34.2% and 14.8% respondents were Casual/Contract Staff, Junior Staff, Senior Staff and Management Staff respectively. The analysis shows no significant difference ($p = 0.055$) in the mean rating of employee's behavioral safety over safety knowledge and communication. Notably, the result of a standard t-test showed a statistically significant difference ($p = 0.01$) between employee's behavioral safety and motivation. Using Pearson correlation, a positive significant relationship was determined $r(154) = .51, p < .01$.

2.12 OPTIMIZED PROCESS SAFETY VIA ASSET INTEGRITY MANAGEMENT SYSTEM **(Akinyemi, E. T*)**

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Considering the overall effects of any Incident/Accident resulting from assets/process failure, Assets Integrity Management is generally a prioritized concern to all stakeholders (Assets Owner/Operator/Regulator) in the Oil and Gas Industry.

This is because mitigation cost (preventive/protective) is always lower than any attendant irreparable loss (Fatalities, Assets, Revenue, Environmental degradation) experienced due to asset integrity failure.

Against this backdrop, this paper seeks to analyze some selected case studies in Nigeria's Oil and gas industry by examining the implementation approach of Assets Integrity Management System (AIMS) and Process Safety Approach of asset owners, from the regulatory perspective. The need to ensure best industry practice as obtainable globally in order to achieve regulatory and statutory requirements with respect to Asset Integrity Management was established.

2.13 RISK ASSESSMENT OF FLOATING, PRODUCTION, STORAGE AND OFFLOADING (FPSO) RISERS USING BOW-TIE METHODOLOGY (*Olamigoke, O.^a, Odumade, A.A.^a, Abhulimen, K.E.^a, Ehinmowo, A.B.^a & Orodu, O.D.^b*)

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The Floating, Production, Storage and Offloading (FPSO) unit concept has become economically competitive for many offshore oil and gas lease developments around the world. A FPSO vessel is a floating vessel is designed to receive oil and gas from subsea wells through flow-lines known as risers, process and store the hydrocarbons, until they can be offloaded unto a tanker. Hydrocarbon spill or release from ruptured risers constitutes a potential environmental hazardous event which could jeopardize safe FPSO operations. Thus, best practice requires that operators of FPSO vessels that identify this as a major hazard demonstrate that their control measures are adequate so as to reduce the risk of a major accident to an acceptable level.

In this paper, the risks associated with hydrocarbon release due FPSO riser rupture have been analyzed via bowtie methodology. The BowtieXP software was used for developing the bowtie diagram which captures flowing hydrocarbons via a riser and FPSO riser rupture as the hazard and top event respectively. The bow-tie diagram clearly specifies risk management measures, in form of several primary and secondary preventive barriers to mitigate the occurrence of initiating events which may lead to FPSO riser failure such as corrosion and buckling which in the event of loss of control result in consequences such as oil spillage into the sea, fire and explosion and loss of production. This work should aid in systematic decision-making for operators to ensure long-term environmentally responsible and safe FPSO operations.

Keywords: FPSO Riser, Riser Rupture, Hazard, Bow-Tie Diagram, Risk Management

3 SECURITY THEME

3.1 IMPLEMENTING SECURE ARCHITECTURE FOR INDUSTRIAL CONTROL SYSTEMS (Odewale, A.*)

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Industrial Control Systems (ICS) have evolved over time from being isolated standalone systems to heterogenous interconnected systems that utilizes existing communication platforms and protocols to increase efficiency, productivity, reduce operational costs and further improve organization's support model. Due to increased efforts in plant's data analytics, interaction between control network and business network is on the increase. More importantly, the advent of Industrial Internet of Things (IIoT) coupled with the need for top executives using live data for crucial decision making has further integrated control system network with business network.

Despite the obvious gains and flexibility this technology has brought forward, the challenge remains the security vulnerabilities. Recent happenings revealed that cyber-attacks are now on the increase especially in the Oil & Gas and manufacturing industries. According to a study on cybersecurity readiness gaps carried out by Business Wire in 2017, 68% of Oil and Gas companies have had at least one security compromise in the past year resulting in the loss of confidential information or operational technology disruptions. [1]

There is, therefore, a need to properly secure Industrial Control System Network to prevent disaster of varying magnitudes. This paper discusses the guidelines required to implement "Purdue model" framework as a defense-in-depth strategy to secure and protect ICS from cybersecurity attacks. The paper also highlights the weak points of the existing purdue model and proposes a modified purdue model which is consistent with the level of current technological trend. Various levels of network hierarchies are identified and corresponding strategies for mitigation are discussed.

[1] J. Grappone, "Cybersecurity Readiness Gaps in America's Oil and Gas Industry," 16 February 2017. [Online]. Available: <https://www.businesswire.com/news/home/20170216005632/en/Study-Reveals-Cybersecurity-Readiness-Gaps-America%E2%80%99s-Oil>.

3.2 MANAGING ACCESS CONTROL IN A HIGH TRAFFIC ENVIRONMENT (*Obani, A.**)

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Problem/Challenge:

Breach of access, either adversarial or non-adversarial, is the first break in barrier which can lead to unsafe acts, unsafe conditions and potential incidents. Effective access control is critical to averting threats especially in a high traffic area. The challenge of such environment lies in defining multiple levels of access and managing these restrictions. This is especially where multiple means of identification are being used and where a cumbersome process could create a nuisance.

Approach to the Solution (Methodology):

An access control system for a high traffic environment, should typically consist of a hybrid of people (manual), technology and processes/procedures. This paper highlights a case study of a high traffic environment- SPDC Industrial Area which employs this methodology.

Findings:

A solely manual access control system cannot be recommended for a high traffic environment due to a high susceptibility of the system to congestions and high error rates. On the flip side, a fully automated access control system cannot be recommended either as there will be need for a backup in the event of downtime/break down of the access control system. It is a combination (hybrid) of people, technology and processes/procedures that make an efficient and effective access control system in a high traffic environment. A proper assessment and characterization of the facility is recommended before the selection of the appropriate access control system, as a failure to do this will lead to retrofitting the facility at very high costs in the future and difficulty in integration.

Solutions/Recommendations

- Automation of manual processes for quicker intervention and processing.
- Upgrade of biometrics systems from finger-print based to Iris based systems.

3.3 VIABLE TECHNICAL SOLUTION FOR THE PROTECTION OF REMOTE WELLHEAD EQUIPMENT (*Egbuna, C.* & Akwari, I.**)

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This paper examines the challenges and opportunities which lay in the protection of oil and gas well head assets in the Niger Delta region of Nigeria. Nigeria is largely dependent on the revenue from oil export for the survival of its economy. However, a blend of crude oil theft, illegal refining, pipeline vandalism and equipment theft has developed into a recognizable significant threat to Nigerian economy in achieving its revenue projections in recent years.

The protection of remote oil and gas assets, particularly well head equipment, has remained a daunting challenge to the upstream oil industry due to their vulnerability, available market, and cost of equipment. This paper aims to look at the pioneer concept of introducing a form of technology in the protection of oil well head equipment which are often located in remote locations in land and swampy terrain across the Niger Delta. The activities of an operator of a major joint venture (JV) will be the case study for this paper and the reference will be the implementation of the concept on oil well head protection over June 2017 and June 2018, as it is estimated that over \$100m is spent annually by the industry to replace stolen well head accessories alone; independent of the consequential effects associated with every incident.

4 HEALTH THEME

4.1 A CASE FOR WORKPLACE WELLNESS PROGRAMMES IN NIGERIA: EVALUATION OF NLNG WORKPLACE WELLNESS PROGRAM (*Alamina, A.* & Ohiosimuan, O**)

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Background: Workplace wellness programmes targeted at modifiable lifestyle behaviors such as physical inactivity, smoking, healthy diets etc. have been in existence since the mid-1970, however, despite the overwhelming documented evidence of its benefits including costs savings, employee wellbeing and overall organizational productivity, only a handful of organizations in Nigeria advocate for such programmes. A major contributing factor for lack of management support for such workplace wellness programmes in Nigeria is leadership failure to clearly see the obvious direct link between workplace wellness and safety, hence the lack of leadership commitment to drive and support such programmes with the same vigour workplace safety programmes are driven. Perhaps this might be due to the inability of health professionals in Nigeria to make a compelling case for such workplace programmes. This paper in evaluating a successful workplace wellness programme seeks to make a case for organizations in Nigeria to place more emphasis on workplace wellness programmes as current evidence strongly suggests that such programmes contribute immensely to workplace safety.

Aim: To demonstrate the benefits of workplace wellness programmes in Nigeria, by evaluating NLNG wellness programme.

Method: 978 employees from NLNG participated in a corporate wellness programme for 100 days, which consisted of over 300,000 participants from 1,200 companies across 185 countries. 359 (37%) completed a pre and post programme questionnaire consisting of 28 core questions to evaluate their health and psychological wellbeing including: employees' health measures; physical activity levels; nutrition habits; stress and happiness; sleep and fatigue; and employee performance. Data generated was subsequently evaluated and also benchmarked against the other participants.

Results: Average age of participants was 39 years. 37% of the participants completed both the pre- and post-survey questionnaire. After the programme, 60% of those who completed both questionnaires reported meeting the recommended 10,000 steps per day, 55% reported being more aware of their nutrition, 53% reported meeting the recommended amount of sleep, while 77% reported a decrease in stress levels, and 60% reported an increase in productivity and concentration. 95% also reported a positive impact of the program on them. Overall there was a 71% increase in those feeling low/no fatigue compared to the start of the programme, and NLNG was 17% higher than the global benchmark for those who reported no-stress at work by the end of the programme.

Conclusion: Workplace wellness programmes contribute not only to organizational productivity but also to workplace safety. Thus, it is pertinent for organizational leadership to adopt an integrated approach to workplace health and safety by rigorously pursuing wellness programmes with the same commitment given to safety, in order to create and sustain a culture of health and safety.

Keywords: Workplace, Wellness, Programmes, Safety.

4.2 ADOPTING A NATIONAL GUIDELINE FOR MEDICAL FITNESS TO WORK - A CASE FOR THE NIGERIAN OIL AND GAS SECTOR (Awotula, P.O. *)

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Medical evaluation for fitness to work refers to a medical assessment carried out to determine the suitability of an individual for a designated role. The aim is to ensure that no medical condition exists which may pose unacceptable risks to the individual, his/her colleagues, any third party, the environment or indeed the installation during work. This is particularly important in the Oil and Gas industry due to its major hazards profile. Factors such as the remoteness of work locations, complex machinery, unpredictable environmental and weather conditions, shift work etc., make offshore work particularly challenging. The idea of medical evaluation for fitness to work in the offshore environment is clearly quite rational in the light of above factors.

In a country such as ours where the Oil and Gas Sector is the major foreign exchange earner, it should be expected that all reasonable steps to maximize workplace productivity in this sector should be prioritized. Medical evaluation for fitness to work when carried out appropriately should result in a downward trend in work related illnesses, injuries and other incidents with clear benefits to overall workplace productivity. Many countries (e.g. The United Kingdom, Norway, Denmark, etc) have designed nationally accepted fitness to work guidelines for offshore work. These guidelines are often referred to in making fitness to work decisions in Nigeria. It is the writers' opinion that whilst it is important to reflect international standards in local fitness to work decisions, it should be beneficial to look inwards and consider factors which may be inherently unique to the Nigerian offshore environment in reaching these decisions.

In a country like Nigeria where specialist occupational medicine practice is low, and where that specialty is struggling to gain recognition, most fitness for work determinations are carried out by untrained medical professionals. It is reasonable therefore, to forge efforts in developing a robust but easy-to-use national guideline for use by any medical professional undertaking medical fitness for work assessments for the oil and gas industry. It is expected that this proposal will be coordinated and enforced through a regulatory steer.

The outcome hoped for with the creation of our own fitness to work guideline is a more targeted and holistic approach to the fitness to work decision making process nationwide with an overall positive impact on workplace productivity in the Oil and Gas Sector. The adoption of a fitness to work guideline for offshore work in Nigeria is expected to not only standardize the fitness to work approach across our local petroleum industry, but to hopefully also stimulate similar discussions among producing countries in the West Africa sub-region soon. The expectation is that with a growing regional migratory workforce, medical fitness certificates issued in any member state would receive reciprocal acceptability throughout the Gulf of Guinea.

4.3 DIVING MEDICINE IN NIGERIA: A REVIEW OF WORK REGULATIONS FOR DIVING (*Ogunleye, K.**)

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Introduction: Under the Diving at Work Regulations 2017 all divers at work must have a valid certificate of fitness to dive issued by a Medical Examiner of Divers. There are medical conditions that may prevent divers from diving or restrict the type of diving that they do.

Problem/ Challenge: A steady rise in the activities of commercial and recreational divers have been observed in lakes, rivers, and coastlines in Nigeria due to the activities of the petroleum industries, fish farming, and underwater mining. However, very little awareness, medical education and professional certification training for prospective and professional divers are available. The lack of awareness among health professionals about pathologies related to the underwater environment poses the biggest challenge in delivering effective healthcare to this subgroup of workers.

Discussion Points: This review highlights the current activities of underwater diving in Nigeria, common and potentially life-threatening conditions, international guidelines for medical screening of prospective divers, treatment options of common cases presented at healthcare facilities onshore and offshore. And takes a critical look at the recently passed law guiding diving activities in Nigeria i.e. THE DIVING AT WORK ACT 2017 and other issues related to diving in Nigeria.

Conclusion and Recommendation: An occupational health coverage for this growing underwater economic activity is very imperative to avert imminent dangers, diagnose and treat diving-related medical disorders. Professional guidelines in the acquisition of skills in diving medicine, certifications, medical fitness screening, and treatments are recommended for review and implementation by occupational health practitioners in Nigeria.

4.4 EMBEDDING FATIGUE RISK MANAGEMENT IN THE OIL AND GAS INDUSTRY

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Operations in the oil and gas industry involve considerable health/safety risks. Industry operators strive to achieve the overarching safety goal of - No harm to personnel, assets, environment and reputation. In spite of the existence of safety management systems fatigue-related incidents continue to occur. There is still a dearth of risk-based fatigue management systems in industry. Fatigue refers to presence of physical, behavioural or cognitive deficit arising primarily from sleep deprivation. Fatigue often results in impaired decision making, increased risk taking and likelihood of errors which can have dire consequences in safety critical roles.

Embedding a Fatigue Risk Management System (FRMS) adopts a framework which entails gap analysis, closure plans, Fatigue Risk Management (FRM) plans, implementation, audits and reviews. An assessment of the fatigue risk among 189 employees working on a Floating Production and Storage Offloading unit (FPSO) comprising a baseline survey, pre and post-intervention survey and redesign of the shift system and a self-reporting system.

Pre-intervention, 82% of workers considered fatigue a problem; 37% fatigued on current roster and 35% reported insufficient sleep. 92% reported Fatigue-related incidents/near miss. Post-intervention, 74% still considered fatigue a problem; 28% fatigued on current roster 6% reported fatigue-related incidents/near misses. A statistically significant difference was observed between the pre and post-intervention responses. Embedding FRMS will manage the fatigue risk to ALARP and engender a more generative work environment with appropriate mitigations, & controls, Embedment of FRMS acts as an enabler towards the achievement of safety goal zero.

4.5 EMPLOYERS AND HEALTHY WORK ENVIRONMENT: IS IT ACHIEVABLE?

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Introduction:

The purpose of this study was to better understand the managerial behaviors that create healthy work environments. Creating healthy work environments (HWE) is important because organizations with HWE may be more successful and because employees should be able to work in humane, rewarding work situations.

Method:

A purposive sample of 78 participants was obtained. Questionnaire was used to elicit response. All participants were 35 years of age or older and were business owners or managers or were responsible for organisational occupational health and safety, and so in a position to influence changes to the workplace in terms of health and wellbeing (i.e., a health and safety officer, team manager or leader, supervisor, or trainer). For the purposes of this study they are referred to as employers because they were acting as workplace representatives.

Results:

Three main factors were identified as influencing employers' views on the promotion of health and wellbeing in the workplace and these are (1) employers' conceptualisation of workplace health and wellbeing, (2) employers' descriptions of (un)healthy workers and perceptions surrounding importance of healthy workers, and (3) employers' beliefs around the role the workplace should play in influencing employee's health and wellbeing.

Conclusions:

The results of this study indicate that several factors influence employers' views on the appropriateness of workplace health and wellbeing initiatives and it is important to understand how best to target employers from different business sizes, industries and geographical locations.

4.6 EVALUATION OF ORGANIZATIONAL STRESS IN NLNG (*Alamina, A.**)

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Background: The negative impacts of work-related stress considered as the second most common occupational illness in the United Kingdom (UK), are widely known, however, there remains a paucity of data on work-related stress in Nigeria. In 2004, the UK Health and Safety Executive developed Management Standards for measuring stress related working conditions, and this is currently used as an industry framework to meet the legal requirements of the UK Health and Safety at Work Act (1974), however, no similar framework exists in Nigeria.

Aim: To evaluate the risk of organizational stress in Nigeria, using NLNG.

Method: A cross-sectional survey, using the modified 25-item HSE Management Standard Indicator tool (MSIT). A pilot survey was conducted prior to the online survey. The questionnaires were distributed online via e-mail to 471 employees, selected by stratified random sampling from 1493 employees working across 3 geographical locations in Nigeria. 367 people (77.9%) completed the survey. Data generated was subsequently compared to data from UK study.

Results: Age range was 24–64 years, with mean age of 40.2 years. 75.7% male and 24.3% female participated. 14.6% were single, 84.3% married, 0.3% separated or divorced, and 0.8% widowed. Overall, the mean stress risk score (MSRS) was 3.75 in this study, while the UK study was 3.62. Across the subscales (Demand, Control, Management Support, Peer Support, Relationships, Role and Change) the MSRS were similar in both studies. However, the MSRS in the UK study for Control and change were 3.43 and 3.03, while in this study it was 3.25 and 2.93 respectively.

Conclusion: From this study, the risk of organizational stress was comparable with that in the UK. There is therefore a need to conduct a larger study across industries in Nigeria, as well as implement a similar industrial framework and a robust legal system to ensure employers comply with their duty of care to employees' health and safety.

Keywords: Stress, Work-related Stress, Organisational Stress

4.7 INTERMITTENT EXPLOSIVE DISORDER IN THE OIL AND GAS INDUSTRY (*Okolo, I.* & Ebeh, C.**)

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There is no such thing as an emotion-free interaction between subordinates, managers and executives. It is not uncommon to find employees/employers who are emotional who tend to 'lose it and boil over' activities and these threats can lead to a tensed work environment.

The Oil and Gas industry has undergone a lot of restructuring in order to improve its operational effectiveness and competitive advantage over competitors. Increase in workload, fear of job loss and sometimes rigid organizational structures are some of the common attributes during re-organizations and a possible mental impact is the Intermittent **Explosive Disorder (IED)**.

IED is an impulsive act of aggression or emotional abuse directed towards others. It is usually not pre-meditated and if you have ever witnessed/ being a victim of IED, you would find it very disturbing. It is usually triggered when people sense that they are losing control over an activity or experience disappointments.

Sometimes we tend to forget that different people with different temperaments exist and think similar approach would apply to all and sundry. Early symptoms such as lack of empathy and aloofness of employees are subtle signs that may trigger IED. Currently, organizations like The Shell Petroleum Development Company of Nigeria Limited (SPDC), have set up proactive employee assistance programs such as the resilience series, fatigue management courses and effective leave management plan to help employees manage this issue.

4.8 OCCUPATIONAL HEALTH (OH) LEGISLATION AND ITS BENEFITS TO NIGERIA (Adeaga, D.*)

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Problem/Challenge:

Industrialization is growing in Nigeria but there is inadequate provision for its attendant ill-effects of occupational diseases and injuries. This is detrimental to workers' health and does not meet international standards. OH cannot be effective without legislation. However, making these laws appears to be elusive. Furthermore, it is thought that an effective OH legislation could create more jobs for the unemployed

Approach to the Solution/Methodology:

This paper explores the barriers to OH legislation and enforcement through descriptive analysis and literature review from textbooks, journals, reports and research papers. It explores the legislative gaps in Nigeria's OH management system, and it also discusses the impact of OH legislation on protecting workers' health and wellbeing. It also explains how more jobs can be created through OH legislation

Findings:

Millions of workers are left at the mercy of occupational illnesses/injuries. OH has so far received minimal attention, and factors responsible for this include lack of enabling legislation, no political will, ignorance/lack of awareness, corruption/political influence, dearth of professionals. The existing factories act does not cover all workers and industries. Discussion reveals the various jobs that can be created through OH legislation

Solutions/Recommendations:

To achieve effective OH system there must first be proper legislation, which should be backed by training of OH professionals, commitment and support from government and private sector. OH awareness creation to the public and to members of government should be embarked upon. There must be strict implementation and enforcement by government agencies to ensure regulatory compliance by employers

4.9 OCCUPATIONAL HEALTH MANAGEMENT OF LOW BACK PAIN: A CASE PRESENTATION (*Erueh, O.**)

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Purpose: Purpose of this presentation is to highlight prevalence of Low back pain among Nurses and beneficial role of Occupational Health Physician in the management.

Problem: There is increasing number of Nurses coming down with low back pain and increasing incidence of Sickness absence due to low back pain and referral to Occupational Health helps a great deal to keep them at work.

Methods: A Case Study of Occupational Health Management of Low back pain of a Bedside Nurse.

Results: There is a global trend that bedside Nursing predisposes Nurses to low back pain and involvement of Occupational Health Management improves outcome of early return to work and staying at work.

Conclusion: This Case Study definitively sheds light on Low back pain as a work place hazard with a high prevalence among Nurses and the beneficial role of Occupational Health Management

Key words: Low back pain, Health Worker and Nurses.

4.10 PREVALENCE OF CARDIOVASCULAR RISK FACTORS AMONG OFFICE WORKERS IN A MULTI-NATIONAL COMPANY IN THE NIGER-DELTA: IMPACT OF NEW DEFINITION OF HYPERTENSION (*Camus, P.*, Ofori, S.* & Obosi, J.**)

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Introduction: The 2017 American College of Cardiology/American Heart Association (ACC/AHA) hypertension guidelines propose a new classification of blood pressure (BP) as well as new thresholds for treatment.

Objectives: This study aimed to determine the prevalence of cardiovascular risk factors of adults attending the staff clinic of a multinational company in Niger-Delta, Nigeria and further to categorize their blood pressures to define the prevalence of hypertension using the new guidelines compared to the usual standard- the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) guidelines.

Methods: This was a cross-sectional study. Data was obtained from 235 individuals. A questionnaire was used to obtain demographic, medical and family history. Blood pressure was measured in a quiet room after a 5-minute rest with an automated BP monitor (Omron M7). The average of 3 readings was taken. Blood samples were taken after an overnight fast for assessment of fasting blood glucose and lipids. Ten-year cardiovascular risk was estimated with the Framingham risk score (FRS) 2008 modified version.

Results: The mean age was 43.34 \pm 7.77 years and majority (92.8%) work onshore. There was a high prevalence of cardiovascular risk factors as 54.0% were overweight, 34.5% were obese, 9.4% were current cigarette smokers, 57.0% consume alcohol regularly, 10.6% were sedentary and 54.5% exercise, but not up to guideline recommendation. With regards to biochemical risk factors, 10.2% had diabetes, 26.0% had high total cholesterol, 54.5% had high low-density lipoprotein, 14.5% had low high-density lipoprotein, and 13.6% had high triglyceride level. The prevalence of hypertension using the JNC7 guidelines was 25.9% and 53.9% using the 2017 ACC/AHA criteria. At a BP threshold of SBP \geq 140/DBP \geq 90mmHg, having a family history of hypertension ($p=0.008$, AOR=3.021, 95% CI 1.326-6.679) and increased BMI ($p=0.0026$, AOR 4.871, 95% CI 1.207-19.664) were independently associated with hypertension. On the other hand, at the threshold of SBP \geq 130/DBP \geq 80mmHg, the variables that were independently associated with hypertension were male gender (AOR 0.155 95% CI 0.043, 0.550 $P=0.004$), family history of hypertension (AOR 4.267 95% CI 1.104, 16.496 $P=0.035$), BMI (AOR 7.433 95% CI 2.431, 22.733 $P=0.001$), and physical inactivity (AOR 0.260 95% CI 0.089, 0.761 $P=0.014$). Overall, among the study participants, using the Framingham risk score, 184 (78.3%) were categorized as low CVD risk, 38 (16.2%) intermediate risk and 13 (5.5%) high risk of CVD.

Conclusions: Applying the 2017 ACC/AHA guidelines doubled the prevalence of hypertension among this study population. While this does not mean automatic increase in number of individuals who will require treatment, implementation of the new guidelines in a setting such as ours should be done only after careful consideration of the consequences of “labeling” individuals as hypertensive and the cost implication of following up and managing the increased population of patients with hypertension.

Key words: Hypertension; Cardiovascular risk, New classification

4.11 PSYCHOSOCIAL EFFECTS OF OFFSHORE OIL AND GAS WORK (*Adeaga, D.**)

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Problem:

Offshore oil and gas work is highly rewarding but also stressful. Job stress and demands are important psychosocial risk factors for offshore oil and gas work. There are many psychosocial effects of offshore oil and gas work, yet not much is being said about it. This paper seeks to increase the knowledge about psychosocial effects of offshore oil and gas work, and also explore means of mitigating them.

Methodology:

This paper identified and described the psychosocial effects of offshore oil and gas work on workers. Literatures from various related studies, journals, reports, empirical cases and other relevant sources were reviewed and analyzed, with keywords such as psychosocial hazards, stress, offshore, and offshore oil work defined.

Findings:

Findings showed that occupational stress like long shift duties; hazardous work environment, noise, long helicopter travel, loneliness and separation from family have psychosocial effects on offshore oil and gas workers, with workers resorting to unhealthy and maladaptive behaviors. These stressors affect workers psychosocially and also impact their family lives and relationships as experienced in intermittent husband syndrome, family conflicts, and unstable relationships. Maladaptive behaviors like smoking, alcoholism and negative attitude towards others were also reported.

Recommendations:

Suggestions for mitigating these psychosocial effects include improving shift schedule and work environment design, light treatment, provision of adequate security for workers, job rotation and enrichment, improving rig facilities, employee assistance program. Furthermore, awareness should be created about occupational psychosocial risks, and workers should be encouraged to discuss about their occupational mental health issues.

4.12 TAKING GOAL ZERO BEYOND THE FENCE: LIFESTYLE AND HEALTH INFLUENCES ON TANKER AND COMMERCIAL DRIVERS' PERFORMANCE AND ROAD SAFETY
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Background: Drivers are key contributors to economic development. Poor health and behaviour poses a challenge to their work performance and safety of even road users. Shell Companies in Nigeria (SCiN), has demonstrated the impact of Human Performance and care agenda on Driver engagement, behaviour, performance and road safety. An 'outside the fence' approach is therefore critical towards reaching a larger pool and achieving drivers' health and public safety

Aim: To determine and intervene on the risk factors from lifestyle, affecting the health of tanker and commercial drivers as a social investment strategy to improve drivers' health and foster 'goal zero culture' (no incidents, no fatalities).

Method: A baseline survey among 731 randomly selected consenting commercial and tanker drivers from three motor parks in Rivers (Mile 3 & Eleme), and Lagos (Ojota) states using close ended Interviewer-administered questionnaires and Focus Group Discussions. Health Screening (for Blood Alcohol Concentration {BAC}, visual acuity, blood pressure, random blood sugar, cholesterol and Body Mass Index). Interventions included Health education, medical consultations, treatment of minor ailments, eye care including glasses. Data was analysed using descriptive and analytical statistics.

Results: Findings showed that 36.9% had raised blood pressure with only 11.5% being known hypertensives; 19.5% of the drivers had trace to significantly raised BAC; 66% of respondents had never had an eye test. Also, 40.7% had visual impairment (with 4% glaucoma-related); 35.5% had elevated blood cholesterol; 18% obese, while 3.6% had elevated blood sugar.

Conclusion: The lifestyles of these drivers were risk factors for the observed non-communicable diseases among them which could potentially interfere with their work performance and invariably, Goal Zero. Health education on, lifestyle modification, continuous monitoring and policy changes to driver monitoring are recommended.

Key words: Drivers, Health, lifestyle, Performance, Safety, Goal Zero